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Review of Ofgem's Commissioned Reports on Beta for Determining the Cost of Equity at RIIO-2

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Overview

National Grid commissioned NERA Economic Consulting (NERA) to review the different approaches in the reports commissioned by Ofgem on beta estimation for determining the cost of equity at RIIO-2.

In this short report, we summarise the different approaches proposed by Ofgem's consultants and identify areas of agreement and disagreement, as well as pointing out the inconsistencies between these reports. The reports discussed are the i) CEPA 2018 report;[1] ii) UKRN 2018 report;[2] iii) Robertson report;[3] and iv) Indepen report.[4] We also discuss Ofgem's recent sector specific methodology consultation and its approach to beta estimation, which relies mainly on Indepen's recommendations.[5]

Overall, we find that there are contradictory views in Ofgem's adviser set on the preferred estimation technique (OLS vs GARCH); the period for which betas are estimated (longest possible vs more recent market data); and, data frequency (e.g. daily vs quarterly). We also find different approaches to leveraging and de-leveraging, with Ofgem itself adopting an approach that is inconsistent with its consultants' recommended approaches (and finance theory).

The contradictory views of Ofgem's consultants should be resolved prior to drawing conclusions on the most reasonable approach for RIIO-2. Given the disparate views expressed in Ofgem's adviser set and the absence of a clear justification for a change, we conclude there is currently no reason to move away from established approaches to beta estimation.

What is beta

Ofgem, along with all other GB economic regulators, uses the capital asset pricing model (CAPM) to estimate the cost of equity. The familiar CAPM can be written as:

(1) $R_i = R_{fR} + \beta_i * ERP$

where Ri is the expected return on equity; βi is the equity beta; RfR is the risk-free rate; and ERP is the equity risk premium.

The equity beta is a measure of the non-diversifiable risk of an asset relative to the risk of the market, i.e. it measures how much asset returns vary relative to the market. A beta below one indicates that asset returns are less volatile than the market, i.e. if the market value increases by 10 per cent, the stock will increase by less than 10 per cent. Conversely, a beta above one means that the stock is more volatile than market. In our example, its value will increase by more than 10 per cent.

The URKN report proposed a GARCH technique to estimate equity betas

UK regulators, such as Ofwat and Ofcom, have typically relied on the Ordinary Least Squares (OLS) model to estimate equity betas.[6] This is also the approach of Ofgem's consultant CEPA.

However, one of the potential restrictions of the OLS model is that it assumes the beta is constant over time and there is a body of empirical evidence suggesting that betas may vary over time.[7] This has motivated the exploration of Generalised Autoregressive Conditional Heteroscedasticity (GARCH) models, which is a technique that allows for the variability of betas over time.

The UKRN report recommends that GARCH models are used for estimating equity betas, while Ofgem's consultants Indepen and Robertson present estimates using both OLS and GARCH models.

In practice, the use of GARCH techniques leads to relatively similar results to OLS, if correctly applied

In theory, we agree that one attraction of the use of GARCH models is their ability to address the time variability of beta. However, we find that if GARCH and OLS are both correctly applied, the beta estimates from both approaches are very similar, for a set of UK and European networks at least.

Three of the UKRN report authors, Mason, Pickford and Wright (MPW) argue that GARCH estimates of equity betas are substantially lower than the equity betas from recent regulatory reviews. However, as we show in a previous report, these results are explained by the use of low frequency data and long horizon periods (which we address in the next sections) rather than the use of GARCH techniques per se. We find that after correcting for these issues, the equity betas from GARCH models are relatively similar to those estimated using OLS models.[8] This is also the view of the fourth author of the UKRN report.[9]

In contrast to MPW, both Robertson and the Indepen report provide similar views to our own. Robertson states that the long run estimates from the GARCH and OLS models are similar.[10] Indepen concluded that OLS should be used by regulators, with OLS estimates not being much different from GARCH estimates, which is consistent with our and Robertson's view.[11]

The UKRN report reliance on low frequency data contrasts with the other consultant's approaches and leads to less precise estimates

Regardless of the estimation model chosen, regulators have to decide on the data frequency in which equity betas are estimated: higher frequency data (such as daily data) or lower frequency data (e.g. quarterly data).

