NERA
ECONOMIC CONSULTING

RIIO-T2 Beta and Risk Assessment

For National Grid

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Executive Summary

This report was prepared by NERA Economic Consulting for National Grid plc (NG plc) to advise on the estimation of beta risk, a key input to the determination of the cost of capital, for the upcoming price control RIIO-2. We review UK and international empirical evidence to inform the range for the asset beta of NG plc's regulated activities in the UK, i.e. electricity transmission (NGET) and gas transmission (NGGT). Our focus in this report is on empirical beta evidence, which reflects the market view of equity risk.

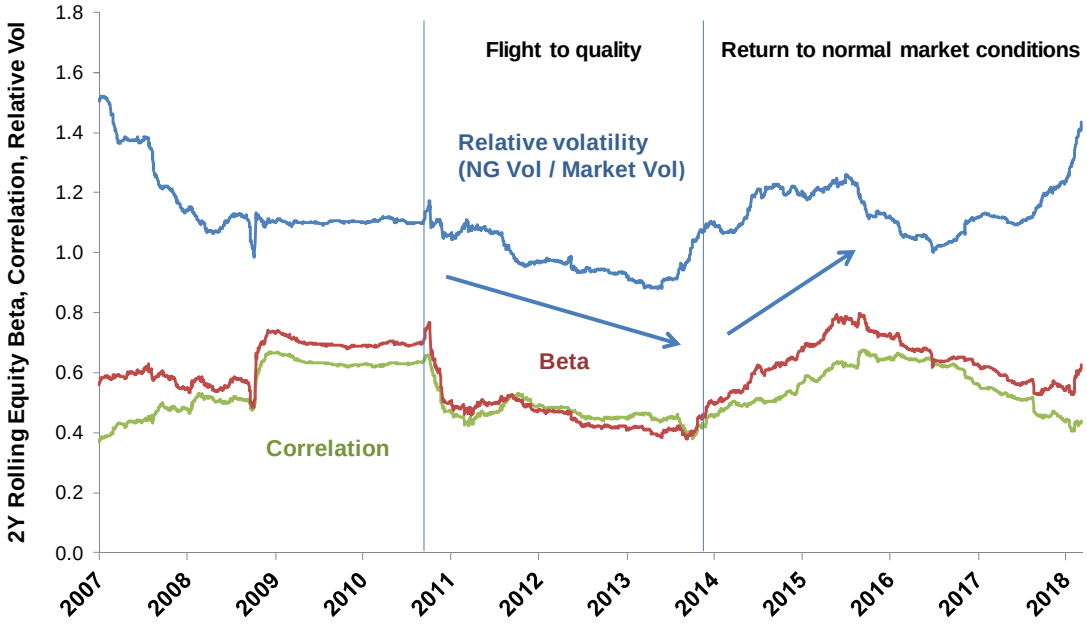
Empirical estimates support an increase in asset betas for NG plc at RIIO-2

Our analysis of UK listed network companies – NG plc, United Utilities, Severn Trent, and Pennon – shows that the majority of asset beta estimates lie in the range of 0.3 to 0.4, with values for NG plc towards the top-end of this range, e.g. NG plc's two-year asset beta is 0.37.

Our analysis shows that UK utility betas have increased from low levels during the time of the RIIO-1 price control, which coincided with the "flight to quality" in the aftermath of the financial crisis. Decomposing the equity beta into its constituent elements, we see that initially, both the correlation component and relative volatility component increased, followed by a decrease. In recent months, relative volatility has increased considerably. This could be a result of increased political risk (e.g. regarding political interference in utility regulation) as well as increased risks with regard to technological developments, e.g. relating to uncertainty over the future role of TO networks.

Overall, the empirical betas have increased considerably since RIIO-T1, supporting higher values at RIIO-T2 (see Figure 1).

Figure 1
Increase in NG plc's equity beta since T1 largely explained by increase in relative volatility



Source: Bloomberg, NERA analysis, cut-off: 9 March 2018, daily data, reference index: FTSE All Share.

Our comparative risk analysis suggests that NG plc investors face greater risks, as supported by the empirical betas

In recent price controls, UK regulators have set asset beta allowances in the range of 0.3 (for water) and 0.44 (for aviation: HAL and NATS). At RIIO-1, Ofgem allowed asset betas of 0.34 and 0.38 for NGGT and NGET, respectively. Our comparative risk analysis suggests that energy networks face higher risk than water networks in relation to system operability risks, and greater exposure to stranding risk due to government's decarbonisation plans and uncertainty over the future role of NGGT and NGET due to embedded generation. On the other hand, water networks face greater risks in relation to pension arrangements.

Our comparative risk analysis is borne out by empirical betas: NG plc's composite asset beta (0.37, 2Y) – even before allowing for lower risk US assets – tends to be higher than UU (0.30, 2Y) and SVT (0.31, 2Y), the main listed UK water companies' betas.

NG plc's composite asset beta understates the risk associated with NG UK network assets, given lower risk US networks

NG plc's composite beta reflects the combined systematic riskiness of NG plc's UK and US operations. UK and US operations have a similar share of NG plc's overall regulated asset base, but US regulatory regimes impose lower risks on investors due to a number of factors, including: some assets are regulated under cost-plus rather than incentive regulation; objective methods for setting cost allowances; less stringent financial output incentives; and, greater investor security offered by court based proceedings which have enshrined property

rights and "prudence standards" which imposes a high evidentiary bar for the disallowance of costs.

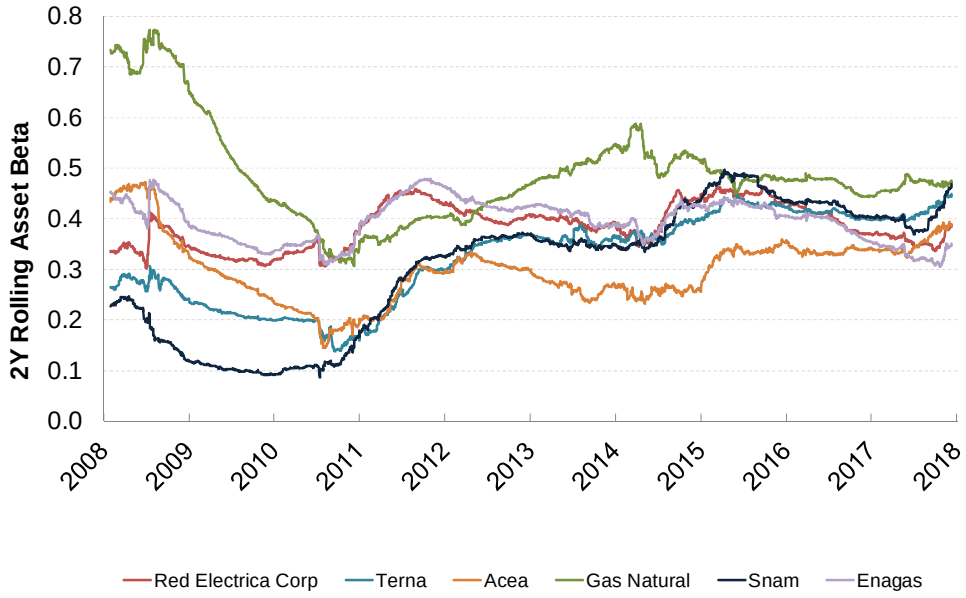
We have solved for the asset beta associated with NG plc's UK businesses by estimating the betas associated with comparator US networks.

We use a sample of US-only comparators as a proxy for the systematic riskiness of NG plc's US operations, and solve for the implied UK beta. Based on a sample of three comparators that operate in the same or similar states as NG plc, we find that their asset betas are below NG plc's group beta, with an average of 0.26. Solving for NG plc's implied UK beta, we obtain a range of 0.46 to 0.47. Using a much wider sample of 22 US comparators, we obtain a similar range of 0.43 to 0.45 for NG plc's UK beta.

European empirical evidence support an asset beta of around 0.4

We have estimated asset betas for listed European networks operating in Italy and Spain. The empirical evidence supports an asset beta of around 0.4 over the most recent two-year period (see Figure 2). Our comparative risk assessment of the Italian and Spanish regimes suggests that investors face broadly similar risks as per NG plc investors, and therefore the 0.4 asset beta provides a relevant benchmark for NG plc.

Figure 2
2Y rolling asset betas for European utilities have increased since the crisis



Source: Bloomberg, NERA analysis, cut-off: 9 March 2018, daily data, reference index: Eurostoxx.

NGET and NGGT face higher risks at RIIO-2 than other networks, and higher asymmetric risks from changes to the regulatory framework at RIIO-2

We have also considered the relative risks faced by NGET and NGGT relative to other regulated networks. We note that TOs face greater risk in relation to the complexity of

investment, e.g. given a greater proportion of the investment programmes relates to bespoke schemes relative to other networks, as observed by Ofgem at RIIO-1. NG also faces far greater cyber security risks given the critical nature of the transmission networks. In addition, at RIIO-T2, NGET and NGGT will face greater asset stranding and system operability risks. Our review of European regulatory decisions supports an asset beta uplift of around 0.06 for TOs that face competition or asset stranding risk, i.e. asymmetric risk that is not captured by empirical beta estimates.

We have also reviewed the risks that NG will face at T2 based on Ofgem's framework consultation document. In many areas Ofgem's proposed approach increases risk, notably in relation to outputs and incentives, with greater focus on relative rather than absolute targets; totex, with potential for within period re-sets; and, cost of debt where Ofgem's proposals will not necessarily allow for the recovery of efficient costs. More generally, Ofgem's proposals appear to increase asymmetric risks, e.g. in relation to potential fail-safe mechanisms such as its proposed anchoring of returns. As in the case of asset stranding, empirical beta estimates do not reflect such risks and therefore understate the risk an investor would face when investing in GB networks. Therefore, these regulatory and asymmetric risk factors support an uplift to the estimated asset betas.

1. Introduction

This report was prepared by NERA Economic Consulting for National Grid plc (NG plc) to advise on the estimation of beta risk, a key input to the determination of the cost of capital, for the upcoming price control RIIO-2.[1] The report focuses on UK and international empirical beta evidence to inform the range for the asset beta of NG plc's regulated activities in the UK, i.e. electricity transmission (NGET) and gas transmission (NGGT).

The remainder of this report is structured as follows:

- Section 2 provides evidence from the UK, including empirical beta evidence for listed networks, recent UK regulatory decisions, and relative risk analysis for NG plc versus other networks. We also decompose NG plc's group beta into a UK asset beta and a US asset beta;
- Section 3 presents similar evidence for European energy networks, including empirical analysis and relative risk analysis for NG plc versus other European regimes;
- Section 4 compares NGET's and NGGT's risks under the RIIO-T1 and the proposed RIIO-T2 frameworks a set out in Ofgem's recent framework consultation; and
- Section 5 concludes.

[1] We prepared this report to respond to beta risk issues set out in Ofgem's recent consultation. See: Ofgem (March 2018) RIIO-2 Framework Consultation Link: https://www.ofgem.gov.uk/system/files/docs/2018/03/riio2_march_consultation_document_final_v1.pdf

2. UK Beta Evidence and Regulatory Precedent

In this section, we first describe our overall methodology for estimating betas. Second, we present empirical beta estimates for UK listed networks, and explain the trend increase since RIIO-1. We then decompose NG plc's asset beta into a beta for UK operations, drawing on US beta estimates. We also present a relative risk assessment of UK energy versus other GB regulatory regimes.

2.1. Methodological considerations

Before we present empirical betas for NG plc and UK comparators, we briefly summarise our methodological choices for estimating equity and asset betas, with regard to the estimation method, the estimation window, data frequency, un-levering and re-levering, as well as our debt beta assumption.

2.1.1. We draw on OLS methods, and prefer high frequency data and short time periods

Our overall approach is to use ordinary least squares (OLS) statistical techniques, and to draw on relatively high frequency data and recent (e.g. 2 year) estimation periods.

The estimation period (e.g. 1, 2, 5 years) and frequency of data (daily, weekly, monthly) have to be considered together to ensure sufficient observations in the regression to lead to precise estimates, i.e. estimates with relatively low standard errors.

In terms of the estimation period, the more recent the time period the more relevant the beta estimate to the risks faced by investors over the control period. The period also has to be sufficiently long to provide the requisite number of observations to estimate statistically robust betas. We consider that a 2 year period and daily observations provides both relevant and robust beta estimates.

The only reason not to draw on daily observations is for stocks that are infrequently traded, and illiquid. For such stocks, daily stock returns are likely to exhibit serial correlation, where the returns on successive days are not independent, and which weakens the efficiency of the beta estimates.[2] For these stocks, weekly or monthly data may be justified. However, in our case, the comparators considered in this report have liquid stocks (based on bid-ask spreads), and hence we use daily return data, which provide statistical robust estimates in combination with 2 year estimation periods.

