NERA
ECONOMIC CONSULTING

Cost of Capital: Beta and Gearing for the 2019 BCMR - Update

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1.   Introduction

NERA has been commissioned by Ofcom to provide consulting support on estimating betas and gearing for the Business Connectivity Market Review (2019 BCMR) including the "Leased Lines Charge Control" (LLCC), which will set prices for BT's "leased lines business" for the period 1 April 2019 to 31 March 2021. By leased lines we refer to BT's active leased lines products.[1]

In our first report for Ofcom ("October 2018 report"),[2] published alongside Ofcom's Business Connectivity Market Review Consultation in November 2018,[3] we provided estimates of equity betas, asset betas and gearing for BT and comparator companies using a 20 July 2018 cut-off date. We also reviewed Ofcom's debt beta assumption and commented on the appropriate beta for BT's leased lines business.

In this report, we update the beta and gearing evidence for BT and comparator companies, using a 31 January 2019 cut-off date. We also respond to issues raised by stakeholders in response to Ofcom's 2018 BCMR Consultation in relation to beta and gearing estimation, including responses submitted by BT and TalkTalk.

The remainder of this report is structured as follows:

- Section 2 presents updated equity and asset beta estimates for BT and comparator company groups considered by Ofcom in previous reviews (UK utilities, UK telecoms, European telecoms, and ICT comparators);

- Section 3 presents updated gearing estimates for BT, UK and EU Telecoms comparators;

- Section 4 addresses the issues raised by stakeholders in response to Ofcom's November 2018 (updated in December 2018) BCMR Consultation in relation to beta and gearing estimation;

- Section 5 provides a summary and conclusions on the asset beta ranges for BT and comparators, including recommended ranges for the "Other UK Telecoms" (OUKT) segment.

We provide the technical details of our analysis in the Appendices.

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[1]   An active leased line is a permanently connected communications link between two premises dedicated to the customers' exclusive use provided with active electronics at either end of the connection.

[2]   NERA (11 October 2018), Cost of Capital: Beta and Gearing for the 2019 BCMR, Link: https://www.ofcom.org.uk/__data/assets/pdf_file/0018/124740/nera-wacc-report.pdf

[3]   Documents published on Ofcom's website: https://www.ofcom.org.uk/consultations-and-statements/category-1/business-connectivity-market-review

2. January 2019 Update of the Equity and Asset Betas for BT and Comparators

In this section, we present updated equity betas and asset betas for BT and comparator company groups including UK utilities, UK telecoms, European telecoms and ICT comparators using a 31 January 2019 cut-off date.

2.1. Overview of Our Beta Estimation Methodology

We estimate updated betas using the same methodology as in our October 2018 report. We do not present updated beta evidence for Sky, given Sky was acquired on 9th October 2018 by Comcast and subsequently delisted on 7 November 2018.[4] We therefore remove Sky from the UK Telecoms comparator group. The key assumptions for estimating betas are summarised in Table 2.1. We provide a more detailed explanation of our methodology and assumptions in Appendix A.

Table 2.1: Overview of Assumptions for Beta Estimation

Comparator groups	UK utilities, UK Telecoms, European Telecoms, ICT comparators
Reference index	local/regional index, world index
Sampling frequency	Daily
Time horizon	1 year, 2 years, 5 years
Debt beta assumption	0.1
(Re-)levering formula	Miller
Cut-off date	31 January 2019

Source: NERA analysis.

2.2. UK Utilities and UK Telecoms Comparators

2.2.1. Equity betas

Table 2.2 and Table 2.3 show the equity betas for BT, UK utilities, and UK telecoms estimated against the FTSE All Share index using daily historical data over 1-year, 2-year, and 5-year periods up to 31 January 2019.

BT's equity beta has continued to decline since July 2018, used as the cut-off date in our October 2018 report, both on a 2-year and a 5-year basis. The 2-year and 5-year average equity betas for UK Utilities have also slightly declined, while the UK telecoms average equity betas remained broadly unchanged for the 2-year and 5-year estimation windows.

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[4]   London Stock Exchange (9 October 2018), Sky plc ("Sky") Cancellation of Listing and Directorate Changes; link:
     https://www.londonstockexchange.com/exchange/news/market-news/market-news-detail/SKY/13822214.html

Table 2.2: BT and UK Utilities Equity Beta Against FTSE All Share

		FTSE All Share		
		OLS/GLS*		
		Beta (Jan 19)	SE (Jan 19)	Beta (Jul 18)
BT				
	1Y	0.72	0.12	0.83
	2Y	0.66	0.09	0.72
	5Y	0.91	0.05	0.94
National Grid				
	1Y	0.69	0.10	0.83
	2Y	0.69	0.07	0.76
	5Y*	0.65	0.03	0.66
Severn Trent				
	1Y	0.62	0.12	0.79
	2Y	0.60	0.08	0.65
	5Y	0.67	0.04	0.69
Pennon				
	1Y	0.62	0.12	0.74
	2Y	0.64	0.09	0.69
	5Y	0.66	0.04	0.68
United Utilities				
	1Y	0.68	0.12	0.84
	2Y	0.64	0.08	0.68
	5Y*	0.70	0.04	0.72
SSE				
	1Y	0.73	0.10	0.79
	2Y	0.65	0.08	0.65
	5Y*	0.81	0.03	0.80
Utilities average				
	1Y	**0.67**		**0.80**
	2Y	**0.64**		**0.69**
	5Y	**0.70**		**0.71**
Utilities average (excl. SSE)				
	1Y	**0.65**		**0.80**
	2Y	**0.64**		**0.69**
	5Y	**0.67**		**0.69**

Notes: Cut-off date is 31 January 2019; daily data.
Source: NERA analysis based on Bloomberg data.

Table 2.3: BT and UK Telecoms Equity Beta Against FTSE All Share

		FTSE All Share		
		OLS/GLS*		
		Beta (Jan 19)	SE (Jan 19)	Beta (Jul 18)
BT				
	1Y	0.72	0.12	0.83
	2Y	0.66	0.09	0.72
	5Y	0.91	0.05	0.94
TalkTalk				
	1Y	1.05	0.20	1.00
	2Y	0.73	0.17	0.74
	5Y*	0.80	0.07	0.81
Vodafone				
	1Y*	1.04	0.10	1.09
	2Y*	1.04	0.07	1.04
	5Y	1.04	0.04	1.04
Telecoms average (excluding BT)				
	1Y	**1.05**		**1.04**
	2Y	**0.89**		**0.89**
	5Y	**0.92**		**0.92**

Notes: Cut-off date is 31 January 2019; daily data.
Source: NERA analysis based on Bloomberg data.

Figure 2.1 and Figure 2.2 show 2-year and 5-year rolling equity betas of BT and the UK comparator companies estimated against the FTSE All Share index, showing the trend in the 2-year and 5-year equity betas over the period January 2014 to January 2019.

Figure 2.1: BT and UK Utilities and UK Telecoms 2Y Rolling Equity Beta Against FTSE All Share
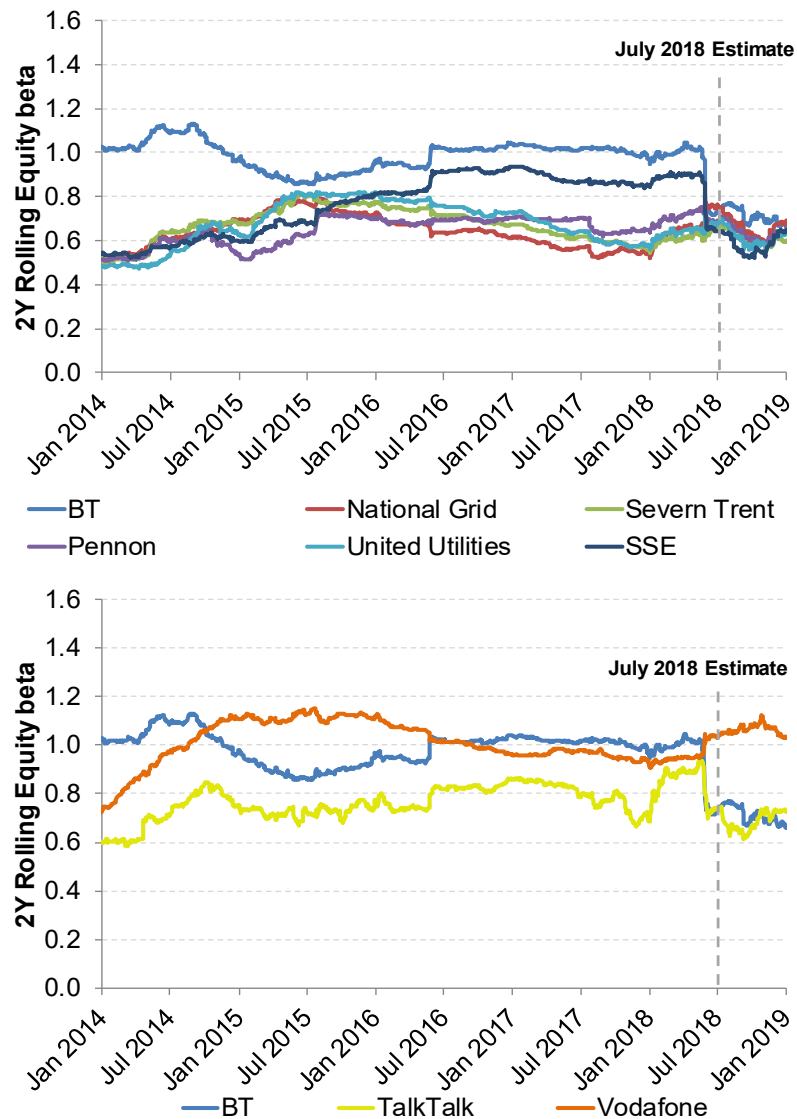
Notes: Cut-off date is 31 January 2019; daily data; 2-year estimation window.
Source: NERA analysis based on Bloomberg data.