MPW adopt the unconventional approach of estimating equity betas based on quarterly data.[12] This means that the estimates are informed by fewer observations, which leads to less precise beta estimates. For this reason, we recommend the use of higher frequency data in the form of daily data.

Robertson provides a similar view to our own, noting that higher frequency data provides more precision in the estimation of equity betas.[13] As such, Robertson relies on daily data in estimating betas.

Indepen's view is consistent with ours and Robertson, stating a preference for daily data over lower frequency data in the form of monthly observations and its recommended equity beta range relies on daily data.[14] Likewise, CEPA provides estimates over daily and weekly time intervals, both of which are considerably shorter frequencies than MPW's proposed quarterly data.[15]

The use of long estimation horizons ignores the existence of structural breaks, as recognised by Indepen and Robertson

Having decided the data frequency from which to estimate the equity betas, the next step is deciding the period that will inform the estimates. For example, should we use data from the last two years or data from the last ten years?

MPW recommend using long time periods for estimating equity betas, going back to 2000.[16] In a previous report, we find that using such a long estimation window ignores the existence of structural breaks, i.e. it ignores that over time, both the company and the market conditions change, resulting in the equity beta estimates failing to reflect the risk faced by the regulated entity over the future price control period. We provide a more detailed explanation of these factors in a previous report.[17]

Following the UKRN report, both Robertson and Indepen acknowledged the existence of structural breaks. Robertson concludes that the existence of structural breaks provides an argument against the use of very long run data.[18] Indepen provides estimates for three estimation windows to account for the possibility of structural breaks and recommends the use of data since the most recent structural break.[19]

CEPA, while not directly stating its preferred estimation period, seems to place weight on data going as back as 2011, which is a considerably more recent period than that suggested by MPW.[20]

In our view, a more recent estimation window, considering estimates based on both two and five years estimation windows, provides an appropriate balance between the number of observations and accounting for the possibility of structural breaks.

Ofgem's consultants do not account for differences in relative risk between UK energy and UK water sectors and National Grid's US operations

All of Ofgem's consultants estimate equity betas for energy and water companies, with the exception of the UKRN report, which provides estimates for only two water companies.

While the consideration of water companies to inform the betas for energy companies at RIIO-2 is reasonable, none of the consultants presents a detailed relative risk analysis of the energy and water sectors, despite empirical evidence showing higher asset betas for NG and SSE relative to water networks. In a separate report for National Grid, we have identified a number of factors, such as capital investment complexity and uncertainty over the future role of energy networks, which suggests that investors in National Grid may face higher risks than the water sector, consistent with the empirical evidence.[21] If Ofgem and its consultants rely on water company betas to inform National Grid's beta, it is necessary to interpret the water sector evidence in light of these additional risks.

Another issue is that none of the consultants provides estimates of betas for international comparators. Only Indepen discusses this possibility, concluding that they are not likely to be appropriate.[22] By contrast, we have conducted an analysis on the suitability of Italian and Spanish networks as comparators for National Grid in a separate report and found that they face similar business and regulatory risks, and provide good benchmarks.[23]

The use of a relative risk analysis can also be used to support a decomposition of the beta of National Grid. We have conducted a relative risk analysis of National Grid's UK and US operations in a separate report, concluding that UK operations were relatively riskier than US operations.[24] This means that when setting a beta that will be applied to the regulated UK operations of National Grid, this would be expected to be above the observed beta for National Grid as a whole. While no Ofgem consultant takes into account the decomposition in their recommendations, Indepen agrees in principle with a decomposition of National Grid's beta.[25,26]