Our approach is in line with standard UK regulatory practice. UK regulators have often relied on relatively short estimation windows combined with daily data. Ofcom, for example, only considered one-year and two-year estimation windows in its Business Connectivity Market Review. It finally decided to use a two-year window, because it "*provides the most*

[2] We look at bid-ask spreads as a proxy for the liquidity of the listing. We consider stocks with bid-ask spreads below 1 per cent are sufficiently liquid/ frequently traded, based on UK and European regulatory approaches. See for example, NERA (2016) Update of the Equity Beta and Asset Beta for BT, A report for Ofcom. Section A4, pp 58-59. Link: https://www.ofcom.org.uk/__data/assets/pdf_file/0028/97039/annex_31.pdf.

appropriate balance between a short enough estimation period to remain relevant on a forward-looking basis, whilst having enough data points to be sufficiently statistically robust".[3] This is also in line with the risk associated with rapid technological change in the telecoms sector.

In the recent past, investors in UK energy networks have seen an increase in both technology-related risk and political risk (especially regarding political interference), and we expect that this will be reflected in the more recent market data. Given these developments, we prefer to rely on shorter estimation windows, e.g. of around two-years, but also report the wider set of estimation windows (1, 2, 5, and 10 years).

2.1.1.1. MPW recommendations

As we set out in a separate report for NG,[4] three of the UKRN report authors, Mason, Pickford and Wright (MPW) recommend estimating betas using a methodology which substantially departs from common regulatory practice and the approach we adopt in this report. Specifically, they recommend betas should be estimated using very long-run estimation periods going back to 2000; aggregated or low frequency data (e.g. quarterly returns); and statistical models from the GARCH family for estimating betas.

As we explain in our report, we disagree with MPW's recommendations. Estimating betas over long horizons going back to 2000 ignores material changes in companies' business and financial risk, changes in market conditions, as well as changes in the regulatory regime, resulting in beta estimates that fail to reflect regulated companies' risk profile at RIIO-2. The use of low frequency quarterly data requires extending the estimation period to ensure sufficient observations, leading to very long estimation periods that are not relevant in terms of risk profile, as noted above. The use of quarterly intervals results in less precise beta estimates, e.g. as measured by the standard errors.

In terms of estimation technique, we show that if we use high daily data and recent time periods, then beta estimates are similar irrespective of whether GARCH or standard OLS statistical models are used. Given the substantial increase in complexity associated with the use of GARCH models, we consider that GARCH methods are less justified compared to standard OLS in the regulatory context, and hence our focus on established OLS methods in this report.

2.1.2. Levering the beta

The systematic risk of a company is measured by the asset beta of the firm, which takes into account all the assets of the firm. Unlike the equity beta, the asset beta is not affected by the firm's particular capital structure. The asset beta is estimated by de-levering the equity beta for the listed companies, using each company's gearing. The asset beta must then be "levered" back to an equity beta using the gearing assumption for the sector as whole. In

[3] Ofcom (2016), Business Connectivity Market Review, Annex 30, p80.

[4] NERA (2018) Review of UKRN report recommendations on beta estimation

levering the beta, we use the so-called Miller formula which is the standard approach in GB regulation, i.e. used by CMA.[5,6]

- Miller: $\beta_e = \beta_a * (1 + D/E)$

For de-levering equity betas, we use net debt to market capitalisation of the respective companies.

2.1.2.1. MPW proposed approach

As with the wider estimation techniques, MPW provide an alternative views on how to estimate the beta for a notionally geared efficient network. MPW argue that the use of a notional gearing to re-lever the asset beta is incorrect and that the most reliable equity beta is the raw estimation.

We do not consider the MPW approach has merit. First, 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. Alternatively, if the regulator were to determine the cost of capital based on listed companies' actual capital structure decisions, this would undermine incentives to optimise capital structure and minimise financing costs, and would tie the sector to the capital structure decisions of the few listed companies.

The use of de-leveraging and re-leveraging the equity beta to reflect the regulator's notional structure has also been adopted by CMA, Ofgem and Ofwat, and therefore our approach is consistent with wider regulatory practice. [7,8]

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5 CMA (2015), Bristol Water plc - A reference under section 12(3)(a) of the Water Industry Act 1991, p333. CMA (2014), Northern Ireland Electricity Limited price determination - A reference under Article 15 of the Electricity (Northern Ireland) Order 1992, p 13-40.

6 An alternative is to use the so-called Modigliani-Miller: $\beta_e = \beta_a * (1 + \{1\text{-Tax Rate}\}*D/E)$. The Miller formula assumes that the capital structure of the firm is constant, or in other words the firm pursues a target capital structure and it rebalances its debt and equity constantly towards its target. By contrast, the Modigliani-Miller formula assumes that the debt *level* of the firm is constant, whilst the capital structure can change. See: Brealey and Myers (2011), Principles of Corporate Finance, 10th edition, p484-486.

7 Ofwat (September 2016), Water 2020: consultation on the approach to the cost of debt, p. 16. Ofwat states: Ofwat cites the following reasons to support a notional approach. These were: *"Customers should not be responsible for funding inefficient financing structures of debt costs";"Companies are free to choose their actual capital structure and the debt instruments raised, but customers will only face the efficient cost of debt for a notionally structured company."*

8 The CMA also supported a notional approach to capital structure and cost of debt in Bristol Water appeal. The CMA states the following: "*In addition, we support Ofwat's use of a notional cost of embedded debt in the context of a multi-company framework. As well as being consistent with other regulators (e.g. Ofgem), this has the benefits of allocating risk/reward to the people best able to manage it (i.e. management), incentivising efficient methods and timings of raising debt, and removing incentives to obfuscate actual debt costs through complex arrangements and capital structures."*
Source: CMA (2015) Bristol Water price determination, p. 304. Link: https://assets.publishing.service.gov.uk/media/56279924ed915d194b000001/Bristol_Water_plc_final_determination.pdf

2.1.3. Debt beta

The debt beta captures the degree of correlation between the returns to debt-holders and the broader economy, analogous to the equity beta which captures correlated risk for equity-holders. Under standard corporate finance theory, both quantities are needed to obtain the asset beta, a measure of business risk which removes the effect from leverage (i.e. quantifies correlated volatility as if the company had no debt), as per the following formula:

$$\beta_a = \beta_d * (g) + \beta_e * (1- g)$$

where

β_a is the unlevered beta ("asset beta");

β_d is the debt beta;

β_e is the equity beta; and

g is the gearing level (Debt/Debt + Equity).

We assume a zero debt beta in our analysis. Ofwat and Ofgem used a zero debt beta in estimating cost of equity at PR14 and the recent RIIO reviews.[9] CEPA also assumes a zero debt beta for its recent report to Ofgem, and the UKRN report provides empirical evidence that the debt beta for UK energy networks is likely to be close to zero when using daily data.[10] The debt beta assumption also tends to have a negligible effect on the overall cost of equity, as observed by the CMA.[11,12]

2.2. Empirical evidence from UK networks

Figure 2.1 shows the evolution of asset betas for NG plc and four listed UK networks comparators – SSE, UU, Severn Trent and Pennon – over the past 10 years. The asset betas for NG plc and the comparators have increased considerably since the height of the financial crisis in Europe (2011-2012), and the RIIO-1 determination in 2013.

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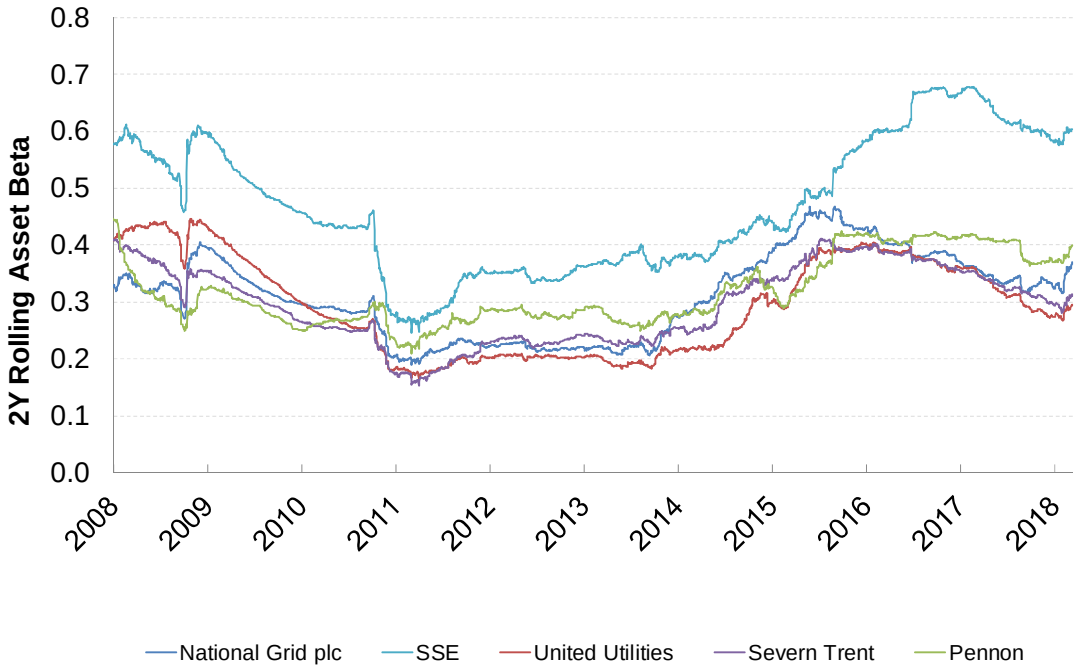
9 Ofgem (December 2012), RIIO-T1: Final Proposals for National Grid Electricity Transmission and National Grid Gas - Finance and uncertainty supporting document; Ofgem (December 2012), RIIO-GD1: Final Proposals - Finance and uncertainty supporting document; Ofgem (July 2014), RIIO-ED1: Draft determinations for the slow-track electricity distribution companies – Financial Issues; Ofwat (December 2014), Setting price controls for 2015-20 Final price control determination notice: policy chapter A7 – risk and reward, p41, 42.

10 CEPA (February 2018), Review of the cost of capital ranges for Ofgem's RIIO-2 for onshore networks, p51. S Wright, P Burns, A Mason, D Pickford (2018), Estimating the cost of capital for implementation of price controls by UK Regulators ("UKRN Report"), p55.

11 The assumed debt beta affects the notional cost of equity only to the extent that leverage for the comparators differs from the notional assumption. If empirical leverage is the same as notional and consistent debt betas are used for un-levering and re-levering, there is no impact on the re-levered cost of equity.

12 For example, at the BW 2015 appeal, the CMA assumed a debt beta of zero, noting that debt beta has very little impact on the overall cost of capital as BW's notional gearing level was similar to the comparators.

Figure 2.1
2Y rolling asset betas for UK utilities have increased since RIIO-1, as a consequence of UK emerging from the financial crisis



Source: Bloomberg, NERA analysis, cut-off: 9 March 2018, daily data, reference index: FTSE All Share.

Table 2.1 shows the latest empirical asset betas for UK networks, using 1-year, 2-year, 5-year, and 10-year estimation windows. This evidence shows that in the most part the asset beta estimates lie in the range of 0.3 to 0.4, with the exception of SSE's beta which is higher, reflecting its significant share of generation and supply activities, which are more risky. NG plc's asset beta is at the top-end of the range, excluding SSE.

Table 2.1
With the exception of SSE, most network asset betas lie in the range of 0.3 to 0.4 with NG plc towards the upper-end of the range[13]

	1Y	2Y	5Y	10Y
National Grid plc	0.54	0.37	0.39	0.32
SSE	0.44	0.60	0.57	0.45
United Utilities	0.35	0.30	0.33	0.27
Severn Trent	0.37	0.31	0.35	0.29
Pennon	0.44	0.40	0.38	0.31
Average	0.43	0.40	0.40	0.33
Average (excl. SSE)	**0.43**	**0.34**	**0.36**	**0.30**

Source: Bloomberg, NERA analysis, cut-off: 9 March 2018, daily data, reference index: FTSE All Share.

2.2.1. Explaining trend in NG plc's beta risk over time

We have conducted an empirical analysis of systematic risk, using stock and index return data to estimate betas for NG plc and other listed UK networks.

Figure 2.2 shows NG plc's equity beta (red line) over the period 2007 to 2018, including a decomposition of the beta into its two components, the relative volatility of the stock return to that of the market (blue line) and the correlation of the stock return with the market (green line).