Figure 2.2: BT and UK Utilities and UK Telecoms 5Y Rolling Equity Beta Against FTSE All Share
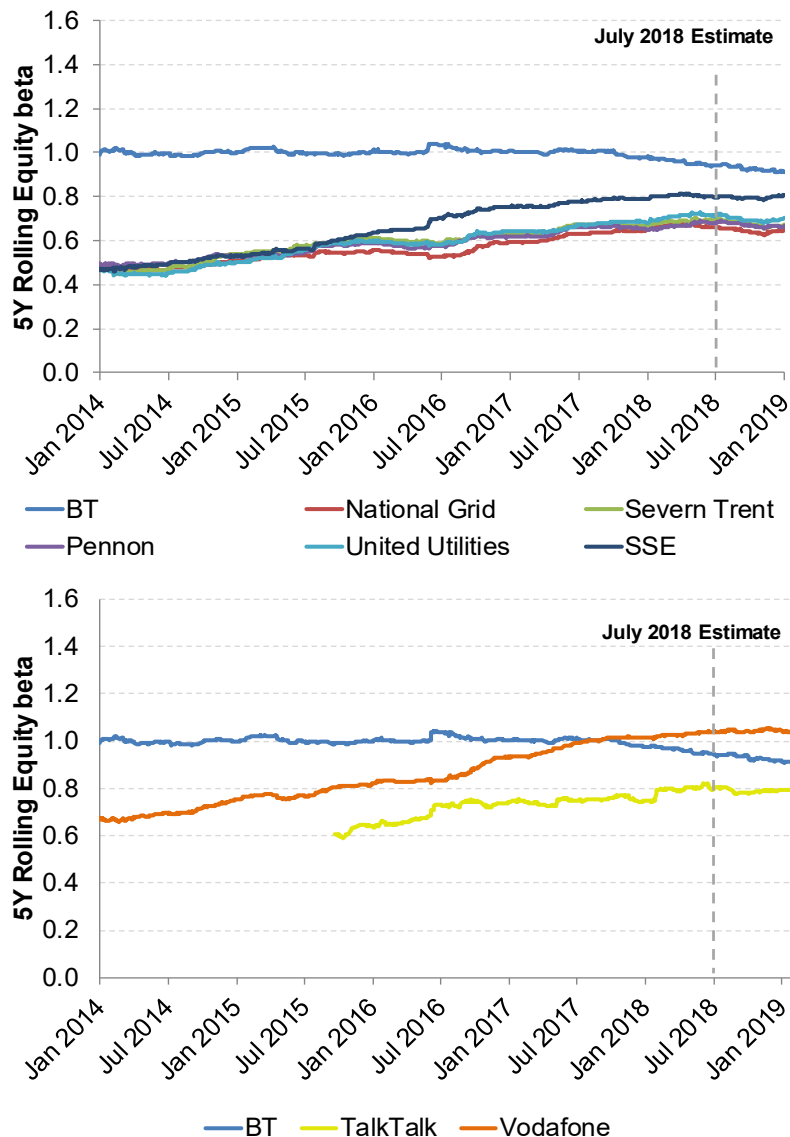
Notes: Cut-off date is 31 January 2019; daily data; 5-year estimation window.
Source: NERA analysis based on Bloomberg data.

Figure 2.3 shows the equity beta for BT and average equity betas for the UK comparators: UK Telecoms and UK Utilities. For the UK Utilities comparator set, we present the averages including and excluding SSE, which has a large proportion of generation and non-regulated activities, and is hence different from traditional utilities.[5]

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[5] In FY2017/2018, SSE derived only about 4 per cent of its total revenues from regulated network activities (electricity transmission and distribution). The largest share of SSE's revenues came from wholesale activities (74 per cent, including generation activities), followed by retail activities (22 per cent). The remaining areas of SSE's business include energy-related services, gas production and storage, as well as telecoms. SSE's telecoms operations are part of the company's Enterprise segment, which among others also includes electrical contracting and private energy networks, and accounted for around 1.4 per cent of SSE's revenues in FY2017/2018. Source: SSE plc Annual Report 2018, p.158.

Figure 2.3: BT vs UK Telecoms and UK Utilities Average – 2Y and 5Y Equity Beta Against the FTSE All Share
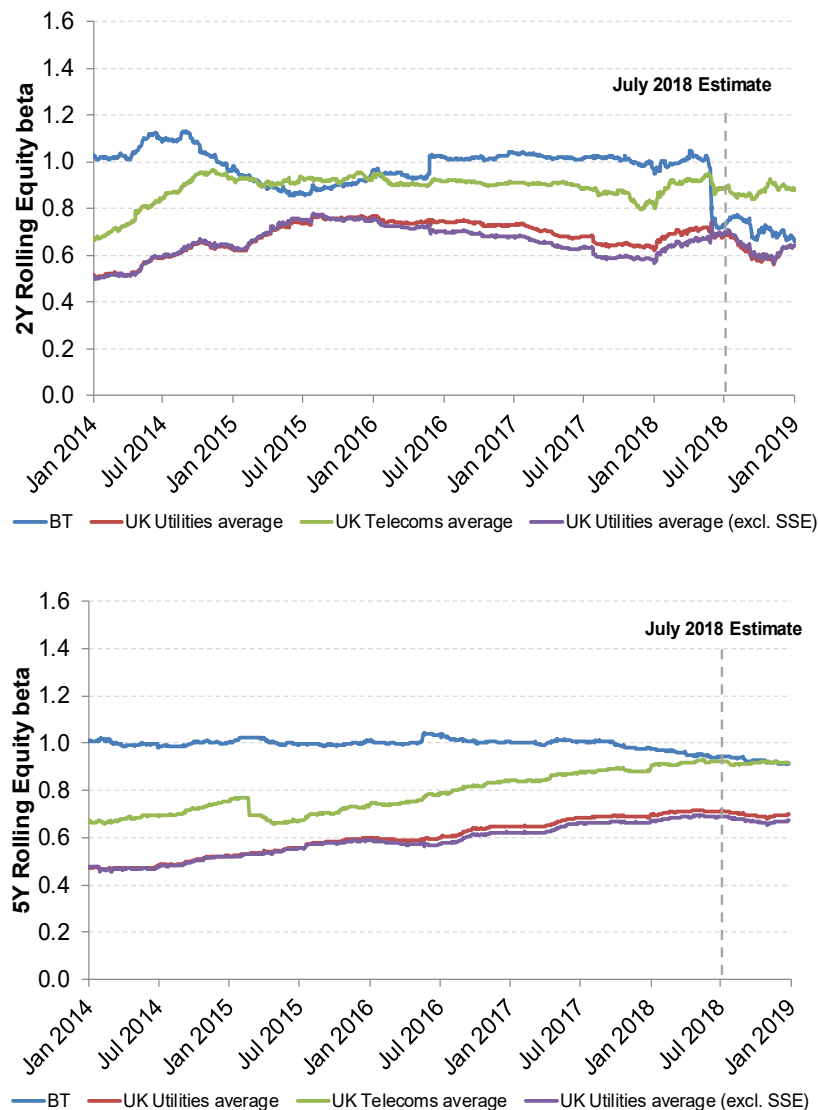
Notes: Cut-off date is 31 January 2019; daily data, 2-year and 5-year estimation window. Source: NERA analysis based on Bloomberg data.

2.2.2. Asset betas

We estimate un-levered asset betas for BT and UK comparators from the equity betas presented in the previous section using the Miller formula as described in Appendix A. We use gearing data from Bloomberg[6] and assume a debt beta of 0.1. We calculate gearing as the total (gross) value of debt to enterprise value, where enterprise value is calculated as the sum of (gross) debt and market capitalisation. To calculate the asset betas, we use the average

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[6]   Bloomberg provides gearing data based on the book value of debt and the market value of equity. Debt also includes finance leases. Cash is not netted off.

gearing estimated over the same estimation window as the equity betas. We present our analysis of current gearing in Section 3.

Table 2.4 and Table 2.5 below show asset betas for BT, UK Utilities and UK Telecoms, estimated against the FTSE All Share assuming a debt beta of 0.1. Figure 2.4 to Figure 2.6 also show the 2-year and 5-year rolling asset betas for BT and the UK comparators against the FTSE All Share index over the period January 2014 to January 2019.

For BT and UK Utilities we see a similar trend in the asset betas as in the equity betas described in the previous section, with 2-year and 5-year asset betas declining for BT and the utility comparators since July 2018, used as the cut-off date in our October 2018 report. We also find very slight reductions in the average 2-year and 5-year asset betas for the UK Telecoms comparators.

Table 2.4: BT and UK Utilities Asset Betas Against FTSE All Share

		FTSE All Share	
	Gearing (Jan 19)	**Asset beta (Jan 19)**	**Asset beta (Jul 18)**
		Debt beta=0.1	**Debt beta=0.1**
BT			
1Y	40%	0.48	0.56
2Y	36%	0.46	0.51
5Y	29%	0.68	0.71
National Grid			
1Y	50%	0.40	0.48
2Y	48%	0.41	0.45
5Y	46%	0.40	0.41
Severn Trent			
1Y	56%	0.33	0.42
2Y	53%	0.34	0.37
5Y	51%	0.38	0.40
Pennon			
1Y	53%	0.35	0.41
2Y	51%	0.37	0.39
5Y	49%	0.39	0.40
United Utilities			
1Y	61%	0.33	0.41
2Y	58%	0.33	0.36
5Y	54%	0.38	0.38
SSE			
1Y	42%	0.46	0.52
2Y	39%	0.43	0.46
5Y	34%	0.57	0.57
Utilities average			
1Y	52%	**0.37**	**0.45**
2Y	50%	**0.37**	**0.41**
5Y	47%	**0.42**	**0.43**
Utilities average (excl. SSE)			
1Y	55%	**0.35**	**0.43**
2Y	52%	**0.36**	**0.39**
5Y	50%	**0.39**	**0.40**

Notes: Cut-off date is 31 January 2019; daily data.
Source: NERA analysis based on Bloomberg data.

**Table 2.5: BT and UK Telecoms Asset Betas Against FTSE All Share**

		FTSE All Share		
		Gearing (Jan 19)	Asset beta (Jan 19)	Asset beta (Jul 18)
			Debt beta=0.1	Debt beta=0.1
BT				
	1Y	40%	0.48	0.56
	2Y	36%	0.46	0.51
	5Y	29%	0.68	0.71
TalkTalk				
	1Y	38%	0.68	0.66
	2Y	36%	0.50	0.51
	5Y	28%	0.60	0.63
Vodafone				
	1Y	45%	0.62	0.70
	2Y	43%	0.64	0.65
	5Y	41%	0.66	0.68
Telecoms average (excluding BT)				
	1Y	42%	**0.65**	**0.68**
	2Y	40%	**0.57**	**0.58**
	5Y	34%	**0.63**	**0.66**

Notes: Cut-off date is 31 January 2019; daily data.
Source: NERA analysis based on Bloomberg data.