Regulators commonly use a re-leveraged equity beta approach

Equity betas reflect the fundamental business risk of a company, as well as its financial risk, depending on its chosen capital structure. For example, a company with a higher leverage has greater volatility in returns to equity holders – as debtholders have a larger prior claim on cash-flows –and its equity beta will reflect this. It is common in a regulatory context to calculate an asset beta measure that abstracts from the capital structure of the firm, and reflects only fundamental business risk. The asset beta is obtained through a process called de-leveraging according to the formula below.

$$(2) \quad \beta_a = Gearing * \beta_d + (1 - Gearing) * \beta_e$$

where β_a = asset beta, Gearing = Net Debt/(Net Debt + Equity) ; β_d = debt beta and β_e = equity beta.

Once an adequate asset beta (range) is identified, these asset betas are re-leveraged using the same formula as above to get re-leveraged equity betas, often based on a notional gearing assumption, i.e. the gearing that the regulator assumes consistently across the price control for the notional stand-alone entity. The notional gearing is expressed as a measure of Net Debt to Regulated Asset Base (RAB). This is the standard approach to de-lever and re-lever as practised the past 20 years or so.[27] It is also the approach adopted by CEPA, as published alongside Ofgem's framework consultation.

There are substantial disagreements between Ofgem and its consultants on the leveraging approach

MPW argue that the equity betas estimated should not be de-leveraged and re-leveraged, as the equity beta can be estimated directly from the data and it is that equity beta that would determine the cost of equity in a CAPM framework. The fourth author of the UKRN report argues that the use of an unadjusted equity beta reflecting companies' actual gearing would be inconsistent with the notional weights used to calculate the weighted average cost of capital. Moreover, he also considers that this approach would mean the regulator's estimate of the cost of equity would be conditional on the gearing of the listed companies.[28]

Indepen also provides an equity beta range without adjusting for leverage because it considers that the actual gearing levels are sufficiently close to the assumed notional gearing that the impact would be small. While it is true that the de-leveraging and re-leveraging approach only changes the equity betas to the extent the gearing measures differ, it is not the case that the two gearing measures are close: for 3 out of the 5 comparators used by Indepen the actual gearings reported by Indepen are considerably different from the notional gearing of 60 per cent assumed by Ofgem.[29] Overall, MPW and Indepen's approach of relying on raw equity betas leads to an under-estimate of the equity beta at Ofgem's proposed notional gearing of 60 per cent of c.0.1 to 0.14, as shown in a separate report.[30]

While not adjusting the equity betas, Indepen comments on the leveraging approach followed by regulators. It considers that there is an inconsistency in the de-leveraging value (based on debt to enterprise value, or D/EV) and the re-leveraging based on an assumed notional debt to RAB (D/RAB). To resolve this inconsistency, Indepen proposes to adjust the notional gearing by replacing the RAB by a measure of the company's EV, derived as RAB*market-to-asset ratio (MAR)[31], and where MAR is assumed to be equal to 1.1.[32] The effect of Indepen's approach is to lower the assumed notional gearing from 60 per cent to 54.55 per cent, and provide for a lower equity beta and cost of equity (given the lower gearing).

In theory, Indepen's approach is unlikely to materially affect the Weighted Average Cost of Capital (WACC), provided the same adjusted gearing value is used when setting the WACC weights as in the cost of equity, as this is typically not very sensitive to the notional gearing assumption. We also note that Indepen's proposed adjustment has no precedent in UK regulation. Finally, Indepen's adjustment is not required in practice, given that there is no evidence that MARs for water and energy companies are considerably different from 1, as shown in a separate report.[33]

More worryingly, Ofgem misconstrues Indepen's approach. Ofgem applies Indepen's adjustment to the actual gearing level used to de-leverage equity betas which results in a higher assumed gearing for the comparators, and a lower implied asset beta of between 0.02 and 0.03.[34] Ofgem's approach is both inconsistent with Indepen's approach (which applies the adjustment to notional gearing) and finance theory. Given that the comparator equity betas reflect the specific capital structure of the companies (i.e. equity betas depend on gearing), these must be de-leveraged using the companies' actual gearing as opposed to Ofgem's higher adjusted gearing, which incorrectly assumes that the same equity betas would apply at a different level of gearing.