Under the OLS CAPM, the equity beta derived from market data can be decomposed into correlation of the stock return with the market, and relative volatility of the stock return to that of the market:

$$equity\ \beta = \rho_{stock,\ market}\ \ x\ \ \frac{\sigma_{stock}}{\sigma_{market}}$$

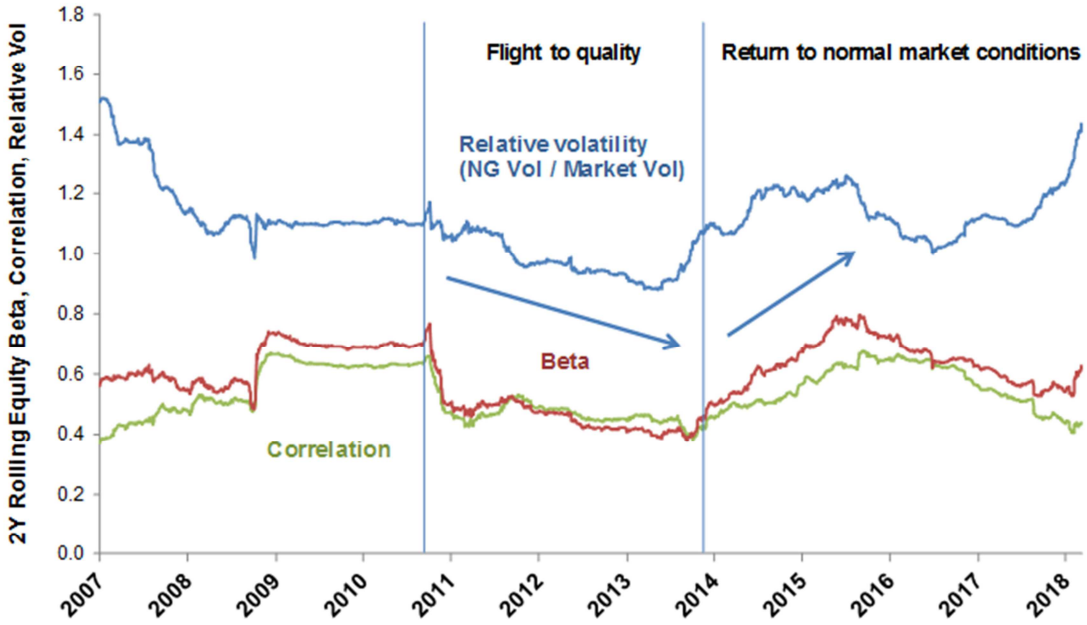
As with other "defensive" stocks, NG plc's equity beta fell in the aftermath of the financial crisis due to higher market volatility relative to NG plc's volatility, and reduced correlation (which was relatively suppressed due to NG plc being a defensive stock). However, NG plc's equity beta has returned back to normal market conditions and pre-crisis levels.

Initially, both the correlation component and relative volatility increased, followed by a decrease. In recent months, relative volatility has increased considerably. This could be a result of increased political risk (e.g. regarding political interference in utility regulation) as well as increased risks with regard to technological developments, e.g. relating to uncertainty over the future role of TO networks.

[13] Where there is more than one relevant comparator, we draw conclusions based on the average beta estimate for the comparator set, to take into account all relevant information.

The trend of higher relative volatility can also be observed for the listed water companies (see Appendix A).

Figure 2.2
Increase in NG plc's equity beta mainly a result of increase in relative volatility



Source: Bloomberg, NERA analysis, cut-off: 9 March 2018, daily data, reference index: FTSE All Share.

2.2.2. Conclusions on UK networks empirical asset betas

In common with other listed networks, NG plc's asset beta has increased since RIIO-1, and as the UK economy has emerged from the financial crisis.[14] As set out in Table 2.1, NG plc's two-year asset beta is 0.37, at the higher end of the asset beta decisions of 0.34 to 0.38 determined at RIIO-1.[15] The reasons for the increase relate to both an increase in correlation with the stock market, and most notably an increase in the relative volatility of NG plc's stock, as we show in Figure 2.2.

NG plc's beta (2Y asset beta of 0.37) is above UU and SVT water companies' beta; we discuss some of the additional risks faced by NG relative to water networks in section 2.4. We also show that NG plc's composite beta understates the risks associated with its UK operations, as the composite beta in part reflects lower risk US operations, as we set out in the following section.

[14] It should be noted that the nature of NG plc.'s UK business changed when the company sold a majority stake (61%) in its gas distribution business on 31 March 2017. This sale increased the share of regulated assets located in the US by about 5 percentage points from 36% to 41%.

[15] Ofgem (17 December 2012), RIIO-T1: Final Proposals for National Grid Electricity Transmission and National Grid Gas - Finance Supporting Document, para 3.44, 3.45.

2.3. Decomposition of NG plc's group asset beta

NG plc carries out regulated activities and a small share of non-regulated activities in the UK and the US. In the financial year 2016/17, non-regulated activities accounted for 5 per cent of the group's revenues and about 6 per cent of the group's fixed assets.[16] US regulated operations accounted for 41 per cent of the group's combined regulated asset base.[17] In order to estimate the systematic riskiness of NG plc's UK operations, we decompose NG plc's overall asset beta into a UK asset beta and a US asset beta, in the following section.

As shown in Table 2.2 below, National Grid USA operates in New York State, Massachusetts, New Hampshire, Rhode Island, Maine and Vermont. A total of four regulatory bodies are involved in setting its tariffs, in line with the location of the individual businesses and customers:[18]

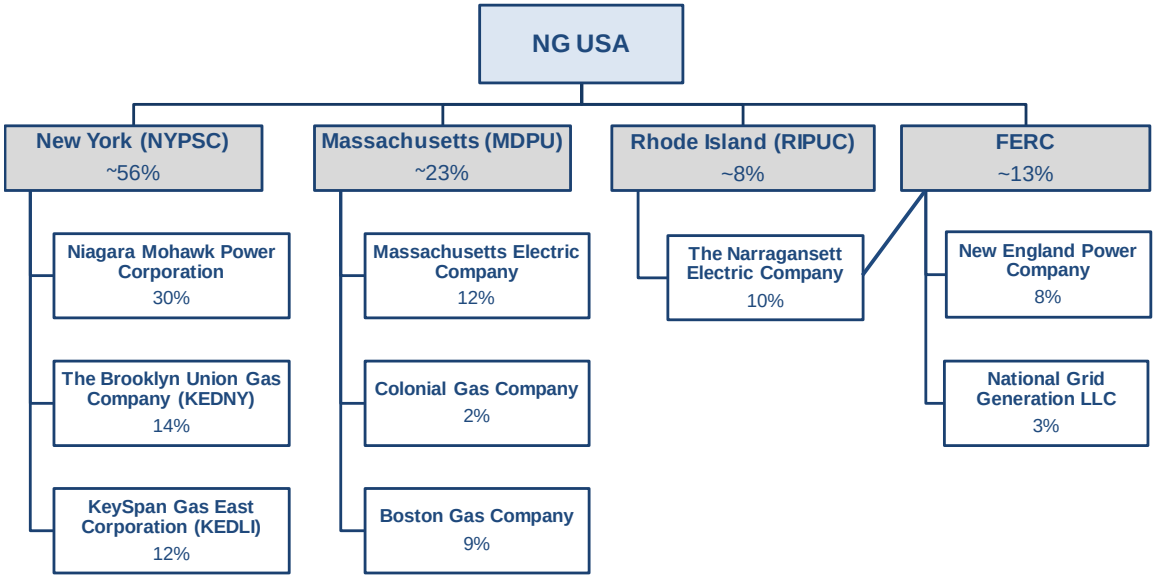
- New York Public Service Commission (NYPSC) – ca 56 per cent of US regulated assets;
- Massachusetts Department of Public Utilities (MDPU) – ca 23 per cent of US regulated assets;
- Rhode Island Public Utilities Commission (RIPUC) – ca 8 per cent of regulated assets; and
- Federal Energy Regulatory Commission (FERC) – ca 13 per cent of US regulated assets.

[16] These activities included UK gas metering activities; the Great Britain-France Interconnector; UK property management; a UK LNG import terminal; US LNG operations; US unregulated transmission pipelines; together with corporate activities. See NG Annual Report 2016/17, p.95, 96.

[17] NG plc (18 May 2017), 2016/7 Full Year Results, p.14-17. This calculation only takes into account NG's remaining 39% stake in its former gas distribution business.

[18] NG plc US Databook for 2016/17, p7,8.

Table 2.2
Overview of NG plc's businesses in the US (% of total regulated asset base)



Notes: Shares of regulated assets do not add up to 100% due to rounding issues. Sources: NG Annual Report; NG (2017), National Grid US Operations – Credit Information Pack.

2.3.1. Relative risk assessment of NG USA relative to NG UK

In this section, we compare the risks investors bear with regard to NG plc's regulated activities in the UK and the US, respectively. We find that investors perceive that NG plc's US businesses face considerably lower equity risk than investors in NGGT and NGET.

In the US, NG plc's operations are subject to various regulatory regimes, depending on their location and the nature of the business. Most of the NG plc's US businesses are subject to some form of incentive regulation (about 90 per cent of regulated assets), albeit a lower-powered incentive regime than the UK, as we explain below. However, around 8 per cent of assets are subject to low risk rate of return regulation. In addition, National Grid Generation, about 3 per cent of regulated assets, operates under a long-term power supply agreement with the Long Island Power Authority.[19]

In terms of commonality, like NGGT and NGET, NG plc's US incentive based regimes are subject to revenue caps, i.e. do not bear material demand or revenue risk. In most other respects, however, the US incentive based regimes are considerably less risky than RIIO-2:

- Greater objectivity in setting allowed costs: in most cases, cost allowances are set based on outturn costs for a base year and projected forwarded, without explicit efficiency factors that reduce allowance over time. Some are also based on historical costs (especially in Massachusetts). The prudency standard for permissible costs sets a high

[19] See NG US Databook for 2016/17, p7,8.

evidentiary bar for the disallowance of incurred costs.[20] By contrast, RIIO draws on more subjective comparative efficiency analysis and technical review of costs;

- US regimes provide a true-up for pension and other post-employment liabilities, whereas NGET and NGGT bear the risk on their post-2012 liabilities;
- US companies generally have less stringent or financial performance related output and quality of service incentives (mainly around reducing and preventing gas leakage and some efficiency incentives);
- The US regimes incorporate greater use of cost pass-through or true-ups, e.g. for commodity prices, commodity related bad debt, some mandated capex, and environmental remediation costs. By contrast, the true-ups or pass-through provisions for NGET and NGET are more limited, e.g. relating to security, network development, infrastructure enhancement, strategic wider works, and some environmental costs.[21]

The US regimes tend to have relatively short regulatory periods (mostly 3-4 years), which provides for frequent updating of allowed revenues in line with costs, and hence a relatively low within-period volatility of returns.[22] Whereas the regulatory period in the UK is eight years under the current regime, it includes a number of uncertainty mechanisms which provide for intra-period updates to key revenue components. As a result, the frequency of updates under the UK and US regimes is more similar than the length of the regulatory periods suggests.

NG plc's businesses in New York (ca 56 per cent of regulated asset base in the US) and Rhode Island (ca 8 per cent of regulated assets) are subject to an asymmetric Earnings Sharing Mechanism (ESM), under which businesses share an increasing fraction of outperformance with consumers. Sharing factors are set with reference to the allowed rate of return, and are staggered: starting at 50 per cent (beyond a 50bp dead-band for KEDNY and KEDLI), they increase to 75 per cent or even 90 per cent beyond a certain number of basis points relative to the allowed return on equity. These sharing factors compare to around 40-50 per cent for NG plc, which apply symmetrically. However, there is greater objectivity for recognition of costs in the US based on the prudency standard, so underperformance may be less unlikely than in the UK.[23]

Overall, US regulatory regimes are determined with reference to case law which has been tested in the courts. The nature of the proceedings offers greater investor security relative to the more subjective approach, and weaker appeals mechanisms, associated with GB price

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[20] See footnote 23.

[21] Ofgem (2012), RIIO-T1: Final proposals for National Grid Electricity Transmission and National Grid Gas – Finance support document, p89, 90.

[22] We understand that in practice NG can file more frequently than the duration of the price controls, as stated here and more recently looks to file every one to three years.