Figure 2.4: BT and UK Utilities and UK Telecoms 2Y Rolling Asset Beta Against FTSE All Share
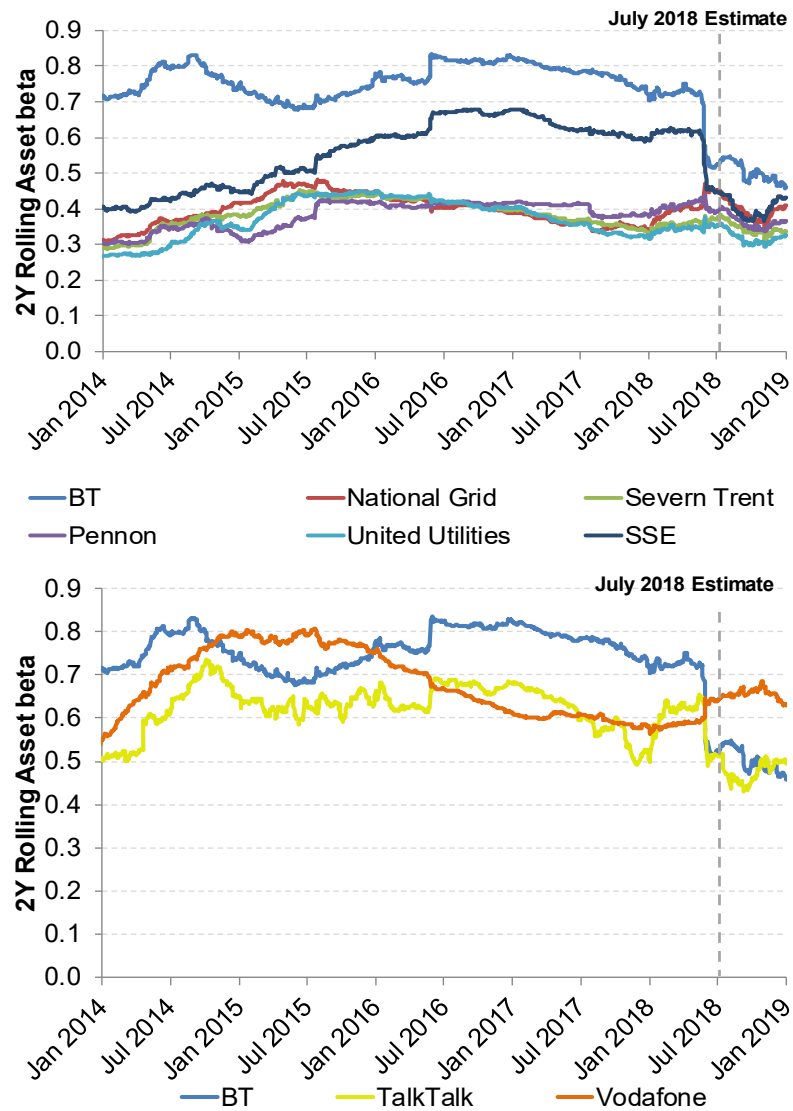
Notes: Cut-off date is 31 January 2019; daily data; 2-year estimation window.
Source: NERA analysis based on Bloomberg data.

Figure 2.5: BT and UK Utilities and Telecoms 5Y Rolling Asset Beta Against FTSE All Share
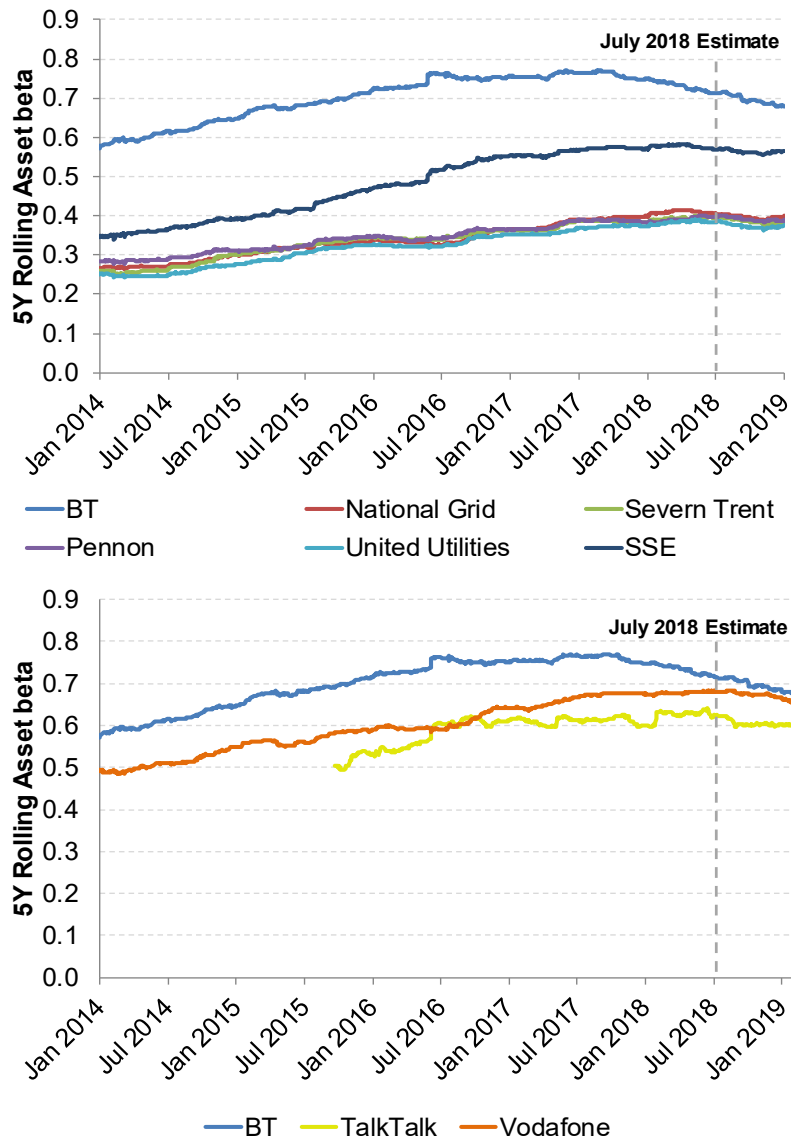
Notes: Cut-off date is 31 January 2019; daily data; 5-year estimation window.
Source: NERA analysis based on Bloomberg data.

Figure 2.6: BT vs UK Utilities and UK Telecoms Average – 2Y and 5Y Asset Beta Against FTSE All Share
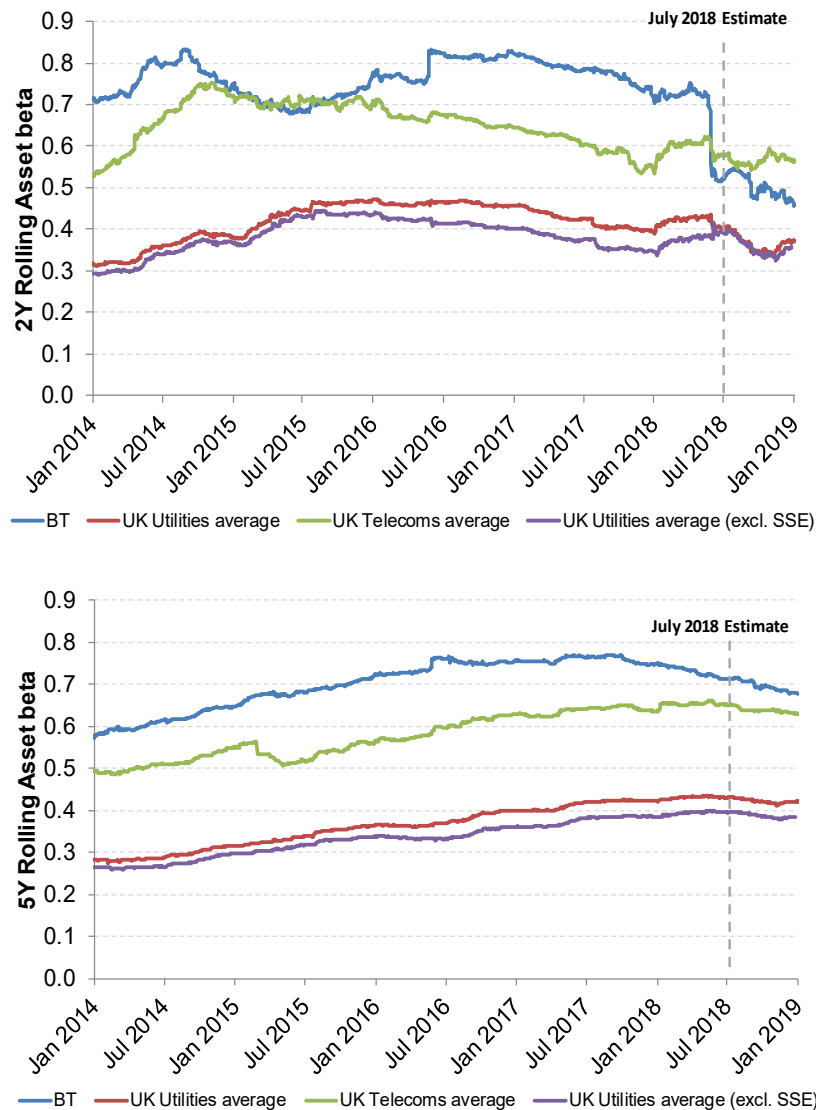
Notes: Cut-off date is 31 January 2019; daily data, 2-year and 5-year estimation window.
Source: NERA analysis based on Bloomberg data.

2.2.3. Discussion of BT and UK comparator asset beta results

In this section, we discuss the asset beta results for BT and UK comparators, as estimated in the previous section.

Table 2.6 summarises the 2-year and 5-year asset beta ranges for BT, UK utilities (excluding SSE) and UK telecoms estimated against the FTSE All Share index presented in our October 2018 report (estimated using a July 2018 cut-off date) and the updated ranges presented in

this report (using a January 2019 cut-off date) Table 2.7 shows the equivalent asset beta ranges using the FTSE All World index as the reference index.[7]

Table 2.6: BT, UK Utilities and UK Telecoms Asset Beta Ranges Against FTSE All Share

Comparators	2Y (Jul 18)	2Y (Jan 19)	5Y (Jul 18)	5Y (Jan 19)
BT	0.51	0.46	0.71	0.68
UK Utilities (excl. SSE)	0.36-0.45	0.33-0.41	0.38-0.41	0.38-0.40
UK Telecoms*	0.51-0.65	0.50-0.64	0.63-0.68	0.60-0.66

*Note: * UK telecoms refers to the UK telecoms comparator sample which does not include BT nor Sky for both the July 2018 and January 2019 cut-off dates.*
Source: NERA analysis based on Bloomberg data.

Table 2.7: BT, UK Utilities and UK Telecoms Asset Beta Ranges Against FTSE All World

Comparators	2Y (Jul 18)	2Y (Jan 19)	5Y (Jul 18)	5Y (Jan 19)
BT	0.38	0.20	0.68	0.57
UK Utilities (excl. SSE)	0.19-0.28	0.13-0.18	0.32-0.35	0.28-0.31
UK Telecoms*	0.42-0.46	0.37-0.42	0.59-0.64	0.53-0.59

*Note: * UK telecoms refers to the UK telecoms comparator sample which does not include BT nor Sky for both the July 2018 and January 2019 cut-off dates.*
Source: NERA analysis based on Bloomberg data.

Overall, we see that both 2-year and 5-year asset betas have fallen for BT and UK comparators when estimated against the FTSE All Share and the FTSE All World indices. The reduction is more substantial for asset betas estimated against the world index, due to the volatility of the world index increasing more compared to the FTSE All Share index, as shown in Table 2.8, which all else equal, would lead to lower betas.[8]

Table 2.8: The 2Y Volatility of FTSE All World Increased Relatively More Than FTSE All Share

Index	July 2018	January 2019
FTSE All World	0.50%	0.63%
FTSE All Share	0.60%	0.66%
FTSE All Europe	0.66%	0.72%

Note: Cut-off dates are 20 July 2018 and 31 January 2019; daily data.
Source: NERA analysis based on Bloomberg data.

Against the FTSE All Share, our preferred index, BT's asset beta has declined since July 2018, from 0.51 to 0.46 on a 2-year basis and from 0.71 to 0.68 on a 5-year basis.

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[7]   We present the detailed asset beta estimates against the FTSE All World index in Appendix C.

[8]   The higher increase in volatility of the FTSE All World index may be explained by the fact that the world index is likely to be more affected by recent events such as China's economic slowdown and the US-China trade war.

We decompose BT's 2-year equity beta estimated against the FTSE All Share into the constituent elements: stock-market correlation, stock volatility and market volatility,[9] to analyse the drivers of the beta changes, as shown in Figure 2.7.