It is clear that there are disparate views amongst Ofgem's adviser set on the correct approach. The disparate views confirm our own view that there is no rationale to move away from the conventional leveraging approach employed by UK regulators to date, and supported by CEPA and the fourth author of the UKRN report.

Conclusions

We find that Ofgem's consultants provide contradictory recommendations for the estimation of betas in RIIO-2.

The use of a GARCH model as proposed in the UKRN report, while theoretically attractive, adds extra complexity and makes limited difference in practice, with results very similar to those estimated using OLS, as was subsequently recognised by Robertson and Indepen.

MPW's reliance on high frequency data is contradicted by all other consultant reports, which for the most part opt for the use of daily data. Aside from the UKRN report, the other advisers also recognise the existence of structural breaks, which provides an argument for more recent as opposed to very long estimation windows.

As a more general point, we find that Ofgem and its consultants fail to take into account the differences in risk between UK water and energy companies and for the decomposition of National Grid plc's composite beta, to identify beta estimates for National Grid's UK and US operations. The set of advisers also fail to consider European energy network companies, which face very similar business and regulatory risks, despite the use of international comparators being commonplace.

For the leveraging process, we find that MPW and Indepen's reliance on raw equity betas, understates the equity beta at the notional gearing level, and is therefore inconsistent with the weights used in the notional WACC. Of equal concern, we find that Ofgem's misconstrued application of Indepen's MAR adjustment results in an understatement of comparator asset betas, and a cost of capital that does not reflect the comparator level of risk. Overall, there is no rationale to move away from the leveraging process as set out in common regulatory practice.

Notes

[1] CEPA (February 2018), Review of Cost of Capital Ranges for Ofgem's RIIO-2 for Onshore Networks. Link: https://www.ofgem.gov.uk/system/files/docs/2018/03/cepa_report_on_baseline_allowed_returns_for_riio-2.pdf

[2] Wright, S, Burns, P, Mason, R, and Pickford, D (2018), Estimating the cost of capital for implementation of price controls by UK Regulators, An update of Mason, Miles and Wright (2003). Link: https://www.ukrn.org.uk/wp-content/uploads/2018/11/2018-CoE-Study.pdf

[3] Donald Robertson (April 2018), Estimating β. Link: https://www.ofgem.gov.uk/system/files/docs/2018/12/ofgem_dr_dec_2018.pdf

[4] Indepen (December 2018), Ofgem Beta Study – RIIO-2 Final. Link: https://www.ofgem.gov.uk/system/files/docs/2018/12/final_beta_project_riio_2_report_december_17_2018_0.pdf

[5] Ofgem (18 December 2018), RIIO-2 Sector Specific Methodology Annex: Finance. Link: https://www.ofgem.gov.uk/system/files/docs/2018/12/riio-2_finance_annex.pdf

[6] An OLS model estimates a beta based on minimising the squared differences between the actual stock return (Ri) and the predicted stock return (RfR + βi*ERPi), over the entire dataset. Under certain conditions (including the variance of the stock and the covariance of the stock with the market being constant), the estimated beta will give a consistent estimate of the true beta.

[7] For example, Engle and Patton (2001) survey the most important stylized facts about the volatility of asset returns. They present evidence of so called volatility clustering, which means that large moves in returns (of either direction) are typically followed by large moves and small moves are typically followed by small moves, creating persistence in volatility. They also show that volatility is mean reverting, i.e. a period of high volatility will eventually give way to a more normal level of volatility and conversely a period of exceptionally low volatility will eventually reverse, too. These stylised observations about asset returns' volatility imply that beta may vary over time. (Source: Engle, R.F., Patton, A.J., 2001. "What good is a volatility model?" Quantitative Finance, vol(1), pp. 237-245)

[8] NERA (1 May 2018), Review of UKRN report recommendations on beta estimation, pp.17-19.