[23] As Makholm writes, "*The prudent investment standard, as defined by Brandeis, sets a high evidentiary bar for disallowances of utility costs, and thus significant imprudence disallowances of costs are comparatively uncommon for North American utilities.*" See: NERA (2015) Half a century of estimating the cost of capital, p. 7 Link: http://www.nera.com/content/dam/nera/publications/2015/PUB_Cost_of_Capital_1115.pdf

controls. For example, the rate cases have enshrined principles in relation to the protection of property rights, and notions of prudency standards in relation to permissible costs.[24]

[24] The regulation of utilities in North America faces a special kind of constraint that most other nations do not exhibit. Particularly in the United States, major regulatory statutes do not become settled methods of government control over private businesses until they are tested in the courts. There are established principles in relation to property rights, and prudency standards. See: NERA (2015) Half a century of estimating the cost of capital, Link: http://www.nera.com/content/dam/nera/publications/2015/PUB_Cost_of_Capital_1115.pdf

Table 2.3
Relative risk assessment supports lower beta for NG plc's US operations

	GB		USA							
	NGET	NGGT	Niagara Mohawk Power Corp	Massachusetts Electric Company	New England Power Company	The Narragansett Electric Company	Brooklyn Union Gas Company (KEDNY)	Keyspan Gas East Corp. (KEDLI)	Colonial Gas Company and Boston Gas Company	National Grid Generation LLC
% of regulated assets in country	• 68%	• 32%	• 30%	• 12%	• 8%	• 10%	• 14%	• 12%	• 11%	• 3%
Principal activities	• Electricity transmission	• Gas transport	• Electricity and gas distribution and retail	• Electricity distribution and retail	• Electricity transmission	• Electiricty and gas transport and retail	• Gas transport	• Gas transport	• Gas transport and retail	• Electricity generation
Location and regulator(s)	• GB • Ofgem		• NY • NYPSC	• MA • MDPU	• MA, NH, RI, ME, VT • FERC	• RI • RIPUC, FERC	• NY • NYPSC	• NY • NYPSC	• MA • MDPU	• NY • FERC
Form / length of revenue period	• Revenue-cap • 8 years [5 years in RIIO-2?]		• Revenue cap • 3 years (2015-17/18)	• Revenue cap • 3 years (2016-18/19)	• Cost plus	• Revenue cap • 4 years (2013-2017)	• Revenue cap • 3 years (2016-19)	• Revenue cap • 3 years (2016-19)	• Revenue cap • 7 years (2010 – 2017)	• Long-term Power Supply Agreement with LIPA • 15 years (from 2013)
Setting cost allowances	• Expert review of totex • DB pension deficit recovery over 15yrs with 3Y re-valuation (but risk on post-2012 liabilities) • Re-openers for some costs		• Based on fully forecasted rate year (appeal possible) • Variable rate CoD allowances • Capital tracker ($2.7bn over 3 years)	• Based on historical costs (appeal possible) • Rate base includes all previously unremunerated investments • Allowance for new energy and outage management systems • Capital tracker ($249mn p.a.)	• Forward-looking monthly formula rates	• Based on projected costs (appeal possible) • Capex recovery for infrastructure and reliability investments outside of base rate • Capital tracker (approved annually by RI Commission)	• Based on fully forecasted rate year (appeal possible) • Variable rate CoD allowances • Capital tracker ($1.9bn over 3 years)	• Based on fully forecasted rate year (appeal possible) • Capital tracker ($1.1bn over 3 years)	• Based on historical costs (appeal possible) • Allowance for some environmental and efficiency related costs • Capital tracker (approved for individual investments)	• Reopener for return on equity possible during Y4-6 (NG or LIPA can request) • NG can request rate reopener one time after 6 years
Outturn cost risk & incentives	• Totex Incentive Mechanism (TIM) • Uncertainty/pass-through of non-controllables • Disapplication of price control		• Pass-through of commodity prices • True-ups for: ► pension liabilities ► commodity related bad debt (partial) ► environmental remediation cost ►property taxes • Earnings sharing (staggered: 50%-75%-90%)	• True-ups for: ►pension liabilities ►commodity related bad debt (partial) ►property taxes	• True-ups for: ► Automatic annual true up for opex and capex ► Pension true-up	• True-ups for: ►pension liabilities ►commodity related bad debt (partial) • Earnings sharing (staggered 50% on first 100 bps above RoE - then 75%)	• Pass-through of commodity prices • True-ups for: ►pension liabilities ►commodity related bad debt (partial) ►environmental remediation cost ►certain mandated capex ►property taxes • Earnings sharing staggered (0%-50%-75%-90%)	• True-ups for: ►pension liabilities ►commodity related bad debt (partial) ►environmental remediation cost ►certain mandated capex • Earnings sharing staggered (0% - 50% - 75% - 90%)	• Pass-through of commodity prices • True-ups for: ►pension liabilities ►commodity related bad debt (partial)	• Annual rate adjustments: ►pension liabilities ►adjustments for new plant in service ►property tax
Quality of Service/Output incentives	• Performance incentives : +0.6/-1.4% of RORE	• Performance incentives : +1.7/-1.4% of RORE	• Gas safety performance metrics: up to 150 basis points at risk annually	• Some efficiency incentives		• Some incentives around gas procurement (+/-)	• Performance incentive: Pipe replacement and leak repair	• Performance incentive: Pipe replacement and leak repair	• Demand side management incentive (+)	

***Notes**: (1) MA=Massachusetts, NY=New York, RI=Rhode Island, NH=New Hampshire, ME=Maine, VT=Vermont; LIPA=Long Island Power Authority. (2) Capital Tracker: A mechanism that allows for the recovery of the revenue requirement of incremental capital investment above that embedded in base rates, including depreciation, property taxes and a return on the incremental investment. (3) Regarding length of control period, in practice NG can file more frequently than the duration of the price controls, as stated here and more recently looks to file every one to three years **Sources**: NG plc 2016/17 accounts, 197; NG plc US Databook for 2016/17, p7,8; NG plc (1 May 2017), National Grid US Operations – Credit Information Pack; NG plc (May 2016), US Regulation Basics; NG plc (2013), National Grid Generation Rate Case Decision; NYPSC (2016), Decision on rates for KEDNY and KEDLI,p.26; NG plc (May 2013), Rhode Island Electric & Gas Rate Case Order; NYPSC (March 2013), Niagara Mohawk Rate Order.*

2.3.2. Asset beta decomposition

In order to obtain a measure of the systematic riskiness of NG plc's UK business, we decompose the NG plc's group asset beta into a UK and US asset beta, based on Equation 1 below.

Equation 1:

$$\beta_{NG} = \frac{Regulated\ assets\ in\ UK}{Total\ regulated\ assets} * \boldsymbol{\beta_{UK}} + \frac{Regulated\ assets\ in\ US}{Total\ regulated\ assets} * \beta_{US}$$

$$\beta_{NG} = 59\% * \beta_{UK} + 41\% * \beta_{US}$$

In order to estimate the beta associated with NG plc's US regulated businesses ($\boldsymbol{\beta_{US}}$), we identified an initial sample of 22 network comparators in the US (see Table 2.4 below).[25] We selected these comparators based on networks operating exclusively in the US, and principally engaged in regulated energy network, retail, or generation activities, as well as ensuring that the stocks met standard liquidity thresholds.[26]

[25] Bloomberg, CEG (2013), Information on equity beta from US companies.

[26] We look at bid-ask spreads as a proxy for the liquidity of the listing. We consider stocks with bid-ask spreads above 1 per cent to meet the liquidity threshold, based on UK and European regulatory approaches. See for example, NERA (2016) Update of the Equity Beta and Asset Beta for BT, A report for Ofcom. Section A4, pp 58-59. Link: https://www.ofcom.org.uk/__data/assets/pdf_file/0028/97039/annex_31.pdf

Table 2.4
We identified a set of 22 comparators to estimate NG plc's US beta risk

Company	Activities	c% assets regulated (2017)	States	Regulatory Regime*
National Grid	▪ Electricity transmission, distribution, retail ▪ Natural gas transportation, distribution, retail ▪ Electricity generation ▪ capacity sale, energy conversion; ancillary services	>95%	New York, Massachusetts, Rhode Island, Maine, Vermont	Incentives (small share of cost-plus)
Ameren Corp	▪ Electricity distribution ▪ Natural gas distribution ▪ Electricity generation	95%	Missouri and Illinois	Incentives
American Electric Power	▪ Electricity transmission and distribution ▪ Electricity generation	82%	Ohio, Virginia, Texas, Louisiana, Indiana, Kentucky, Oklahoma, Arkansas, Michigan, Tennessee, West Virginia	Both
Black Hills Corp	▪ Natural gas, oil, and coal production ▪ Electricity generation ▪ Energy marketing	80%	South Dakota, Wyoming, Nevada, Colorado, New Mexico, California	Both
CenterPoint Energy	▪ Electricity transmission and distribution ▪ Natural gas distribution ▪ Electricity generation ▪ Retail ▪ Gathering operations	81%	Texas	Both
Chesapeake Utilities Corp	▪ Natural gas transport and distribution ▪ Propane distribution ▪ IT services	80%	Delaware	Both
Consolidated Edison	▪ Electricity transmission and distribution ▪ Gas distribution ▪ clean energy business and steam	87%	New York	Incentives
Dominion Energy	▪ Electricity transmission, distribution, retail ▪ Electricity generation	70%	Virginia, West Virginia, North Carolina, Connecticut	Both
Entergy Corp	▪ Electricity transmission, distribution ▪ Electricity generation (mainly nuclear)	87%	Arkansas, Louisiana, Mississippi, Texas, Michigan, Nebraska	Both
Eversource Energy	▪ Electricity transmission, distribution, retail ▪ Natural gas distribution, retail ▪ Acquired water utility in 2017	82%	Connecticut, Massachusetts, New Hampshire	Both
First Energy Corp	▪ Electricity generation, transmission and distribution ▪ Natural gas transmission and retail ▪ Oil exploration and production ▪ Energy management, energy-related services	90%	Ohio, West Virginia	Both
Great Plains Energy	▪ Electricity generation and delivery	100%	Missouri	Both
Idacorp	▪ Electricity generation, purchase, transmission, distribution and sale ▪ Electricity and natural gas marketing	98%	Idaho, Oregon	Incentives
NiSource	▪ Natural gas transmission and distribution ▪ Natural gas storage ▪ Electricity generation, transmission, distribution	84%	Indiana, Kentucky, Maryland, Massachusetts, Ohio, Pennsylvania and Virginia	Both
Northwest Natural Gas	▪ Natural gas transportation and distribution ▪ Natural gas storage	97%	Oregon	Incentives
Northwestern Corp	▪ Electricity generation, transmission, distribution, retail ▪ Natural gas distribution and retail	100%	South Dakota, Nebraska, and Montana	Incentives
PG&E Corp	▪ Electricity generation, transmission, distribution ▪ Natural gas distribution, storage	100%	California	Incentives
Portland General Electric	▪ Electricity generation, transmission, distribution and retail	100%	Oregon	Incentives
South Jersey Industries	▪ Energy-related products and services: ▪ Natural gas transportation, distribution, storage, retail ▪ Electricity generation and retail	79%	New Jersey	Incentives
Spire	▪ Natural gas distribution and retail	68%	Missouri	Incentives
Unitil	▪ Natural gas distribution ▪ Electricity distribution	99%	New Hampshire, Massachusetts, Maine	Incentives
WGL Holdings	▪ Natural gas and other energy-related products sales and delivery	85%	Washington	Both
Xcel Energy	▪ Electricity generation, transmission, distribution ▪ Natural gas transport and distribution	72%	Michigan, Wisconsin, North Dakota, South Dakota, Colorado, Texas, New Mexico	Both

***Notes**: *Incentive versus rate of return regulation ("Both" indicates there are elements of both regimes). Based on NERA analysis and CEG (2013), Information on equity beta from US companies; **Source**: Bloomberg. High-level estimate of % of assets regulated based on segmental financial data provided by Bloomberg.*

Of this initial set of comparators, 3 comparators operate in the same states, and hence similar regulatory regimes, as NG plc. In particular, Consolidated Edison operates in New York (where NG USA has about 56 per cent of its regulated assets), and Unitil Corp and Eversource Energy have significant operations in Massachusetts, New Hampshire (and Maine), where about 30 per cent of NG USA's regulated assets are located.

Table 2.5 summarises their asset betas over different estimation windows. The average two-year asset beta is 0.23, and all asset betas are below NG plc's group two-year beta of 0.37.

Table 2.5
US comparators operating in same/similar states as National Grid have an average 2Y asset beta of 0.23[27]

	1Y	2Y	5Y	% regulated	States
National Grid plc	0.54	0.37	0.39	>95%	New York, Massachusetts, New Hampshire, Vermont, Maine, Rhode Island
Consolidated Edison	0.17	0.13	0.21	87%	New York
Eversource Energy	0.22	0.20	0.31	82%	Connecticut, Massachusetts, New Hampshire
Unitil Corp	0.28	0.35	0.34	99%	New Hampshire, Massachusetts, Maine
Average of comparators	**0.22**	**0.23**	**0.29**	**89%**	

Source: Bloomberg, NERA analysis, cut-off: 9 March 2018, daily data, reference index: S&P500.

Using the average asset beta of these three comparators as a proxy of the systematic riskiness of NG plc's operations in the US, and drawing on Equation 1, we calculate an implied UK asset beta of 0.47 based on a two-year estimation window, and 0.46 based on a five-year estimation window (see Table 2.6 below). Our estimate is considerably higher than the composite NG plc asset beta of 0.37 (two –year beta), and approximately mid-point of the empirical asset betas of UK water companies and SSE (see Table 2.1).

[27] Where there is more than one relevant comparator, we draw conclusions based on the average beta estimate for the comparator set, to take into account all relevant information.

Table 2.6
We estimate NG plc's UK asset beta of 0.46-0.47 based on three most direct comparators operating in same/similar states[28]

	NG plc overall	US	UK
Share of regulated assets		41%	59%
2Y asset beta	0.37	0.23	**0.47**
5Y asset beta	0.39	0.29	**0.46**

Source: Bloomberg, NERA analysis.

To check the sensitivity of our results to the three main comparators, we also present asset betas for the full sample of 22 comparators, as shown in Table 2.7 below. We obtain very similar results for the two-year betas, which are in the range of 0.13 to 0.38, with an average of 0.26. This average is considerably lower than NG plc's two-year asset beta of 0.37.

[28] As stated above, the shares of NG plc's regulated assets located in the US and UK are based on the current shares, which reflects the sale of 61 per cent of NG plc.'s gas distribution assets on 31 March 2017. The relative share of assets in the US increased by around 5 percentage points following the sale (see footnote 8), and the implied betas are insensitive to the use of pre- or post-sale shares. For example, using the pre-sale US-UK asset shares of 36:64 provides an implied NG UK beta of 0.45 for both 2 and 5 year, i.e. a reduction of 0.01-0.02.