Figure 2.7: BT's 2Y Equity Beta Decomposition
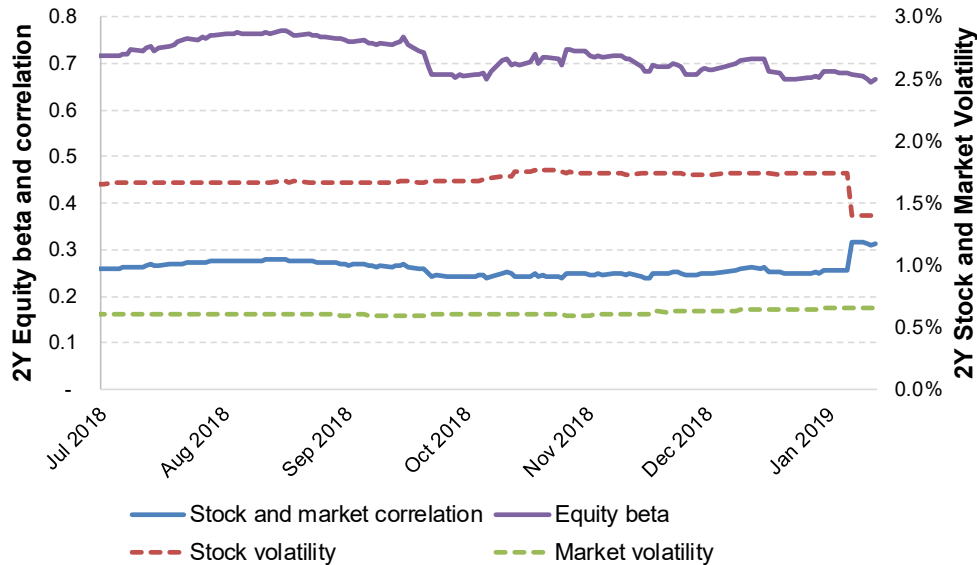
Notes: Cut-off date is 31 January 2019; daily data, 2-year estimation window; reference index is FTSE All Share.
Source: NERA analysis based on Bloomberg data.

Figure 2.7 shows that the main driver of BT's equity beta decline since July 2018 is a decline in the correlation of BT's stock with the market.[10] The declining correlation of BT's stock with the market may be driven by BT specific events, including the possibility of spinning off Openreach as suggested by a BT shareholder[11] or BT announcing better than expected results

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[9] The equity beta measures the riskiness of a stock relative to a market portfolio based on the following equation

$$Equity\ \beta = \frac{\sigma_{im}}{\sigma^2_{market}}$$

where σ_{im} is the covariance between the stock returns and the market returns, and σ^2_{market} is the variance of the returns on the market. Since the covariance of the stock and the market return σ_{im} can be re-written as the product of i) the correlation coefficient of the stock and the market return ($\rho_{stock,\ market}$), ii) the standard deviation of the stock return (σ_{stock}) and iii) the standard deviation of the market return (σ_{market}), the equity beta formula can therefore be rewritten as:

$$Equity\ \beta = \rho_{stock,\ market} \times \frac{\sigma_{stock}}{\sigma_{market}}$$

[10] We note that at the end of January 2019, there is a jump in the correlation (which places it at a level above that of our July 2018 cut-off used in our October 2018 report) and a sudden decline in stock volatility, which offset each other, leading to a relatively constant equity beta. This is related to the observation on 24 January 2017, when BT's shares dropped around 23 per cent after worse than expected consequences from an accounting scandal in Italy, falling out of the estimation window. Source: https://www.theguardian.com/business/live/2017/jan/24/bt-shares-profits-italy-accountig-scandal-sterling-public-finances-live

[11] Source: https://www.thetimes.co.uk/article/us-activist-greenlight-capital-has-eye-on-bt-split-with-openreach-rjtjw0xsq

in November 2018[12], which would affect BT but not the wider market, potentially resulting in a declining correlation. Another potential driver may be the general rally of telecoms stock prices towards the end of 2018, at a time where the wider market was declining, which could have also contributed to the declining correlation observed.[13]

The UK Utilities asset beta range estimated against the FTSE All Share has declined slightly since July 2018 from 0.36-0.45 to 0.33-0.41 on a 2-year basis while on a 5-year basis the range is relatively unchanged (0.38-0.41 using July 2018 cut-off vs. 0.38-0.40 using January 2019 cut-off). One potential explanation for the decline in asset betas for UK Utilities is associated with a the "defensive" characteristics of utility stocks, which offer stable returns over time, resulting in their asset betas falling at times of heightened market volatility.[14] The second factor explaining the recent decline in UK utility betas may reflect the ongoing price control reviews for water (PR19) and energy (RIIO-2), which are characterised by a series of regulatory announcements[15] which affect the utility stocks but not the wider market, thus reducing the utility stocks' correlation with the market and their betas.

For UK Telecoms, the asset beta range estimated against the FTSE All Share is relatively similar on a 2-year basis (0.51-0.65 using July 2018 cut-off vs. 0.50-0.64 using January 2019 cut-off), while on a 5-year basis the range has declined slightly since July 2018 from 0.63-0.68 to 0.60-0.66.

BT's asset beta positioning relative to the UK comparator betas estimated against the FTSE All Share has not changed significantly since our October 2018 report. In our October 2018 report, which used a July 2018 cut-off, BT's 2-year asset beta (0.51) was above the UK Utilities range (0.36-0.45) and at the lower end of the UK Telecoms range (0.51-0.65). In this update, which uses a January 2019 cut-off, BT's 2-year asset beta (0.46) is above the UK Utilities range (0.33 to 0.41) but below the UK telecoms range (0.50 to 0.64). For the 5-year estimation window, BT's asset beta (0.71 in July 2018 and 0.68 in January 2019) is still considerably above the UK Utilities range (0.38-0.41 in July 2018 and 0.38 to 0.40 in January 2019) and closer to the UK Telecoms asset beta (0.63-0.68 in July 2018 and 0.60 to 0.66 in January 2019). The 5-year asset betas are generally higher for BT and its UK comparators than the 2-year asset betas.

In Appendix B, we present confidence intervals for the 2-year and 5-year asset betas for BT and UK comparators. The results show a similar pattern as described in our October 2018 report: the confidence intervals for the 2-year asset betas have increased substantially in the most recent period due to a significant increase in standard errors for the UK comparators since

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[12] Source: https://www.btplc.com/news/index.htm#/pressreleases/results-for-the-half-year-to-30-september-2018-2786794; https://www.ft.com/content/32c0dd76-ddbe-11e8-8f50-cbae5495d92b and https://www.ft.com/content/492ab52e-f7a3-11e8-af46-2022a0b02a6c.

[13] Source: https://www.bloomberg.com/news/articles/2018-12-17/five-things-to-watch-in-european-tech-media-and-telecom-in-2019

[14] As discussed in NERA (11 October 2018), Cost of Capital: Beta and Gearing for the 2019 BCMR, Appendix A.

[15] Ofgem (30 July 2018), RIIO-2 Framework decision, link: https://www.ofgem.gov.uk/publications-and-updates/riio-2-framework-decision; Ofgem (18 December 2018), RIIO-2 Sector specific methodology consultation, link: https://www.ofgem.gov.uk/publications-and-updates/riio-2-sector-specific-methodology-consultation; Ofwat (11 July 2017), Delivering Water 2020: Consulting on our methodology for the 2019 price review, link: https://www.ofwat.gov.uk/consultation/delivering-water2020-consulting-on-our-methodology-for-the-2019-price-review/; Ofwat (13 December 2017), Delivering Water 2020: Our final methodology for the 2019 price review, link: https://www.ofwat.gov.uk/publication/delivering-water-2020-final-methodology-2019-price-review/.

the referendum on the UK's membership of the EU and are considerably wider than the confidence intervals for 5-year asset betas.

2.3. European Telecoms Comparators

2.3.1. Equity betas

Table 2.9 below shows the equity beta estimates for BT and European Telecoms comparators, estimated against the FTSE All Europe index using daily historical data over 1-year, 2-year and 5-year periods up to 31 January 2019.

We find that for most of the European Telecoms comparators, the 2-year and 5-year equity betas have declined since July 2018, used as the cut-off date in our October 2018 report, with the 5-year equity beta decline being less pronounced compared to the 2-year equity beta.

Table 2.9: BT and European Telecoms Equity Beta Against the FTSE All Europe

| | | FTSE All Europe | | |
| | | OLS/GLS* | | |
		Beta (Jan 19)	SE (Jan 19)	Beta (Jul 18)
BT				
	1Y	0.69	0.11	0.86
	2Y	0.60	0.08	0.63
	5Y	0.73	0.04	0.75
Telefonica				
	1Y	0.79	0.07	0.94
	2Y	0.87	0.06	1.04
	5Y*	1.10	0.03	1.13
Deutsche Telekom				
	1Y	0.53	0.07	0.64
	2Y	0.58	0.05	0.69
	5Y*	0.83	0.03	0.86
Belgacom				
	1Y	0.59	0.10	0.75
	2Y	0.65	0.07	0.68
	5Y	0.67	0.03	0.68
KPN				
	1Y	0.75	0.09	0.71
	2Y	0.67	0.07	0.71
	5Y	0.79	0.04	0.79
Orange				
	1Y	0.59	0.06	0.72
	2Y	0.66	0.05	0.75
	5Y	0.97	0.03	1.02
Telecom Italia				
	1Y*	0.89	0.13	1.07
	2Y*	0.92	0.10	1.13
	5Y*	1.23	0.05	1.27
Iliad				
	1Y	0.82	0.21	0.65
	2Y	0.82	0.13	0.64
	5Y	0.78	0.05	0.74
Orange Belgium				
	1Y	0.51	0.13	0.66
	2Y	0.55	0.09	0.55
	5Y*	0.51	0.04	0.52
Telenor				
	1Y*	0.47	0.09	0.50
	2Y*	0.46	0.07	0.50
	5Y*	0.65	0.03	0.65
Tele2				
	1Y	0.94	0.12	1.01
	2Y	0.95	0.08	0.93
	5Y*	0.81	0.04	0.79
Swisscom				
	1Y*	0.58	0.07	0.70
	2Y*	0.57	0.05	0.62
	5Y*	0.59	0.02	0.60
EU Comparators Avg.				
	1Y	**0.68**		**0.76**
	2Y	**0.70**		**0.75**
	5Y	**0.81**		**0.82**

Notes: Cut-off date is 31 January 2019; daily data.
Source: NERA analysis based on Bloomberg data.

Figure 2.8 shows the evolution of the 2-year equity betas of the European Telecoms comparators and BT estimated against the FTSE All Europe index, over the period January 2014 to January 2019. Figure 2.9 shows the same but for the 5-year equity betas.