[9] Wright, S, Burns, P, Mason, R, and Pickford, D (2018), Estimating the cost of capital for implementation of price controls by UK Regulators, An update of Mason, Miles and Wright (2003), p.9.

[10] Donald Robertson (April 2018), Estimating β, p.39.

[11] Indepen (December 2018), Ofgem Beta Study – RIIO-2 Final, Main Report, Executive Summary, p.xi.

[12] Wright, S, Burns, P, Mason, R, and Pickford, D (2018), Estimating the cost of capital for implementation of price controls by UK Regulators, An update of Mason, Miles and Wright (2003), p.53 and Appendix G.

[13] Donald Robertson (April 2018), Estimating β, pp. 3, 39 and 40.

[14] Indepen (December 2018), Ofgem Beta Study – RIIO-2 Final, Main Report, pp.19 and 45.

[15] CEPA (February 2018), Review of Cost of Capital Ranges for Ofgem's RIIO-2 for Onshore Networks, pp.52 and 53.

[16] Wright, S, Burns, P, Mason, R, and Pickford, D (2018), Estimating the cost of capital for implementation of price controls by UK Regulators, An update of Mason, Miles and Wright (2003), p.G-139.

[17] NERA (1 May 2018), Review of UKRN report recommendations on beta estimation, pp.4-10.

[18] Donald Robertson (April 2018), Estimating β, p.36.

[19] Indepen (December 2018), Ofgem Beta Study – RIIO-2 Final, Main Report, pp.5-7 and 45.

[20] CEPA (February 2018), Review of Cost of Capital Ranges for Ofgem's RIIO-2 for Onshore Networks, p.53.

[21] NERA (2019), Review of Indepen report recommendations on beta estimation, Section 6.

[22] Indepen (December 2018), Ofgem Beta Study – RIIO-2 Final, Main Report, pp.23 and 24.

[23] NERA (2019), Review of Indepen report recommendations on beta estimation, Section 6.

[24] NERA (2019), Review of Indepen report recommendations on beta estimation, Section 3.

[25] Indepen (December 2018), Ofgem Beta Study – RIIO-2 Final, Main Report, pp.37 and 38.

[26] Indepen raises conceptual questions that it considers must be answered before the use of the decomposition evidence. We address these concerns in a separate report (Source: NERA (2019), Review of Indepen report recommendations on beta estimation, Section 3.)

[27] See for example Ofcom (28 March 2018), Wholesale Local Access Market Review: Statement, Annex 20, pp.74-139; Ofwat (December 2014), Setting price controls for 2015-20 Final price control determination notice: policy chapter A7 – risk and reward, pp.32-42; Competition Commission (28 September 2007), BAA Ltd, A report on the economic regulation of the London airport companies (Heathrow Airport Ltd and Gatwick Airport Ltd), Appendix F, pp.F-7, F-8 and F-19 to F-31

[28] Wright, S, Burns, P, Mason, R, and Pickford, D (2018), Estimating the cost of capital for implementation of price controls by UK Regulators, An update of Mason, Miles and Wright (2003), pp.55-58.

[29] Indepen (December 2018), Ofgem Beta Study – RIIO-2 Final, Main Report, pp.32 and 46.

[30] NERA (2019), Review of Indepen report recommendations on beta estimation, Section 4.

[31] Market-to-asset ratio is defined as market value of the company over the RAB.

[32] Indepen (December 2018), Ofgem Beta Study – RIIO-2 Final, Main Report, pp.31-34.

[33] NERA (2019), Review of Indepen report recommendations on beta estimation, Section 4.

[34] Ofgem (18 December 2018), RIIO-2 Sector Specific Methodology Annex: Finance, pp.39 and 40.

About NERA

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