Table 2.7
The full set of US comparators has an average 2Y asset beta of 0.26[29]

	1Y	2Y	5Y	10Y	% regulated
National Grid Plc	0.54	0.37	0.39	0.32	>95%
Ameren Corp	0.22	0.24	0.33	0.39	95%
American Electric Power	0.13	0.18	0.30	0.33	82%
Black Hills Corp	0.31	0.31	0.47	0.47	80%
Centerpoint Energy	0.29	0.36	0.44	0.35	81%
Chesapeake Utilities Corp	0.37	0.30	0.50	0.59	80%
Consolidated Edison	0.17	0.13	0.21	0.26	87%
Dominion Energy	0.14	0.19	0.31	0.35	70%
Entergy Corp	0.20	0.21	0.26	0.33	87%
Eversource Energy	0.22	0.20	0.31	0.33	82%
First Energy Corp	0.16	0.19	0.23	0.31	90%
Great Plains Energy	0.27	0.27	0.30	0.30	100%
Idacorp	0.25	0.33	0.41	0.39	98%
NiSource	0.19	0.22	0.35	0.34	84%
Northwest Natural Gas	0.33	0.37	0.35	0.38	97%
Northwestern Corp	0.24	0.26	0.33	0.37	100%
PG&E Corp	0.32	0.27	0.32	0.33	100%
Portland General Electric	0.22	0.24	0.33	0.35	100%
South Jersey Industries	0.36	0.38	0.42	0.45	79%
Spire	0.20	0.26	0.31	0.40	68%
Unitil Corp	0.28	0.35	0.34	0.18	99%
WGL Holdings	0.13	0.29	0.44	0.49	85%
XCEL Energy	0.15	0.17	0.27	0.30	72%
Average US comparators	**0.23**	**0.26**	**0.34**	**0.36**	**87%**

Source: Bloomberg, NERA analysis, cut-off: 9 March 2018, daily data, reference index: S&P500.

Using the full sample, we obtain an implied asset betas for NG plc's UK operations of 0.45 (2Y) and 0.43 (5Y), only marginally lower than the betas we obtained using the most relevant comparators only.

[29] Where there is more than one relevant comparator, we draw conclusions based on the average beta estimate for the comparator set, to take into account all relevant information.

Table 2.8
Solving for NG plc UK asset beta – full set of comparators[30]

	NG plc overall	US	UK
Share of regulated assets		41%	59%
2Y asset beta	0.37	0.26	**0.45**
5Y asset beta	0.39	0.34	**0.43**

Source: Bloomberg, NERA analysis.

This empirical evidence clearly shows that investors perceive that US networks face lower equity risk than the UK networks. As a consequence, NGET's and NGGT's asset betas lie above the composite NG plc asset beta, with an implied value of between 0.43 to 0.47 based on decomposing the NG plc composite beta into UK and US operations.

2.4. UK relative risk assessment and regulatory precedent

We have compared the risks faced by NG plc's UK transmission networks (NGET and NGGT) relative to other UK networks against a range of risk factors. Table 2.9 summarises our risk assessment relative to a wider set of UK network regulatory regimes.

In general, the regulatory regimes in energy and water are closely aligned, although energy networks face greater risk from the longer regulatory review period, and from the cost of debt indexation mechanism which increases the pro-cyclicality of returns relative to a fixed ex ante allowance.[31] Water companies potentially face greater risk from the treatment of pensions relative to energy networks, where water companies can recover 50 per cent of deficits as at PR09.[32] By contrast, energy networks can recover the established deficit as at 2013 with triennial revaluation to allow for changes in the value of the deficit, but face risk on post-establishment deficits.[33]

[30] As stated above, the shares of NG plc's regulated assets located in the US and UK are based on the current shares, which reflects the sale of 61% of NG plc.'s gas distribution assets on 31 March 2017. The relative share of assets in the US increased by around 5 percentage points following the sale (see footnote 8), and the implied betas are insensitive to the use of pre- or post-sale shares. For example, using the pre-sale US-UK asset shares of 36:64 provides an implied NG UK beta of 0.43 for 2 year beta and 0.42 for 5 year beta, i.e. a reduction of 0.01-0.02.

[31] However, we note that Ofgem and its advisers did not accept that the cost of debt indexation method increased the procyclicality of returns. See for example, FTI (2012) A report for Ofgem (2012) Cost of capital study for the RIIO-T1 and GD1 price controls, p. 96. Link: https://www.ofgem.gov.uk/ofgem-publications/53728/riio-t1-cost-capital-study-riio-t1-and-gd1.pdf.

[32] At PR09, Ofwat determined the price control allowance for pension deficit repair costs associated with companies defined benefit pension schemes assuming a 10- to 15-year deficit repair period starting in 2009 or 2010. Ofwat allowed companies to recover about 50 per cent of pension deficit repair costs from customers from PR09, with the rest dealt with by management action or shareholder contributions. Source: Ofwat (October 2013), IN 13/17: Treatment of companies' pension deficit repair costs at the 2014 price review. Link: https://0980a19b0bb02fe4a86d-0df48efcb31bcf2ed0366d316cab9ab8.ssl.cf3.rackcdn.com/wp-content/uploads/2015/11/prs_in1317pr14pension.pdf

[33] Ofgem (17 December 2012), RIIO-T1: Final Proposals for National Grid Electricity Transmission and National Grid Gas - Finance Supporting Document, Appendix 5.

However, Ofwat intends to introduce a cost of debt indexation mechanism albeit for new debt only at PR19.[34] In its RIIO-2 framework consultation, Ofgem also proposes to reduce the length of price control form 8 years to 5 years.[35] Therefore, there may be further alignment between energy and water following RIIO-2 and PR19 price control reviews.

In addition to differences in the regulatory framework, our comparative analysis suggests that investors in NGET and NGGT face higher risk than investors in water networks for the following reasons:

- Greater capex size (as measured by capex/RAB);
- Greater system operability risks;
- Greater exposure to stranding risk due to government's decarbonisation plans and uncertainty over the future role of NGGT and NGET due to embedded generation; and

By contrast, ET and GT bear somewhat lower risk than companies in the aviation sector (HAL and NATS). Whereas energy companies have higher incentives with regard to cost and output, aviation companies are exposed to material within-period volume and competition risks, given their price cap regime.

[34] Ofwat (December 2017) Delivering Water 2020: Our final methodology for the 2019 price review, Link: https://064f1d25f5a6fb0868ac-0df48efcb31bcf2ed0366d316cab9ab8.ssl.cf3.rackcdn.com/wp-content/uploads/2017/12/Final-methodology-1.pdf

[35] Ofgem (March 2018), RIIO-2 Framework Consultation, para 4.20.

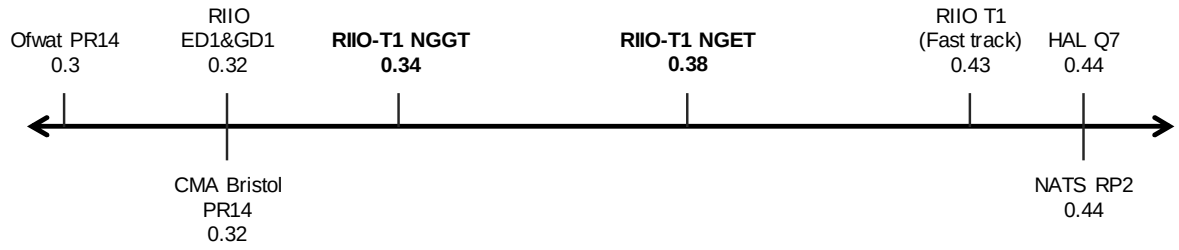
Table 2.9
Relative risk assessment: ET/GT face greater risk in terms of size of capex and asset stranding

	NGET (T1)	NGGT (T1)	Gas Distribution	Electricity Distribution	Water	Heathrow	NATS (air traffic control)
Form / length of control	• Revenue-cap • 8-years	• Revenue-cap • 8-years	• Revenue-cap • 8-years	• Revenue-cap • 8-years	• Revenue-cap • 5-years	• Price-cap • 5-years	• Part revenue part price-cap • 5-years
Setting cost allowances	• Expert review of totex • DB pension deficit recovery over 15yrs with 3Y re-valuation (but risk on post-2012 liabilities) • Re-openers for some costs	• Expert review of totex • DB pension deficit recovery over 15yrs with 3Y re-valuation (but risk on post-2012 liabilities) • Re-openers for some costs	• Comparative benchmarking of totex (UQ efficiency) • DB pension deficit recovery over 15yrs with 3Y re-valuation (but risk on post-2012 liabilities) • Re-openers for some costs	• Comparative benchmarking of totex (UQ efficiency) • DB pension deficit recovery over 15yrs with 3Y re-valuation (but risk on post-2012 liabilities) • Re-openers for some costs	• Comparative benchmarking of totex (UQ efficiency) • 50% sharing of pension deficit repair costs with customers	• Opex based on benchmarking & capex agreed with airlines • Pass-through of pension deficit costs	• Opex based on benchmarking & capex agreed with airlines • DB pension deficit allowance and 80% pass through of savings / overspend within period
Outturn cost risk & incentives	• TIM • Uncertainty/pass-through of non-controllables • Disapplication of price control	• TIM • Uncertainty/pass-through of non-controllables • Disapplication of price control	• TIM • Uncertainty/pass-through of non-controllables • Disapplication of price control	• TIM • Uncertainty/pass-through of non-controllables • Disapplication of price control	• Totex sharing • Pass-through of non-controllables • IDoK/SAE clause	• Full risk on opex and pass-through of efficient actual capex (s.t. delay penalties)	• 5-year opex roller and pass-through of efficient capex
- Capex/opening RAB	• 13% (T1)	• 9% (T1)	• 6%	• 11%	• 6-8% (WaSC-WOC)	• 4%	• 10%
- Totex/opening RAB	• 16% (T1)	• 11% (T1)	• 13%	• 15%	• 13-22% (WaSC-WOC)	• 11%	• N/a
- Totex sharing factor	• 48% (T1)	• 45% (T1)	• 62-64%	• 53-58(70)%	• 50-57%	• 100% opex, 0% capex	• 5-year opex roller, 0% capex
Financing cost risk	• COD update = 10Y trailing average iBoxx	• COD update = 10Y trailing average iBoxx	• COD update = 10Y trailing average iBoxx	• COD update = 10-20Y trailing average iBoxx	• Fixed at weighted average of industry embedded and new forecast COD	• Fixed at weighted average of HAL embedded and new forecast COD	Fixed at weighted average of NERL embedded and new forecast COD
Quality of Service/Output incentives	• Performance incentives : +0.6/-1.4% of RORE	• Performance incentives : +1.7/-1.4% of RORE	• Performance incentives : +1.3/-0.7% of RORE	• Performance incentives : +2.2/-2..8% of RORE	• Performance incentives (SIM,ODI): +0.8/-2.1% of RORE	• Service quality: asymmetric -7% penalty.+2% reward of airport charges	• Delays: +/-1% revenue
Stranding/ competition / regulatory risk	• Uncertainty over future role and operation of system from distributed generation	• Uncertainty over future role given uncertainty of CCGT role in energy mix, and decarbonisation of heat	• Uncertainty over future gas flows (domestic heat decarbonisation)		• Competition in NHH retail; future competition for water/ bioresources	• Competition from other London/UK and European hub airports	• No competition in immediate future

Source: Bloomberg, NERA analysis.

Our relative risk analysis is in line with Ofgem's decision to set asset betas for NGET and NGGT above water, but below aviation at RIIO-T1, as shown in Figure 2.3.

Figure 2.3
Our relative risk assessment suggests that NGET and NGGT's asset beta risk lies between water and aviation, in line with regulatory precedent



Source: NERA calculations based on regulatory decisions.

As can be seen from Figure 2.1 above, the most recent regulatory asset beta determinations as shown in Figure 2.3 corresponded to a time when the empirical betas of UK networks were considerably lower than they are today and therefore the absolute level of recent historical regulatory decisions are not relevant to RIIO-2. As Table 2.10 shows, NG plc's two-year asset beta was 0.22 at the time of the RIIO-T1 Final Proposals (17 December 2012).[36] In contrast, the current two-year asset beta is much higher at 0.37.

As we explain in section 2.3 above, NG plc's asset beta also reflects the companies less risky US assets (around 40 per cent of total RAB), and hence we estimate the standalone betas for NGET and NGGT to be higher than NG plc's overall beta in the range of 0.43 to 0.47.

Similarly, the empirical asset betas of water companies were considerably lower at RIIO-T1 than today. The average (excluding SSE) asset beta was 0.24 at RIIO-T1, compared to 0.34 now. This increase in empirical betas since RIIO-1 indicates that there has been an increase in the market view of equity risk, which should be taken into account at RIIO-2.

[36] Ofgem (17 December 2012), RIIO-T1: Final Proposals for National Grid Electricity Transmission and National Grid Gas.