Figure 2.8: BT and European Telecoms – 2Y Rolling Equity Beta Against FTSE All Europe
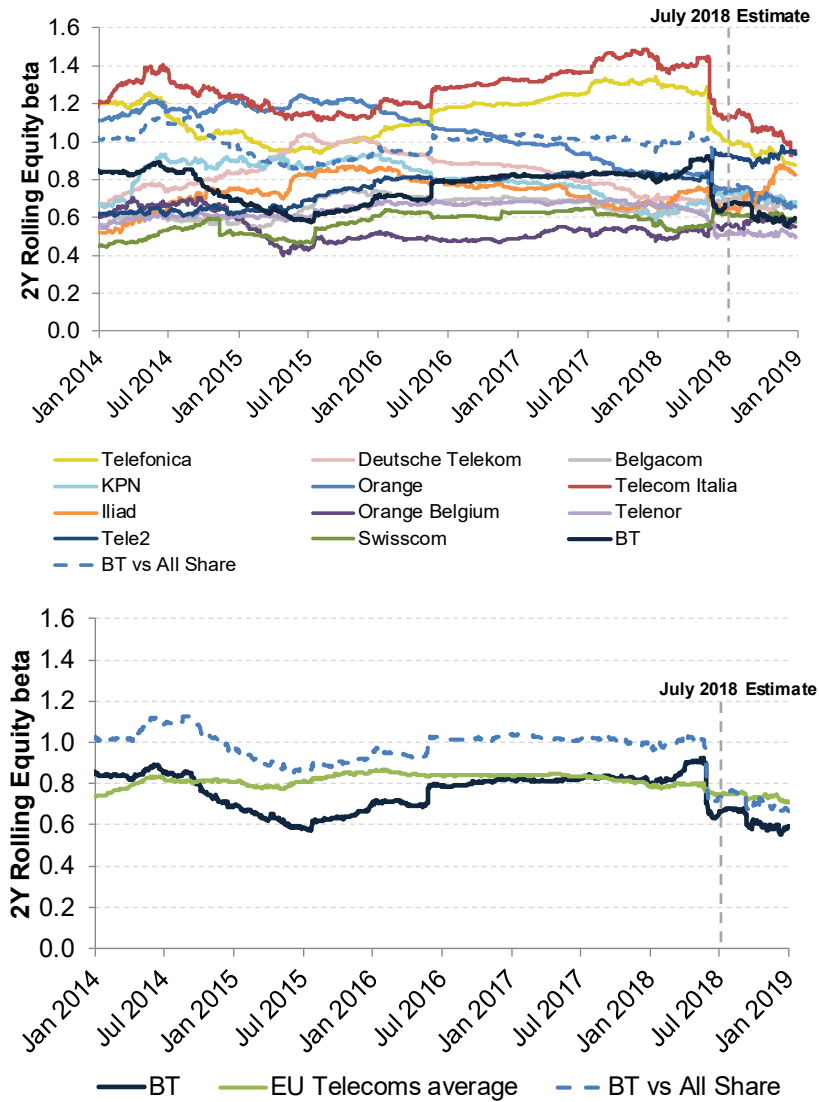
Notes: Cut-off date is 31 January 2019; daily data; 2-year estimation window.
Source: NERA analysis based on Bloomberg data.

Figure 2.9: BT and European Telecoms – 5Y Rolling Equity Beta Against FTSE All Europe
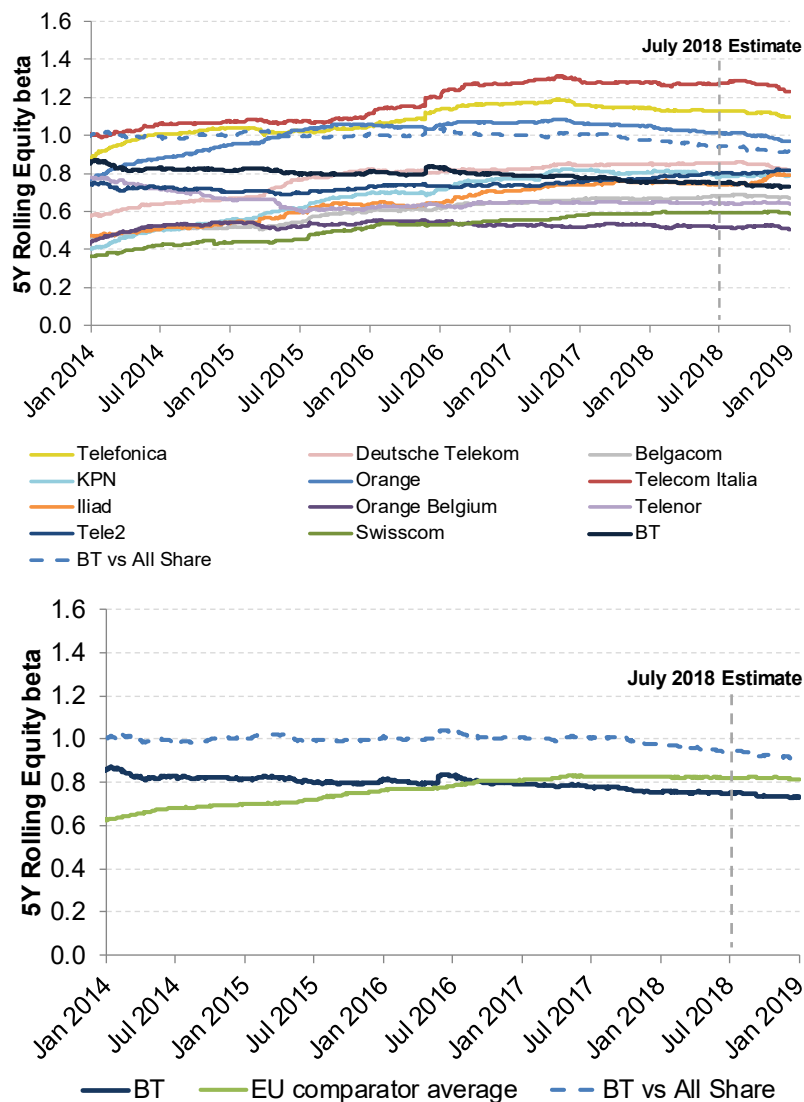
Notes: Cut-off date is 31 January 2019; daily data; 5-year estimation window.
Source: NERA analysis based on Bloomberg data.

2.3.2. Asset betas

Table 2.10 below shows asset betas for the European Telecoms comparators and BT, estimated against the FTSE All Europe. We calculate 1-year, 2-year and 5-year asset betas based on the equivalent equity betas presented in the previous section using the Miller formula, with gearing calculated on a gross debt basis using data from Bloomberg and assuming a debt beta of 0.1.

In addition, Figure 2.10 and Figure 2.11 show the evolution of 2-year and 5-year rolling asset betas for BT and European Telecoms comparators against the FTSE All Europe index over the period January 2014 to January 2019.

We observe a similar trend in the asset betas as in the equity betas discussed in the previous section, with 2-year asset betas declining for most of the European Telecoms comparators relative to the July 2018 cut-off used in our October 2018 report. The 5-year betas remain unchanged on average, although there is some variation among the individual comparators.

Table 2.10: BT and European Telecoms Asset Beta Against the FTSE All Europe

		FTSE All Europe	
	Gearing (Jan 19)	Asset beta (Jan 19)	Asset beta (Jul 18)
		Debt beta=0.1	Debt beta=0.1
BT			
1Y	40%	0.45	0.58
2Y	36%	0.42	0.45
5Y	29%	0.55	0.57
Telefonica			
1Y	58%	0.39	0.46
2Y	57%	0.43	0.50
5Y	55%	0.55	0.57
Deutsche Telekom			
1Y	47%	0.33	0.39
2Y	46%	0.36	0.42
5Y	46%	0.49	0.51
Belgacom			
1Y	24%	0.47	0.61
2Y	22%	0.53	0.56
5Y	21%	0.55	0.56
KPN			
1Y	43%	0.47	0.47
2Y	41%	0.44	0.47
5Y	44%	0.49	0.47
Orange			
1Y	47%	0.36	0.43
2Y	47%	0.40	0.45
5Y	48%	0.55	0.56
Telecom Italia			
1Y	71%	0.33	0.42
2Y	69%	0.35	0.43
5Y	68%	0.46	0.47
Iliad			
1Y	32%	0.59	0.55
2Y	24%	0.65	0.55
5Y	17%	0.67	0.66
Orange Belgium			
1Y	26%	0.40	0.53
2Y	25%	0.44	0.44
5Y	29%	0.39	0.39
Telenor			
1Y	22%	0.39	0.41
2Y	24%	0.37	0.40
5Y	24%	0.51	0.51
Tele2			
1Y	18%	0.79	0.83
2Y	20%	0.78	0.74
5Y	20%	0.67	0.65
Swisscom			
1Y	26%	0.46	0.54
2Y	26%	0.45	0.48
5Y	25%	0.47	0.47
EU Comparators Avg.			
1Y	38%	**0.45**	**0.51**
2Y	36%	**0.47**	**0.50**
5Y	36%	**0.53**	**0.53**

Notes: Cut-off date is 31 January 2019; daily data.
Source: NERA analysis based on Bloomberg data.

Figure 2.10: BT and European Telecoms – 2Y Rolling Asset Beta Against FTSE All Europe
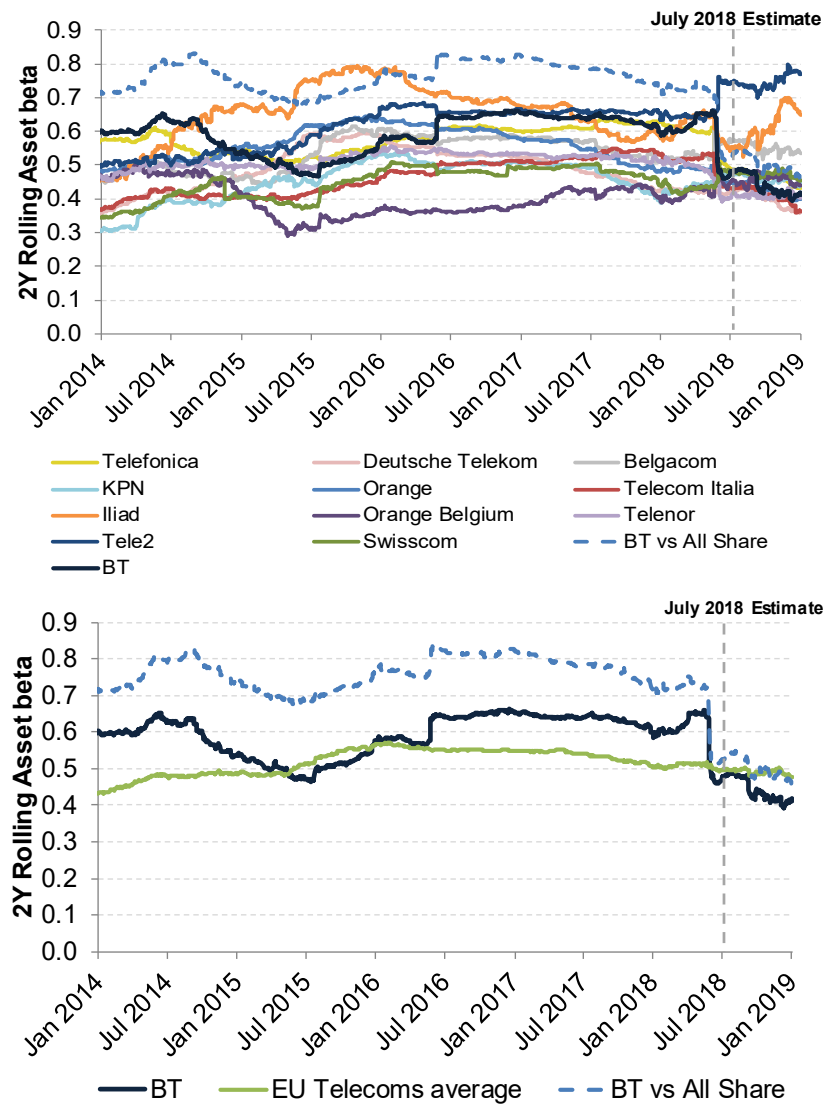
Notes: Cut-off date is 31 January 2019; daily data; 2-year estimation window.
Source: NERA analysis based on Bloomberg data.

Figure 2.11: BT and European Telecoms – 5Y Rolling Asset Beta Against FTSE All Europe
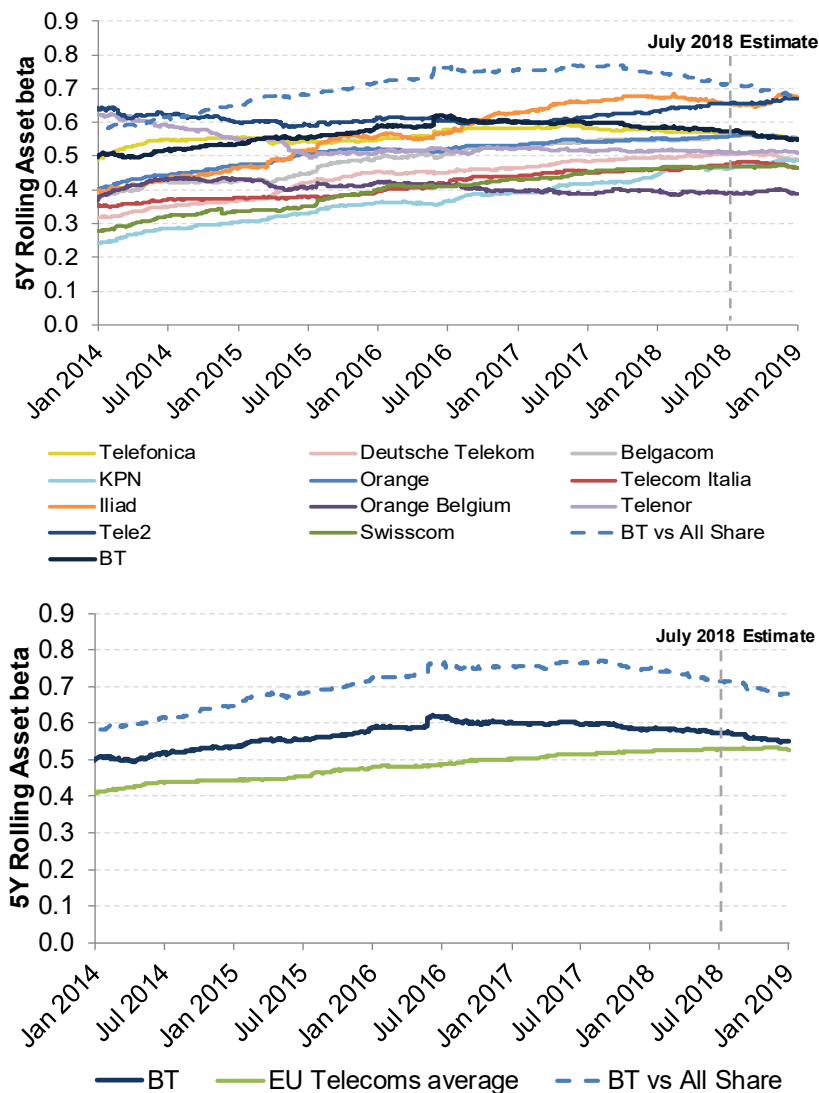
Notes: Cut-off date is 31 January 2019; daily data; 5-year estimation window.
Source: NERA analysis based on Bloomberg data.

2.3.3.   Discussion of European Telecoms asset beta results

In this section we discuss the asset beta results for BT and European Telecoms comparators, as estimated in the previous section.

Table 2.11 summarises the 2-year and 5-year asset beta ranges for BT and European Telecoms comparators estimated against the FTSE All Europe index presented in our October 2018 report (using a July 2018 cut-off) and the updated ranges presented in this report (using

a January 2019 cut-off date). Table 2.12 shows the equivalent asset beta ranges using the FTSE All World index as the reference index.[16]

Table 2.11: European Telecoms Asset Beta Ranges Against FTSE All Europe

Comparators	2Y (Jul 18)	2Y (Jan 19)	5Y (Jul 18)	5Y (Jan 19)
BT (against FTSE All Europe)	0.45	0.42	0.57	0.55
European Telecoms	0.40-0.74	0.35-0.78	0.39-0.66	0.39-0.67

Note: Cut-off date is 31 January 2019.
Source: NERA analysis based on Bloomberg data.

Table 2.12: European Telecoms Asset Beta Ranges Against FTSE All World

Comparators	2Y (Jul 18)	2Y (Jan 19)	5Y (Jul 18)	5Y (Jan 19)
BT	0.38	0.20	0.68	0.57
European Telecoms	0.38-0.63	0.22-0.65	0.43-0.74	0.40-0.75

Note: Cut-off date is 31 January 2019.
Source: NERA analysis based on Bloomberg data.

Overall, we observe that asset betas for BT and most of the European Telecoms comparators have declined when estimated against the FTSE All Europe and FTSE All World indices for both the 2-year and 5-year estimation windows. Similarly to UK comparators discussed in Section 2.2.3, the decline in the asset betas is more substantial when betas are estimated against the world index, due to the volatility of the world index increasing more compared to the FTSE All Europe index since July 2018, as shown in Table 2.8.

The European Telecoms 2-year asset beta range estimated against the FTSE All Europe has widened from 0.40-0.74 in July 2018 to 0.35-0.78 in January 2019, although as can be seen from Table 2.10, most comparators have seen their asset betas fall, resulting in a decline in the average 2-year asset beta for the European Comparators group from 0.50 to 0.47. The only exceptions are Iliad and Tele2, where Tele2's increase in asset beta drives the increase in the upper bound of the 2-year asset beta range for the European Telecoms comparator group.

For the European Comparators whose asset betas declined since July 2018, we generally observe declining correlations with the market driving the reduction in asset betas. These declines may potentially be associated with Telecoms specific events affecting these stocks but not the wider markets, such as new developments in the 5G rollout (such as the Italian auction of spectrum) and a more favourable market sentiment at a time where most of the market was in a sell-off, as analysts started to view Telecoms as relatively cheaper and prospects for mergers increased.[17] Tele2 and Iliad are the only two comparators whose asset betas have increased since July 2018. While Tele2 saw its relative volatility increase due to its higher stock volatility, Iliad saw both its correlation and relative volatility increase.

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[16] We present the detailed asset beta estimates against the FTSE All World index in Appendix C.

[17] Sources: https://www.ft.com/content/8e530d28-c705-11e8-ba8f-ee390057b8c9; https://www.bloomberg.com/news/articles/2018-12-17/five-things-to-watch-in-european-tech-media-and-telecom-in-2019 and http://europa.eu/rapid/press-release_IP-18-6588_en.htm

Using a 5-year estimation window, the asset beta range for the European Telecoms comparators is relatively unchanged from 0.39 to 0.66 in July 2018 to 0.39 to 0.67 in January 2019, reflecting the stable nature of the 5-year asset beta estimates. The average 5-year asset beta for the European Telecoms comparators did not change from the 0.53 estimated in July 2018.

When estimating BT's asset beta against the FTSE All Europe index, we find that on a 2-year basis BT's asset beta lies in the lower half of the European Telecoms range (0.42 vs 0.35-0.78 using January 2019 cut-off), while on a 5-year basis BT's asset beta lies in the upper half of the range (0.55 vs 0.39-0.67 using January 2019 cut-off). We obtain similar results when estimating both BT and European Telecoms asset betas against the world index.

As shown in Appendix B, the confidence intervals for the 2-year asset beta estimates for European Telecoms comparators have increased substantially in the most recent period and are considerably wider than the confidence intervals for 5-year asset betas.

2.4. ICT Comparators

2.4.1. Equity and asset betas

Table 2.13 and Table 2.14 show the equity and asset betas for ICT comparators estimated against the relevant local/regional indices, with asset betas estimated assuming a debt beta of 0.1.

Consistent with our October 2018 report, for each comparator we indicated whether this comparator is active in each of BT's ICT product and services lines: Managed Networked IT Services and Security; Unified Communications and IT Infrastructure; and Professional Services and IT Consulting. Based on this, we categorise the sample of comparators into two tiers: Tier 1 (includes all companies active across all 3 ICT product and service lines offered by BT) and Tier 2 (includes companies that are active across at least two of the three main ICT product and service lines offered by BT), where Tier 1 is a subset of Tier 2.

Table 2.13: 2Y Betas of ICT Comparators

Company	Country of listing	(1) Managed networked IT services	(2) Unified Comms/ IT Infrastructure	(3) Professional Services/ IT consulting	Local/Regional index	Average 2Y gearing	2Y Equity beta (Local index)	SE	2Y Equity beta (World index)	SE	2Y Asset beta (Local index)		2Y Asset beta (World index)		Tier 1?
IBM	US	Y	Y	Y	S&P 500	22%	0.92	0.06	1.08	0.09	0.74		0.87		✓
UNISYS CORP	US	Y	Y	Y	S&P 500	50%	1.28	0.14	1.51	0.19	0.69	*	0.80	*	✓
AMDOCS LTD	US	Y	Y	Y	S&P 500	0%	0.64	0.04	0.79	0.06	0.64		0.79		✓
TELETECH HLDGS	US	Y	Y	Y	S&P 500	15%	0.89	0.11	1.08	0.14	0.77	*	0.93	*	✓
CDW CORP/DE	US	N	Y	Y	S&P 500	23%	0.99	0.07	1.26	0.09	0.79		0.99	*	
COGNIZANT TECH-A	US	N	Y	Y	S&P 500	2%	0.96	0.05	1.23	0.07	0.94		1.21		
XEROX CORP	US	N	Y	Y	S&P 500	43%	1.03	0.08	1.38	0.11	0.63	*	0.83	*	
INDRA SISTEMAS	SP	Y	Y	Y	FTSE All Europe	42%	0.95	0.10	1.03	0.12	0.31	*	0.64	*	✓
CANCOM AG	GE	Y	Y	Y	FTSE All Europe	4%	1.38	0.13	1.57	0.14	0.36	*	1.52	*	✓
ATOS SE	FR	Y	Y	Y	FTSE All Europe	13%	1.35	0.11	1.24	0.14	0.38	*	1.09		✓
SOPRA STERIA GRO	FR	N	Y	Y	FTSE All Europe	22%	1.38	0.12	1.24	0.15	0.52		0.99		
CAP GEMINI	FR	N	Y	Y	FTSE All Europe	18%	1.22	0.07	1.23	0.09	0.48	*	1.03	*	
TIETO OYJ	FI	N	Y	Y	FTSE All Europe	10%	0.84	0.08	0.67	0.10	0.65	*	0.61	*	
CGI GROUP INC-A	CA	N	Y	Y	S&P/TSX Composite	8%	0.81	0.06	0.70	0.06	0.75		0.65	*	
Average (Jan 19)															
Tier 1						21%	1.06		1.19		0.56		0.95		
Tier 2 (all comparators)						19%	1.05		1.14		0.62		0.92		
Average (Jul 18)															
Tier 1						20%	0.89		0.99		0.53		0.80		
Tier 2 (all comparators)						19%	0.89		0.98		0.56		0.79		

*Notes: Cut-off date is 31 January 2019; daily data; two-year estimation window; *GLS reported where regression diagnostics show heteroscedasticity or autocorrelation.*
Source: NERA analysis based on Bloomberg data.