Table 2.10
Empirical asset betas were considerably lower at RIIO-T1 compared to today

	Cut-off: 17 December 2012			Cut-off: 9 March 2018		
	1Y	2Y	5Y	1Y	2Y	5Y
National Grid	0.21	0.22	0.28	0.54	0.37	0.39
SSE	0.32	0.36	0.41	0.44	0.60	0.57
United Utilities	0.17	0.20	0.26	0.35	0.30	0.33
Severn Trent	0.22	0.24	0.26	0.37	0.31	0.35
Pennon	0.26	0.29	0.27	0.44	0.40	0.38
Average	0.24	0.26	0.30	0.43	0.40	0.40
Average (excl. SSE)	**0.22**	**0.24**	**0.27**	**0.43**	**0.34**	**0.36**

Source: Bloomberg, NERA analysis, daily data, reference index: FTSE All World.

2.5. Conclusion on UK and US evidence on NG plc's asset beta

In this section, we have shown that empirical beta estimates have increased from low levels during the time of the RIIO-1 price control, which coincided with the "flight to quality" in the aftermath of the financial crisis. The majority of UK network asset betas fall in the range of 0.3 to 0.4, with NG plc beta values towards the top-end of this range.

For example, NG plc's current empirical asset beta (0.37, 2Y) lies above the two principal water comparators, UU (0.30, 2Y), and Severn Trent (0.31, 2Y). Our relative risk assessment of NG plc against other UK regulatory regimes identifies capex levels and complexity, and asset stranding risk, as sources of greater risk for NG investors relative to the water sector.

We show that NG plc's composite asset beta understates the beta risk of NG plc's UK assets. Based on a sample of three listed US networks that operate in the same or similar states as NG USA, we estimate an asset beta for NG plc's US operators of 0.26 with an implied NG UK beta of 0.46 to 0.47. Using a wider sample of 22 US comparators, we obtain a similar range of 0.43 to 0.45 for NG plc's UK beta.

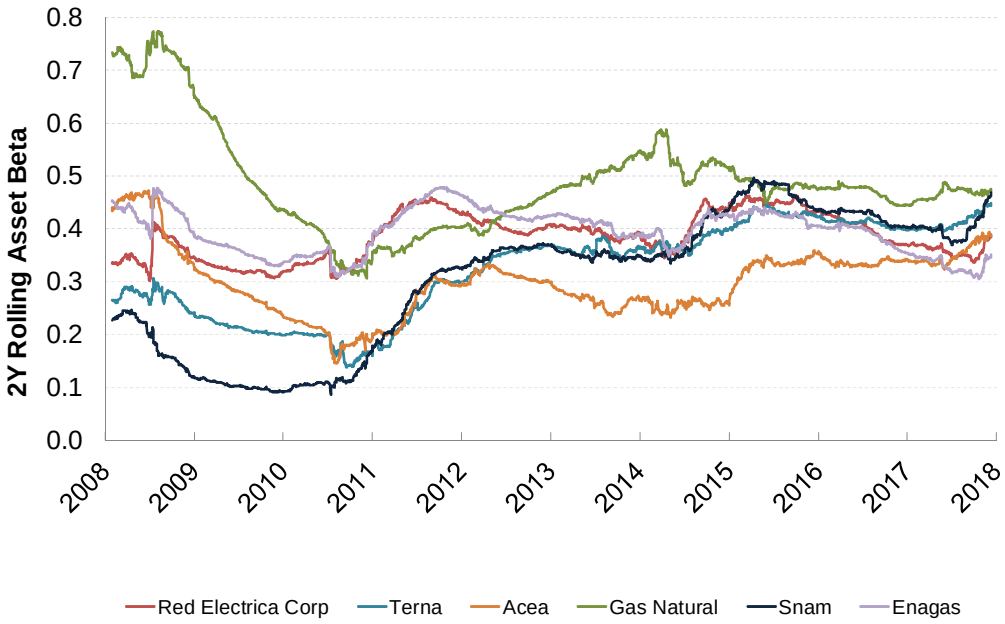
3. Beta Evidence from European comparator networks

In this section, we present empirical beta evidence for listed European networks. We also present a comparative risk analysis for NG plc versus the principal European regimes.

3.1. Empirical evidence from European energy networks

Figure 3.1 presents the two-year asset betas of listed European comparators (i.e. Italian and Spanish transmission and distribution networks) over the past 10 years.[37] As with the UK listed networks, asset betas for these networks have generally increased since the financial crisis.

Figure 3.1
2Y rolling asset betas for European utilities have increased since the crisis



Source: Bloomberg, NERA analysis, cut-off: 9 March 2018, daily data, reference index: Eurostoxx.

Table 3.1 below provides the most recent asset beta estimates for these comparators, for a range of estimation windows. This evidence supports an asset beta of around 0.4 over the most recent 2 year period.[38]

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[37] There are other listed European network companies (e.g. Elia, Fluxys), but their stocks have generally been illiquid and are hence not included in this analysis.

[38] Our estimates are also in line with Oxera's recent range proposed in its Report for ENA. Oxera estimate asset betas for both UK and European utility comparators, and concluded that 0.38 to 0.42 is an "appropriate assumption" for RIIO-2 based on the empirical betas of the same sample of European network comparators. Oxera's range reflects a debt beta assumption of 0.05. Assuming a debt beta of zero, in line with our approach, Oxera's range would be 0.36 to 0.40, which falls within our proposed range. See Oxera (28 February 2018), The cost of equity for RIIO-2 - Prepared for Energy Networks Association, p42-48. We use the Miller formula to solve for the implied asset beta: $\beta_{assets}=\beta_{equity}*(1-gearing)+\beta_{debt}*gearing$.

Table 3.1
Empirical asset beta estimates for listed European utilities[39]

	Country	1Y	2Y	5Y	10Y
Snam (GT)	Italy	0.56	0.47	0.42	0.25
Terna (ET)	Italy	0.54	0.45	0.41	0.29
Acea (ED)	Italy	0.56	0.39	0.32	0.27
Enagas (GT)	Spain	0.46	0.35	0.38	0.37
Red Electrica (ET)	Spain	0.54	0.39	0.40	0.37
Gas Natural (GD)	Spain	0.46	0.47	0.47	0.44
Average		**0.52**	**0.42**	**0.40**	**0.33**

Source: Bloomberg, NERA analysis, cut-off: 9 March 2018, daily data, reference index: Eurostoxx.

3.2. Risk assessment relative to European comparators

We have also compared NG plc to the listed European comparators with regard to the systematic risks that investors face when investing in these companies.

Table 3.2 summarises our risk assessment for these markets, relative to NGET and NGGT. We find that in general, NGET and NGGT face similar risks as Italian and Spanish networks.

In Italy, networks are regulated under a hybrid of a price cap (on opex) and a rate of return regime (on capex). Due to a periodic true-up, only a very small share of opex is subject to volume risk (around 5 per cent).[40] Moreover, opex cost risk is partially mitigated through a 50 per cent sharing factor. Italian networks face very little capex risk given that capex is effectively passed through.

Whereas the Italian networks face relatively low risk based on volume and cost risk considerations, the regulator has announced its intention to introduce a RIIO-like incentive based framework. This will increase the systematic risk of these networks, and is likely to be reflected in the current beta estimates (see section 3.1). Given the expected change to the regime, we consider the more recent Italian empirical beta evidence (0.39 to 0.47, 2Y, as per Table 3.1) is broadly indicative of the risk faced by NG investors.

In Spain, transmission networks are regulated under revenue caps, as are NGET and NGGT. On the cost side, they are subject to a 50 per cent sharing factor on capex, but bear the full cost risk on opex. Gas Natural (GD) is subject to a revenue cap, based on opex and capex volume drivers. There is no sharing of opex and capex out or underperformance which indicates that it faces greater cost risk than UK networks, although this is mitigated by annual

[39] Where there is more than one relevant comparator, we draw conclusions based on the average beta estimate for the comparator set, to take into account all relevant information.

[40] See for example Aeegsi, Decision 514/2013/R/gas (Tariff regulation for gas transport for RP4), Article 13.

updates to the allowance in line with volume drivers and unit costs.[41] As with the Italian regime, we consider that investors in NGET and NGGT bear a similar degree of risk as investors in Spanish transmission networks and Gas Natural, which have asset betas in the range of 0.35 to 0.47 (2Y), as per Table 3.1.

[41] **Gas**: Ley 18/2014, https://www.boe.es/boe/dias/2014/10/17/pdfs/BOE-A-2014-10517.pdf; **Electricity**: Ley 24/2013 (https://www.boe.es/boe/dias/2013/12/27/pdfs/BOE-A-2013-13645.pdf), Royal Decree 1047/2013 (https://www.boe.es/boe/dias/2013/12/30/pdfs/BOE-A-2013-13766.pdf) and Royal Decree 1048/2013 (https://www.boe.es/boe/dias/2013/12/30/pdfs/BOE-A-2013-13767.pdf).

Table 3.2
Relative risk assessment shows that NG plc bears similar risks as listed European comparators

	GB		Italy	Spain	
	NGET	NGGT	Snam (GT),Terna (ET), Acea (ED)	Enagas (GT), Red Electrica (ET)	Gas Natural (GD)
Form / length of revenue period	• Revenue-cap • 8 years [5 years in RIIO-2?]		• Hybrid of price cap (opex) and cost plus/pass through (capex), but virtually no volume risk on opex as a result of true up • 4 years (8 years under discussion)	• Revenue-cap • 6 years • Volume drivers for GT revenues based on outturn demand	• Revenue-cap (s.t. volume drivers) • Volume drivers/unit costs can be updated every 6 years
Setting cost allowances	• Expert review of totex • DB pension deficit recovery over 15yrs with 3Y re-valuation (but risk on post-2012 liabilities) • Re-openers for some costs • COD update = 10Y trailing average iBoxx		• Based on actual opex in base year, updated annually according to CPI-X formula.	• Allowances set based on "standard" costs for capex and opex (review of historical data & technical input) • Standard costs revised at the start of every regulatory period and every 3 years for GT	• Revenues not linked to RAB but based on base year costs (2002) rolled forward with volume drivers (demand and customer number growth)
Outturn cost risk & incentives	• TIM • Uncertainty/pass-through of non-controllables • Disapplication of price control		• Opex: 50% sharing factor, limited volume risk • Ex-post recognition of actual capex spent • Additional WACC for some investments (e.g. security of supply)	• Opex: no sharing factor • Capex: 50% sharing factor; profit from underspend capped at 12.5% of costs (ET only)	• No explicit sharing of out or underperformance
Quality of Service/Output incentives	• Performance incentives : +0.6/ -1.4% of RORE	• Performance incentives : +1.7/ -1.4% of RORE	• Quality of service premiums/penalties (mainly technical, e.g. interruptions)	• ET: Availability incentive (of minor importance, capped)	
Other	• Uncertainty over future role of system from distributed generation	• Uncertainty over future role given uncertainty about energy mix, and decarbonisation of heat	• Risks from prospective regulatory reforms (longer controls, outputs based regime)		• Higher unit remuneration for some assets

Sources: **Italy**: *Aeegsi, Decision 514/2013/R/gas (Tariff regulation for gas transport for RP4), Aeegsi, Decision 654/2015/R/EEL (Tariff regulation for electricity transmission);* **Spain**: *Gas: Ley 18/2014, https://www.boe.es/boe/dias/2014/10/17/pdfs/BOE-A-2014-10517.pdf; Electricity: Ley 24/2013 (https://www.boe.es/boe/dias/2013/12/27/pdfs/BOE-A-2013-13645.pdf), Royal Decree 1047/2013 (https://www.boe.es/boe/dias/2013/12/30/pdfs/BOE-A-2013-13766.pdf) and Royal Decree 1048/2013 (https://www.boe.es/boe/dias/2013/12/30/pdfs/BOE-A-2013-13767.pdf).*

3.3. Conclusions on European evidence

We have estimated asset betas for listed European networks in Italy and Spain. The empirical evidence supports an asset beta of around 0.4 over the most recent 2 year period. Our comparative risk assessment of the Italian and Spanish regimes suggests that investors face broadly similar risks as per NG investors, and therefore 0.4 asset beta provides a relevant benchmark for NG plc's UK networks.

4. Comparative risk assessment of RIIO-T2 relative to RIIO-T1

In this section, we assess NG plc's systematic riskiness at RIIO-2 relative to RIIO-1. We focus on the following risk aspects for NGET and NGGT at RIIO-T2:

- Risks that are (largely) independent of Ofgem's regulatory framework, including complexity of investment programme; cyber security risks, and asset stranding risk; and,
- Potential risks related to Ofgem's proposals in its Framework Consultation.

4.1. NG plc's risks that are largely independent of Ofgem's regulatory framework

4.1.1. Complexity of investment

At RIIO-T1, Ofgem considered both the scale and complexity of investment as risk factors. Ofgem took into account factors such as the size of the project, the number of projects, interlinkages with other projects and the projects' bespoke nature when assessing the complexity of networks' investments.[42]

At RIIO-T1, Ofgem found that NGGT's investments were more complex than those of gas distribution networks, but less complex than those of the electricity networks (NGET and SHETPLC/SPTL). The reason was that NGGT would have fewer and more isolated projects than electricity transmission networks, but larger and more bespoke projects than gas distribution networks. NG also faces greater risk in relation to connection expenditure, given that the timing uncertainty of timing and scale of investment based on customer requirements and the influence of political factors on connections which are less prominent for distribution networks.