Table 2.14: 5Y Betas of ICT Comparators

Company	Country of listing	(1) Managed networked IT services	(2) Unified Comms/ IT Infrastructure	(3) Professional Services/ IT consulting	Local/Regional index		Average 5Y gearing	5Y Equity beta (Local index)	SE	5Y Equity beta (World index)	SE	5Y Asset beta (Local index)		5Y Asset beta (World index)		Tier 1?
IBM	US	Y	Y	Y	S&P 500		20%	0.94	0.03	1.03	0.04	0.77	*	0.84		✓
UNISYS CORP	US	Y	Y	Y	S&P 500	*	40%	1.44	0.10	1.64	0.12	0.90		1.02		✓
AMDOCS LTD	US	Y	Y	Y	S&P 500		1%	0.70	0.03	0.78	0.04	0.70		0.78		✓
TELETECH HLDGS	US	Y	Y	Y	S&P 500	*	11%	0.95	0.05	1.02	0.07	0.85	*	0.92	*	✓
CDW CORP/DE	US	N	Y	Y	S&P 500	*	30%	0.98	0.04	1.11	0.05	0.71		0.80		
COGNIZANT TECH-A	US	N	Y	Y	S&P 500		2%	1.14	0.04	1.29	0.05	1.12	*	1.27		*
XEROX CORP	US	N	Y	Y	S&P 500	*	41%	1.19	0.05	1.38	0.06	0.74		0.85		
INDRA SISTEMAS	SP	Y	Y	Y	FTSE All Europe	*	40%	0.98	0.05	1.17	0.08	0.63		0.74		✓
CANCOM AG	GE	Y	Y	Y	FTSE All Europe	*	7%	0.98	0.06	1.34	0.08	0.92	*	1.25	*	✓
ATOS SE	FR	Y	Y	Y	FTSE All Europe		13%	0.97	0.04	1.12	0.07	0.86		0.99		✓
SOPRA STERIA GRO	FR	N	Y	Y	FTSE All Europe		25%	0.82	0.06	1.01	0.08	0.64		0.79		
CAP GEMINI	FR	N	Y	Y	FTSE All Europe	*	17%	1.07	0.03	1.23	0.06	0.90		1.03		*
TIETO OYJ	FI	N	Y	Y	FTSE All Europe	*	9%	0.71	0.04	0.77	0.06	0.66	*	0.71		*
CGI GROUP INC-A	CA	N	Y	Y	S&P/TSX Composite	*	12%	0.72	0.05	0.72	0.05	0.65		0.65		
Average (Jan 19)																
Tier 1							19%	0.99		1.16		0.80		0.93		
Tier 2 (all comparators)							19%	0.97		1.11		0.79		0.90		
Average (Jul 18)																
Tier 1							18%	0.97		1.12		0.80		0.92		
Tier 2 (all comparators)							19%	0.95		1.07		0.77		0.87		

*Notes: Cut-off date is 31 January 2019; daily data; five-year estimation window; *GLS reported where regression diagnostics show heteroscedasticity or autocorrelation.*
Source: NERA analysis based on Bloomberg data.

2.4.2.   Discussion of ICT asset beta results

In this section, we discuss the asset beta results for BT and ICT comparators estimated in the previous section.

Table 2.15 and Table 2.16 summarise the 2-year and 5-year asset beta ranges for BT and ICT comparators, estimated against the FTSE All World and the local/regional indices, respectively. As explained in Appendix A, we put relatively more weight on the asset betas for ICT comparators estimated against the world index, as we are comparing beta estimates of companies that operate in different jurisdictions and under different regulatory regimes.

Table 2.15: ICT Comparators Asset Beta Ranges Against FTSE All World

Comparators	2Y (Jul 18)	2Y (Jan 19)	5Y (Jul 18)	5Y (Jan 19)
BT	0.38	0.20	0.68	0.57
ICT - Tier 1	0.56-1.19	0.64-1.52	0.77-1.22	0.74-1.25
ICT - Tier 2 (all comparators)	**0.56-1.19**	**0.61-1.52**	**0.61-1.25**	**0.65-1.27**

Notes: Cut-off date is 31 January 2019.
Source: NERA analysis based on Bloomberg data.

Table 2.16: ICT Comparators Asset Beta Ranges Against Local/Regional Indices

Comparators	2Y (Jul 18)	2Y (Jan 19)	5Y (Jul 18)	5Y (Jan 19)
BT	0.51	0.46	0.71	0.68
ICT - Tier 1	0.26-0.74	0.31-0.77	0.64-0.95	0.63-0.92
ICT - Tier 2 (all comparators)	**0.26-0.86**	**0.31-0.94**	**0.57-1.15**	**0.63-1.12**

Notes: Cut-off date is 31 January 2019.
Source: NERA analysis based on Bloomberg data.

Overall, we see that both 2-year and 5-year asset betas have increased for the ICT comparators when estimated against the world index, contrary to the observed declines in UK comparators' and European Telecoms comparators' asset betas discussed in Sections 2.2.3 and 2.3.3.

The 2-year asset beta range for ICT comparators against the FTSE All World has increased considerably from 0.56-1.19 using July 2018 cut-off to 0.61-1.52 using January 2019 cut-off, with the average asset beta increasing from 0.79 to 0.92. [18] We also observe an increase in the 5-year asset betas, where the range increased slightly from 0.61-1.25 using July 2018 cut-off to 0.65-1.27 using January 2019 cut-off, and a slight increase in the average since July 2018 from 0.87 to 0.90. These increases have mostly been driven by increases in correlations with the market. Moreover, for the European stocks, we also see considerable increases in stock volatility, which contributes to the higher asset beta increases compared to other comparators.

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[18]   When we refer to "ICT comparators" we are referring to the full set of ICT comparators, i.e. ICT Tier 2.

The changes in asset betas when regressed against the local/regional indices are broadly similar.

When estimated against the world index, BT's asset beta is below the lower end of the asset beta range for ICT comparators for both the 2-year (0.2 vs 0.61-1.52) and a 5-year (0.57 vs 0.65-1.27) estimation window. When estimated against a local/regional index, BT's asset beta lies toward the bottom end of the range for ICT comparators, (0.46 vs 0.31-0.94 on a 2-year basis and 0.68 vs 0.63-1.12 on a 5-year basis).

Similarly to the results for UK and European comparators, the confidence intervals for the 2-year asset beta estimates are considerably wider than the confidence intervals for 5-year asset betas, as shown in Appendix B.

3. Gearing

In this section, we analyse changes in gearing for BT and the UK and EU comparators to assess the appropriateness of Ofcom's gearing range of 25 to 50 per cent for BT included in the Ofcom's 2018 BCMR Consultation.[19]

3.1. UK Utilities and UK Telecoms

Figure 3.1 shows the evolution of gearing (spot) for BT, UK Utilities and UK Telecoms comparators over the period from January 2014 to January 2019.

Figure 3.1: BT and UK Telecoms / Utilities Gearing
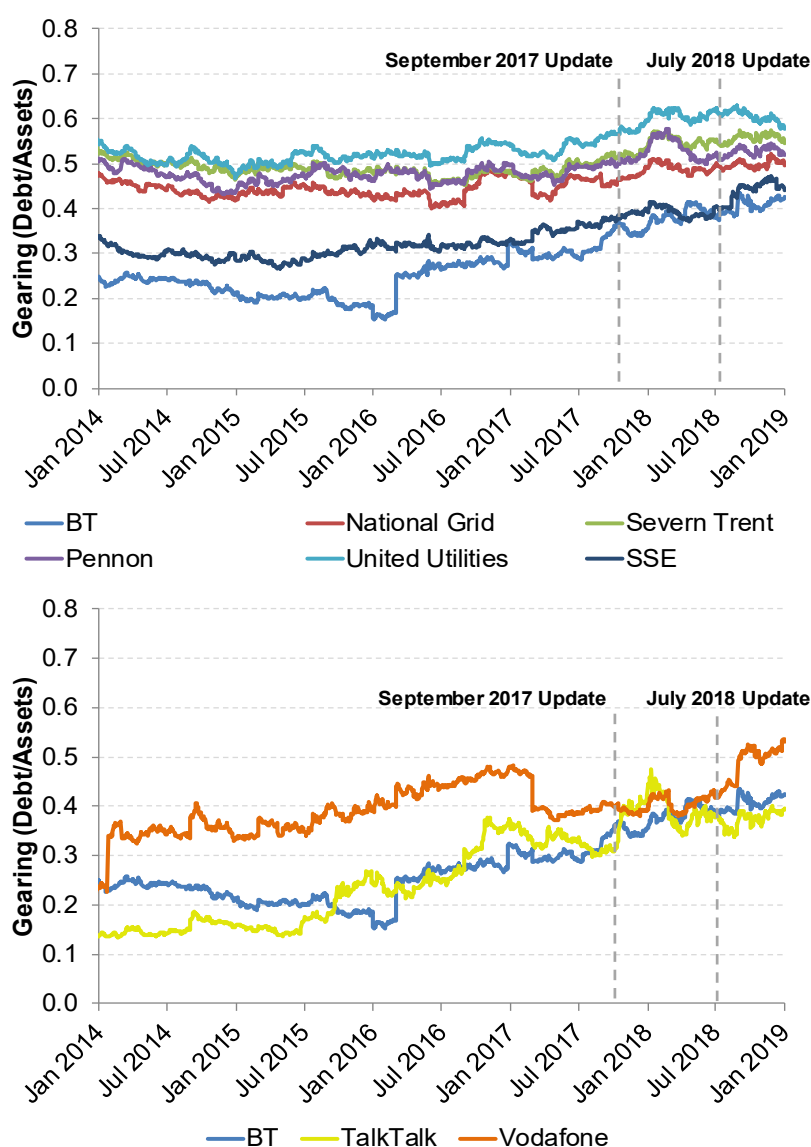
Notes: Cut-off date is 31 January 2019; daily data.
Source: NERA analysis based on Bloomberg data.

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19   Ofcom (19 December 2018), Business connectivity market review, Annex 21, pp.226 and 227.

Table 3.1 shows the latest estimates of spot gearing levels for BT and UK comparators, as well as the latest 1-year average, which allows us to smooth out the volatility of a single day estimate.