At T1, Ofgem considered that NGET's investments would be more complex than those of gas distribution networks and NGGT's, but equally complex as SHETPLC/SPTL's investments, as electricity transmission networks would face similar technical issues as SHETPLC/SPTL.

4.2. Cyber security risks

A recent joint government and Ofgem consultation has identified cyber security for energy networks as a key strategic issue in upgrading the energy system to 2030.[43] Moreover, Ciaran Martin, director general for government and industry cyber security at the Government

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[42] Ofgem (2012), RIIO-T1: Final proposals for National Grid Electricity Transmission and National Grid Gas – Finance support document, Table 3.3 and Table 3.4

[43] UK Government, Ofgem (July 2017) Upgrading our energy system, p. 26. Link: https://www.ofgem.gov.uk/system/files/docs/2017/07/upgrading_our_energy_system_-_smart_systems_and_flexibility_plan.pdf

Communications Headquarters (GCHQ), has recently warned about the growing threat of cyber-attacks on critical infrastructure such as energy supplies.[44]

NGET and NGGT face greater cyber security risks and potential costs than other networks, given the nature and systemic importance of energy transmission. Energy transmission is the most critical system within the UK. Transmission assets cover the whole of the UK, compared with the localised nature of the distribution networks. As a result, energy transmission is a single point of failure for mainland UK with a critical effect on all other sectors.

This system is now reliant on digital assets to be able to run the networks, and hence subject to the risk of cyber-attacks. Due to the complexity of the transmission systems, the costs to raise the cyber security of NG plc's operational technologies will be far in excess of other utilities.

4.2.1. Asset stranding risk

In the coming years government policy towards the heat sector could materially affect the role of gas distribution and transmission networks in the UK. In particular, the future role of these networks will depend on a wide range of factors, including the overall level of emissions target set for the heat sector (if any), the extent to which this target is expected to be achieved by reductions in gas demand by consumers currently using gas to heat homes, and the range of policy interventions put in place to achieve them.

The long-term effects of decarbonisation policy on gas networks are uncertain. In an extreme downside, networks might see very marked declines in throughput and user numbers or even their networks becoming partially redundant. In a number of other (more) credible scenarios, demand for these networks will not shrink this rapidly, or may even grow slightly compared to its current levels such as through conversion to biogas or hydrogen.

4.2.1.1. Government's decarbonisation agenda drives changes in energy supply and leads to system operability risks

The government's decarbonisation agenda is driving significant changes in the energy supply market with traditional sources of energy supply replaced with divergent mix, with material yet uncertain implications for NGET.

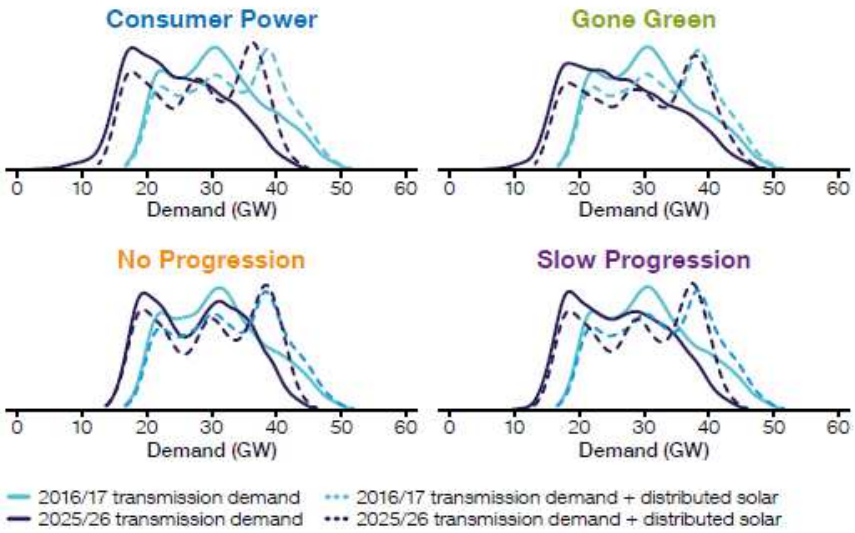
The potential for increased levels of embedded generation and storage at the distribution level may lead to changes in the use of transmission networks at T2. For example, the amount of solar generation has increased significantly. According to Future Energy Scenarios (FES) 2017, under the scenario "Consumer Power", as many as 33 GW of solar panels could be connected

[44] See Guardian (2018), "Major cyber-attack on UK a matter of 'when, not if' – security chief", Link: https://www.theguardian.com/technology/2018/jan/22/cyber-attack-on-uk-matter-of-when-not-if-says-security-chief-ciaran-martin.

to electricity system, with a majority connected at distribution level, including "behind the meter".[45]

FES modelling shows that on sunny days around noon there is very low demand on TO, which imposes system operability challenges (in terms of voltage control). This affects both the System Operator function and NGET as a transmission owner (TO), as NGET TO is responsible for a range of technical aspects related to altering production in order to avoid blackouts due to over- or under-supply. Other features include a reduction in peak demand, and prolonged periods of low demand, shown by growth in left hand tail of the relevant distributions (see Figure 4.1).

Figure 4.1
Change in demand profile, and increase in left side tail of distribution as demand declines on transmission networks from PV



Source: National Grid (2016) System Operability Framework, p21.

4.2.1.2. Regulatory precedent supports asset beta uplift of around 0.06 for stranded asset risk

Gas networks in Great Britain, including NGGT, bear additional risk from falling gas flows and asset stranding risk, as a result of UK Government's decarbonisation targets.

At RIIO-GD1, Ofgem responded to such stranding risk by allowing front loaded asset depreciation for gas distribution networks.[46] In its Framework Consultation document, Ofgem

[45] NG (2017), FES, http://fes.nationalgrid.com/media/1253/final-fes-2017-updated-interactive-pdf-44-amended.pdf.

[46] Ofgem (17 December 2012), RIIO GD1: Final Proposals -Finance and uncertainty supporting document, para 2.3-2.5.

does not propose to change the current approach.[47] In relation to all energy networks (i.e. including TOs), Ofgem acknowledges the risk around future utilisation of assets: [48]

"We should take steps in RIIO-2 that minimises the risk that consumers pay for new investment to create or refurbish assets that are not utilised, or significantly underutilised in future."

Whereas at RIIO-GD1, Ofgem allowed for accelerated depreciation of gas network assets to accommodate stranding risk, a number of other regulators compensate gas networks for stranding risk by allowing for a higher cost of equity via a beta uplift.

In France, Finland and Sweden, regulators apply a higher beta for gas networks compared to electricity networks, recognising higher risks faced by gas networks. For example in France, the regulator set a higher asset beta for gas transmission operators (0.45) compared to the electricity transmission operators (0.37), taking into account the uncertainty about the long-term prospects for gas.[49] As summarised in Table 4.1, regulators on average allow for a beta uplift of around 0.06 for gas networks relative to electricity networks.

Some other European regulators compensate for gas network stranding risk not via a beta uplift but by allowing for a premium added on top of the CAPM-based cost of equity (see Table 4.1). For example in Austria, the regulator sets a higher cost of equity (a 3.5 per cent premium on top of CAPM) for gas transmission than electricity because of the additional capacity risk borne by gas TSOs. The regulator also allows gas TSOs additional remuneration for new investments if promoters can justify the elevated risks of these projects.[50]

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47 Ofgem (March 2018), RIIO-2 Framework Consultation, para 4.74 – 4.94.

48 Ofgem (March 2018), RIIO-2 Framework Consultation, para 4.83 – 4.88. Ofgem also discusses the potential requirement for alternative frameworks to address demand risk. *We would also like to explore whether it may be appropriate for certain types of investment (with greater uncertainty around their long-term need) to have different risk arrangements. This could include having an ongoing incentive to ensure reasonable utilisation of assets – this could consider the physical load level but more broadly is likely to be linked to the economic value of the asset over its proposed lifetime. As an analogy, we operate a developer-led regime for interconnection assets where developers take the risk of low income (likely to be linked to low utilisation) within a cap and floor band, earning a higher return on equity if demand matches or exceeds their forecasts, but a lower return where it fails to do so. Any incentive like this must be carefully balanced with the need to ensure that reasonable connection requests are efficiently delivered."*

49 CRE (2016), Délibération de la Commission de régulation de l'énergie du 17 novembre 2016 portant projet de décision sur le tarif d'utilisation des réseaux de transport de gaz naturel de GRTgaz et de TIGF, p57; CRE (2016), Délibération de la Commission de régulation de l'énergie du 17 novembre 2016 portant décision sur les tarifs d'utilisation des réseaux publics d'électricité dans le domaine de tension HTB, p55.

50 E-Control (2017), Methodology pursuant to section 82 Gaswirtschaftsgesetz (Natural Gas Act, GWG) 2011 for transmission systems of Austrian Gas Transmission System Operators, p. 6,7; E-Control (2014), Methodology and criteria for evaluating investments in electricity and gas infrastructure projects, p.6.

Table 4.1
Regulators have allowed for beta uplifts or accelerated depreciation to account for stranding risk

Regulator	Year	Type and size of uplifts	Reason for including uplifts
France	2016	Higher asset beta for gas transport (0.45), as compared to 0.37 for electricity, implying a beta uplift of **0.08**	Uncertainty about the long-term perspective for gas.
Sweden	2014/ 15	1) Higher beta compared to electricity transmission (0.45 versus 0.39), implying a beta uplift of **0.06** 2) Additional cost of equity premium of 1.5 per cent for gas transmission	1) Higher customer substitution risk; 2) Political and regulatory risk, high demand risk (small number of clients) and high supply risk (depend on one Danish pipeline).
Finland	2015	1) Higher beta compared to electricity transmission (0.45 versus 0.40), implying a beta uplift of **0.05** 2) Additional cost of equity premium of 1.7 per cent for gas transmission (and 1.3 per cent for gas distribution).	Higher capacity risk due to dependence on Russia as sole supplier of gas.
Austria	2017	Cost of equity premium of 3.5 per cent for gas transmission	For taking on the marketing risk of network capacities for which there is no demand.

Source*:* **France***: CRE (2016), Délibération de la Commission de régulation de l'énergie du 17 novembre 2016 portant projet de décision sur le tarif d'utilisation des réseaux de transport de gaz naturel de GRTgaz et de TIGF, p57; CRE (2016), Délibération de la Commission de régulation de l'énergie du 17 novembre 2016 portant décision sur les tarifs d'utilisation des réseaux publics d'électricité dans le domaine de tension HTB, p55 ;* **Sweden**: *Swedish Energy Markets Inspectorate, Kalkylranta vid berakning av intaktsram for naturgasforetagen avseende tillsynsperioden 2015-2018, p3,4, 17-19, https://www.ei.se/en/for-energiforetag/naturgas/Naturgasnat-och-natprisreglering/Intaktsramar-2015-2018/swedegas-ab-transmission/; EY and Swedish Energy Markets Inspectorate (2015), WACC för elnätföretag för tillsynsperioden 2016-2019, p3,4, https://www.ei.se/en/for-energiforetag/el/Elnat-och-natprisreglering/forhandsreglering-av-elnatstariffer-ar-2016-20191/dokument-elnatsreglering/?p=2;* **Finland***: **Electricity** - Finish Energy Market Authority (2015),Valvontamenetelmät neljännellä 1.1.2016- 31.12.2019 ja viiden-nellä 1.1.2020 –31.12.2023 valvontajaksolla - Sähkön kantaverkkotoiminta, p48,49, https://www.energiavirasto.fi/documents/10191/0/Liite_2_Valvontamenetelm%C3%A4t_S%C3%A4hk%C3%B6nkanta.pdf/9b9f5e5f-3b7a-4f9f-b461-27318cdca5db; **Gas** - Finish Energy Market Authority (2015), Valvontamenetelmät kolmannella1.1.2016 –31.12.2019 ja neljän-nellä 1.1.2020 –31.12.2023 -Valvontajaksolla Maakaasun siirtoverkkotoiminta, p48,49, https://www.energiavirasto.fi/documents/10191/0/Liite_2_Valvontamenetelm%C3%A4t_Maakaasunsiirto_final_261115.pdf/c9aea1ca-7e2a-4d6e-9c76-4592827729f1;* **Austria**: *E-Control (2017), Methodology pursuant to section 82 Gaswirtschaftsgesetz (Natural Gas Act, GWG) 2011 for transmission systems of Austrian Gas Transmission System Operators, p. 6,7; E-Control (2014), Methodology and criteria for evaluating investments in electricity and gas infrastructure projects, p.6.*

4.3. NG plc's risk at RIIO-2 compared to RIIO-1

We have reviewed Ofgem's Framework Consultation to identify those factors that Ofgem considered as part of its risk assessment at RIIO-1. There are a number of proposals that may affect NG plc's systematic risk under RIIO-T2, if eventually adopted. These include:

- **Reducing the regulatory period from 8 years to 5 years:** At RIIO-1, Ofgem introduced a longer regulatory period of 8 years. For RIIO-2, it is proposing to revert to a five-year price control given the risk around forecasting costs, albeit with the flexibility to set some allowances for a longer period where companies provide a justification.[51]
- **ESO separation:** Separation of electricity system operator (ESO) price control from the NGET's TO price control, and to review the remuneration model, including a RAV model or a margin based approach, more closely associated with asset-light businesses.[52]
- **Extending competition:** Ofgem's intention is to extend third party provision to other controls using the criteria developed for ET, i.e. where the asset is new, separable and high value.[53]
- **Outputs and incentives:** Ofgem will consider designing incentive mechanisms that reward/penalise based on companies' relative as opposed to absolute performance, which increases risk, and to re-calibrate targets to make them more stretching during review.[54]
- **Uncertain costs:** Ofgem proposes to develop real price effect (RPE) indexation method; it also proposes to re-set cost allowances during review at the "*revealed upper quartile performance*".[55]
- **Cost of debt allowance:** Ofgem will investigate a number of changes to the existing mechanism, including use of A rated benchmark; taking into account companies' ability to outperform (so-called "halo") which is likely to provide for a lower allowance.[56] It is also consulting on potential alternative approaches, such as a fixed allowance for embedded debt costs.
- **Cost of equity:** It is consulting on a potential cost of equity indexation mechanism, where the allowed return would be updated for changes in the RFR and/or ERP/TMR.[57]
- **So-called "fail safe" mechanisms to guard against higher than expected returns**: these measures – such as hard cap/floor – could reduce NG plc's up- and downsides, but also remove its incentives to outperform once the upper limit is reached. The measures could also increase risk where they involve companies' returns being dependent on other

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51 Ofgem (March 2018), RIIO-2 Framework Consultation, p. 29. Link: https://www.ofgem.gov.uk/system/files/docs/2018/03/riio2_march_consultation_document_final_v1.pdf.

52 Ofgem (March 2018), RIIO-2 Framework Consultation, p. 39.

53 Ofgem (March 2018), RIIO-2 Framework Consultation, p. 55.

54 Ofgem (March 2018), RIIO-2 Framework Consultation, p. 61.

55 Ofgem (March 2018), RIIO-2 Framework Consultation, p. 64.

56 Ofgem (March 2018), RIIO-2 Framework Consultation, p. 81.

57 Ofgem (March 2018), RIIO-2 Framework Consultation, p. 93.

companies' performance and regulatory assessment, e.g. in relation to anchoring returns.[58]

Overall, we consider that in many areas Ofgem's proposed approach at RIIO-2 will increase both beta and asymmetric risks, notably in relation to outputs and incentives, with greater use of relative rather than absolute targets; totex, with potential for within period re-sets; and, cost of debt where Ofgem's proposals will not necessarily allow for the recovery of efficient costs.

4.4. Conclusions on RIIO-2 risks

We have identified NG plc's key risk factors at RIIO-T2. We expect greater risk for NG plc with regard to complexity of its investment programme, asset stranding and system operability risks relative to T1.

More generally, Ofgem's proposals for T2 appear to increase risk and notably asymmetric risks, e.g. in relation to potential fail-safe mechanisms such as anchoring. As in the case of asset stranding, empirical beta estimates do not reflect asymmetric risks and therefore understate the risk an investor would face when investing in GB networks. Therefore, these risk factors support an uplift to the estimated asset betas presented in this paper.

[58] Ofgem (March 2018), op. cit., para 7.121 – 7.143.

5. Conclusion

In this report, we have considered evidence on the appropriate level of NG plc's asset beta at RIIO-T2, relying principally on empirical estimates, which reflects the market view of equity risk.

Our empirical evidence for UK listed network companies – NG plc, United Utilities, Severn Trent, and Pennon – show that the majority of beta estimates lie in the range of 0.3 to 0.4, with values for NG plc towards the top-end of this range, e.g. NG plc's two-year asset beta is 0.37.

However, NG plc's composite beta reflects the combined systematic riskiness of NG plc's UK and US operations. UK and US operations have a similar share of NG plc's overall regulated asset base, but US regulatory regimes impose lower risks on investors due to a number of factors, including: some assets are regulated under cost-plus rather than incentive regulation; objective methods for setting cost allowances; less stringent financial output incentives; and, greater investor security offered by court based proceedings which have enshrined property rights and "prudence standards" which imposes a high evidentiary bar for the disallowance of costs.

Using a sample of US-only comparators as a proxy for the systematic riskiness of NG plc's US operations, we have solved for the implied UK beta. We obtain a range of 0.43 to 0.47 for NG plc's implied UK beta (2Y), which is considerably higher than the two-year asset beta of the overall company (0.37).

We have also estimated asset betas for listed energy networks operating under the Italian and Spanish regulatory regimes, which impose a similar degree of systematic riskiness on investors as the GB regime. The empirical evidence supports an asset beta of around 0.4 over the most recent 2 year period.

We have identified NG plc's key risk factors at RIIO-T2. We expect greater risk for NG plc with regard to complexity of its investment programme, asset stranding and system operability risks relative to T1. Our review of European regulatory decisions supports a beta uplift of around 0.06 for TOs that face competition or asset stranding risk.

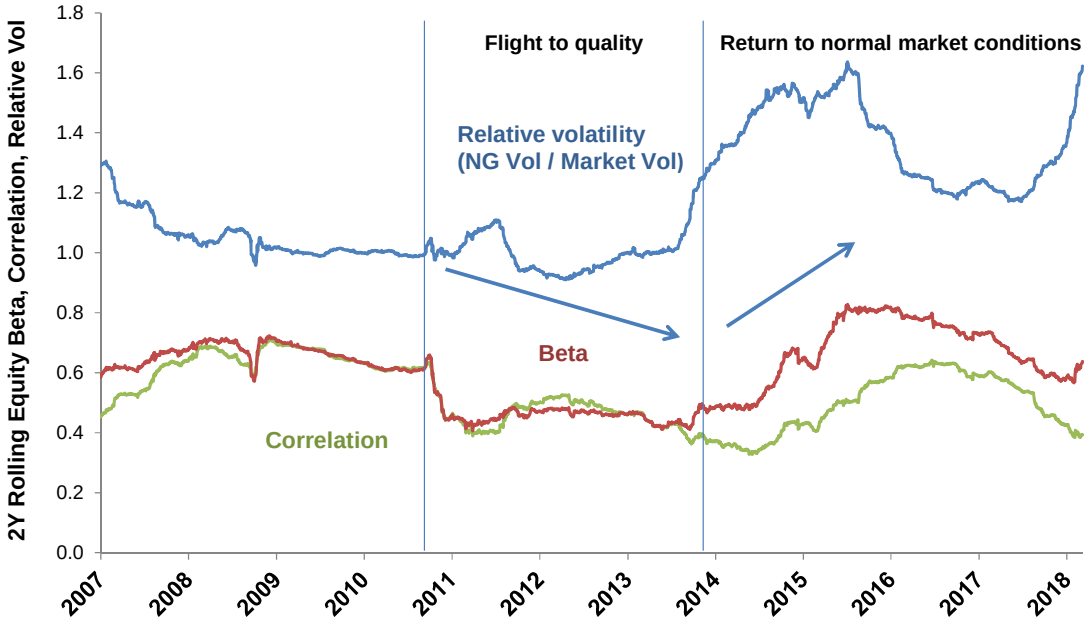
Moreover, Ofgem's framework consultation indicates higher risk in relation to outputs and incentives, with greater use of relative rather than absolute targets; totex, with potential for within period re-sets; and, cost of debt where Ofgem's proposals will not necessarily allow for the recovery of efficient costs. More generally, Ofgem's proposals appear to increase regulatory and asymmetric risks, e.g. in relation to potential fail-safe mechanisms such as its proposed anchoring of returns.

Appendix A. Beta decomposition for listed UK water companies

In section 2.2.1, we show the decomposition of NG plc's equity beta into its correlation and relative volatility components.

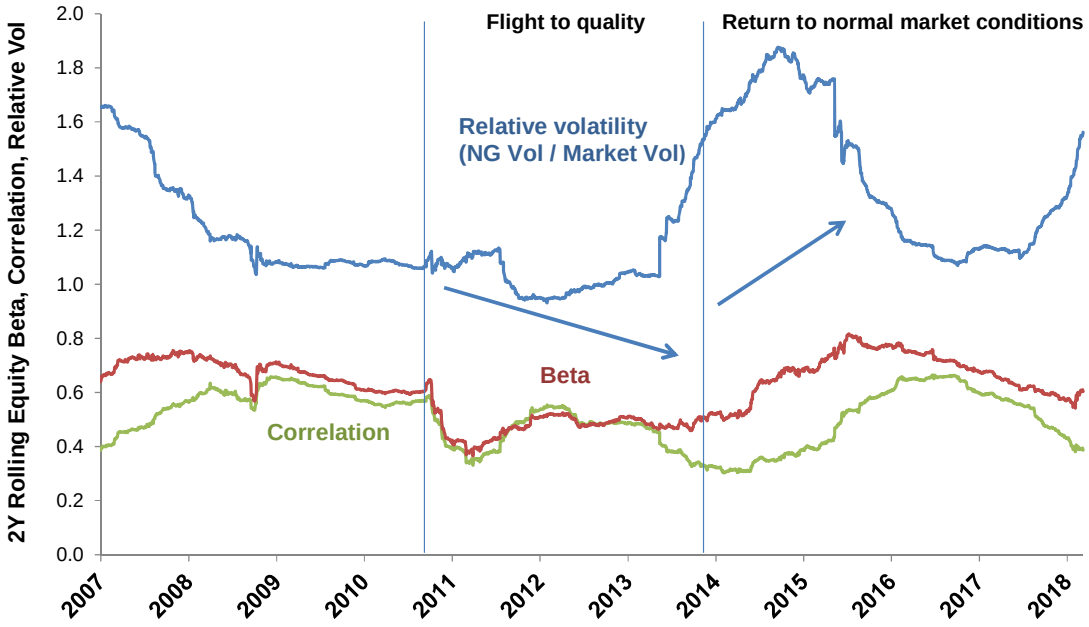
The trends observed for NG plc can also be observed when decomposing the betas of listed water companies in the UK, as shown in Figure A.1, Figure A.2, and Figure A.3 below.

Figure A.1
United Utilities – Equity beta decomposition



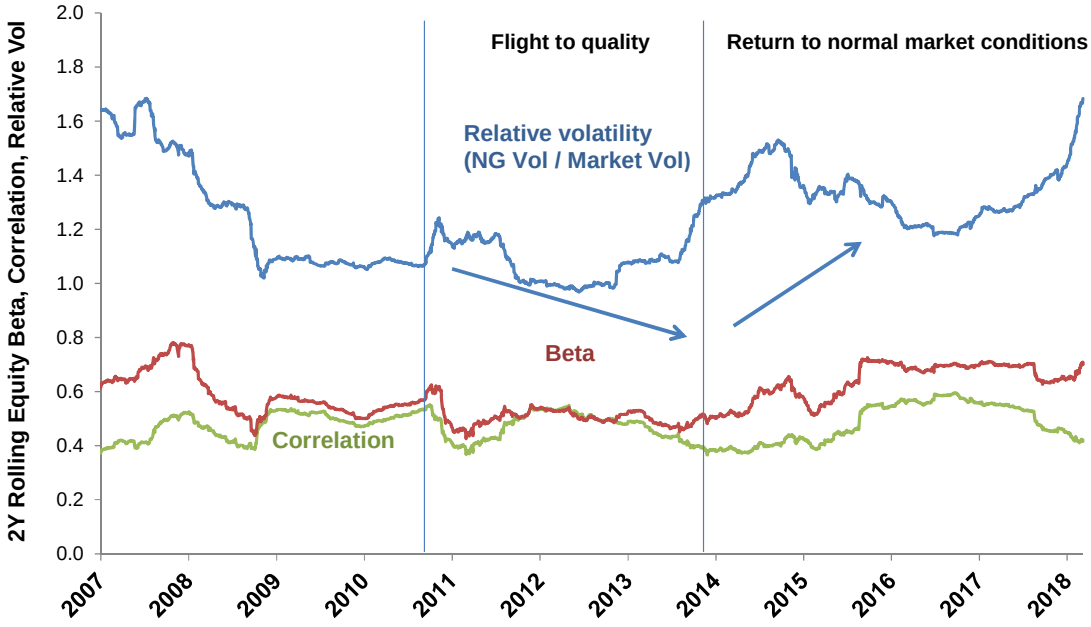
Source: Bloomberg, NERA analysis, cut-off: 9 March 2018, daily data, reference index: FTSE All Share.

Figure A.2
Severn Trent – Equity beta decomposition



Source: Bloomberg, NERA analysis, cut-off: 9 March 2018, daily data, reference index: FTSE All Share.

Figure A.3
Pennon – Equity beta decomposition



Source: Bloomberg, NERA analysis, cut-off: 9 March 2018, daily data, reference index: FTSE All Share.

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