Table 3.1: BT and UK Comparators Gearing Levels

Comparators	1Y Avg (Jul 18)	1Y Avg (Jan 19)	Spot (Jul 18)	Spot (Jan 19)
BT	37%	40%	40%	43%
UK Utilities (excl. SSE)	48%-59%	50%-61%	48%-62%	50%-58%
UK Telecoms	37%-40%	38%-45%	38%-43%	40%-53%

Note: Cut-off date is 31 January 2019.
Source: NERA analysis based on Bloomberg data.

As shown in Figure 3.1, BT's spot gearing has exhibited an upward trend since 2016 and is currently around 43 per cent, up from the 40 per cent estimate using the July 2018 cut-off date.[20] The 1-year average gearing exhibits a similar pattern, with the current 1-year average standing at 40 per cent, slightly higher than the 37 per cent calculated in July 2018.

The gearing of UK utilities (excluding SSE) has remained broadly similar to the level in July 2018 and remains 10 to 20 percentage points above the gearing levels of BT.

The upper bound of the gearing range of UK Telecoms comparators has increased compared to July 2018, due to an increase in gearing for Vodafone, which increased its debt to fund the acquisition of Liberty Global.[21, 22]

3.2. European Telecoms

Figure 3.2 shows evolution of gearing (spot) for BT and the European Telecoms comparators over the period January 2014 to January 2019.

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[20] 2016 debt increase due to acquisition of EE and associated debt (as per BT's 2016 annual report p.102); subsequent increases in D/E a result of the falling share price since early 2017.

[21] Source: FactSet.

[22] On a net debt basis, Vodafone's debt did not change considerably.

Figure 3.2: BT and European Telecoms Gearing
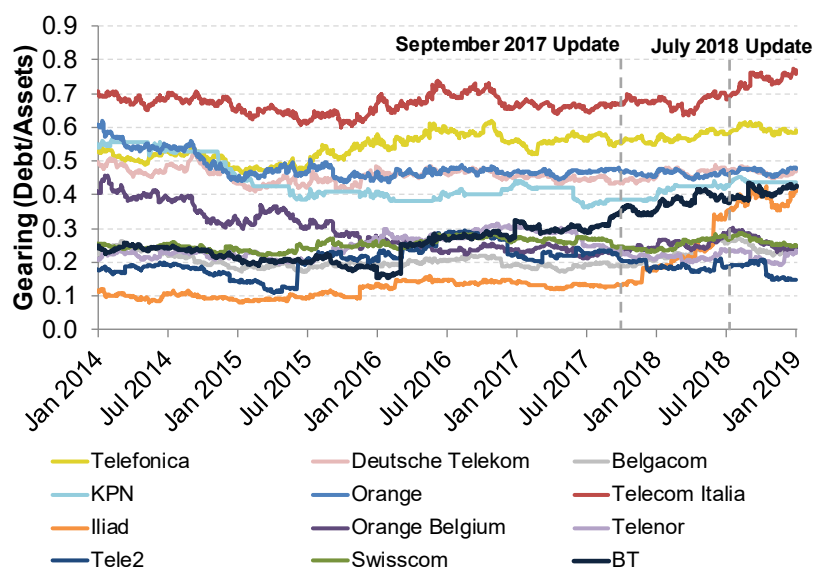
Notes: Cut-off date is 31 January 2019; daily data.
Source: NERA analysis based on Bloomberg data.

Table 3.2 shows the latest estimates of (spot) gearing levels for BT and European Telecoms comparators, as well as the latest 1-year averages.

Table 3.2: BT and European Telecoms Gearing Levels

Comparators	1Y Avg (Jul 18)	1Y Avg (Jan 19)	Spot (Jul 18)	Spot (Jan 19)
BT	37%	40%	40%	43%
European Telecoms	18%-67%	18%-71%	18%-72%	15%-76%
European Telecoms (excl. Telecom Italia)	18%-57%	18%-58%	18%-59%	15%-59%

Note: Cut-off date is 31 January 2019.
Source: NERA analysis based on Bloomberg data.

Overall, gearing for the European Telecoms comparator set has not changed significantly since July 2018, most notably when we look at the 1-year average excluding Telecom Italia, which is the only European Telecoms comparator that does not have an investment grade credit rating.[23] BT's actual gearing remains around the mid-point of the European Telecoms comparators gearing range.

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[23]   We expect the sub-investment grade rating to be at least partially driven by its high gearing, compared to the rest of the sample. See Telecom Italia Group Website (2019), Investors – Rating, link: http://www.telecomitalia.com/tit/en/investors/financial-profile/rating.html.

4. Response to Issues Raised by Stakeholders on Ofcom's BCMR Consultation

In this section we address the issues raised by TalkTalk and BT in their submissions to Ofcom in response to Ofcom's 2018 BCMR Consultation.

4.1. The Use of 5-year Betas When Setting an Indicative Asset Beta Range (TalkTalk and BT)

4.1.1. TalkTalk's position on the estimation window to use

In its report, TalkTalk considers that 2-year asset beta estimates should be used for the purposes of setting the cost of capital for leased lines. TalkTalk argues that given that a further referendum on the membership of the EU is not expected, weight should be placed on an estimation window which excludes the observations around the referendum date, but which reflects the subsequent changes in market expectations after the referendum. Moreover, TalkTalk argues that changing from 2-years to 5-years betas would add to regulatory uncertainty.[24]

4.1.2. BT's comment on 5-year betas

BT agrees with the use of 5-year asset betas to account for the current uncertainty surrounding more recent market information. BT further notes that given UK-focussed companies underperformed the FTSE All Share following the depreciation of sterling after the EU referendum, which was accompanied by a reduction in betas, it follows that if the sterling were to appreciate in the next few years, UK-focused companies would outperform the FTSE All Share, and their betas would increase. As a result, Ofcom should account for this risk of future changes by allowing a degree of headroom above the mid-point of its estimated beta range.[25]

4.1.3. NERA's response

In our October 2018 report, we recommended to place weight on the 5-year estimates in setting the asset beta for leased lines. As we explained, due to ongoing uncertainty around Brexit, the standard errors of the 2-year asset beta estimates increased considerably relative to our previous estimates from 2017, resulting in a substantial widening of the confidence intervals for the 2-year asset beta estimates. In contrast, we showed that 5-year asset betas exhibit substantially narrower confidence intervals, due to being less affected by the recent increase on standard errors and relying on more observations, resulting in more statistically robust estimates. Due to the ongoing uncertainty around Brexit and how it would affect BT and other UK companies going forward, we recommended placing weight on the 5-year beta estimates, which captures both the time before the Brexit referendum and the time after, with approximately equal weight on both, whereas the two-year estimation window captures the period after the referendum.[26]

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[24]   TalkTalk (January 2019), Business Connectivity Market Review, TalkTalk submission, pp.73 and 74.

[25]   BT (25 January 2019), Response to Ofcom's consultations on the Physical Infrastructure and the Business Connectivity Markets, Annexes 2-6, pp.17-18.

[26]   NERA (11 October 2018), Cost of Capital: Beta and Gearing for the 2019 BCMR, Section 5, pp.51 and 52.

As shown in Appendix B, the confidence intervals for the updated asset beta estimates presented in this report continue to be substantially wider for the 2-year estimation window compared to the 5-year estimation window, likely due to the prevailing uncertainty around Brexit, which continues to justify placing weight on the 5-year asset beta estimates.

We note that in our October 2018 report, we considered that the effect of the EU referendum may not represent a one-off effect, but instead may have led to a change in market fundamentals which would continue to affect the betas even after the single day observations fell out of the estimation window. However, given it remains unclear how Brexit will proceed and whether the market fundamentals (including the change rate) would change back to "normal", we recommended putting weight on the 5-year betas because these included observations from both periods: before and after the EU referendum.[27] We consider our recommendation remains appropriate.

In summary, the updated asset beta results continue to support our recommendation to place weight on 5-year asset betas, to account for the higher standard errors of the 2-year asset betas and the uncertainty associated with Brexit.

4.2. Comparators Used for Setting BT's Gearing (TalkTalk)

4.2.1. TalkTalk's recommended gearing comparators

TalkTalk does not agree with the use of TalkTalk's and Sky's gearing to inform the gearing of Openreach, as it considers that they face different systematic risks. It further suggests the notional gearing should be aligned with other UK regulated sectors and more weight should be placed on companies like Telefonica and Deutsche Telekom, given their size and credit rating comparability with BT.[28]

4.2.2. NERA's response

In our assessment of the gearing presented in our October 2018 report, we did not put weight on any particular comparator (such as Sky or TalkTalk), but instead considered whether Ofcom's previous gearing range of 25 to 50 per cent was consistent with the evidence from the range of beta comparators. We found that the lower bound was consistent with a number of European telecoms comparators, while the upper bound was in line with the lower end of the utilities range, which we consider to be less risky than telecoms.[29] We therefore concluded that the gearing range set by Ofcom was consistent with broader market evidence from the relevant comparators.

TalkTalk also argues that two specific comparators should be favoured over the wider set of comparators to assess forward-looking gearing, but does not provide evidence why these two comparators should be selected from the wider sample. We consider that looking at the broad set of telecom comparators is a reasonable way to assess a forward-looking gearing range, as it provides an overall view of the gearing of relevant comparators, without singling out any specific firm.

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[27] NERA (11 October 2018), Cost of Capital: Beta and Gearing for the 2019 BCMR, Section 5, Appendix A.

[28] TalkTalk (January 2019), Business Connectivity Market Review, TalkTalk submission, pp.74-76.

[29] NERA (11 October 2018), Cost of Capital: Beta and Gearing for the 2019 BCMR, Section 6.

4.3. Relative Risk Assessment of Leased Lines (TalkTalk and BT)

4.3.1. TalkTalk considers leased lines to be less risky than OUKT

TalkTalk considers that Ofcom should not continue to include leased lines in the Other UK Telecoms (OUKT) group, which includes BT's mobile network (EE) and a sports broadcaster (BT Sport), given leased lines are likely to face a lower systematic risk than these other business activities included in OUKT. It further considers that a beta for leased lines should be in line with betas for other regulated firm such as Heathrow Airport, NATS and Network rail. [30]

4.3.2. BT considers leased lines to be riskier than OUKT

In contrast, BT's view is that leased lines face higher systematic risk than the other activities in OUKT on the basis of:[31]

- Leased lines, which rely on fixed networks, having higher fixed and sunk costs (higher operational leverage) than mobile retail services (EE) and fixed retail services; and

- Leased lines being more exposed to volume risk than mobile networks, as their demand varies more with economic conditions.

4.3.3. NERA's response

In our October 2018 report[32], we concluded that there was no strong evidence that indicated leased lines were riskier or less risky than other business activities included in OUKT. We relied on evidence from our earlier reports for Ofcom as well as new evidence presented in our October 2018 report, as follows:

- In our March 2016 report for Ofcom, we found that empirical asset beta ranges for Pay TV were only slightly higher than asset beta ranges of telecoms comparators in general and that Pay TV ranges were relatively wide. This did not provide us with strong enough evidence to conclude BT's Pay TV business was substantially riskier than OUKT activities, including leased lines;[33]

- In our November 2017 report for Ofcom, we found no evidence of statistically significant differences in the betas of fixed vs mobile network telecoms operators.[34] Moreover, in our October 2018 report we also presented the shares of fixed lines activities for BT and other telecoms comparators, and did not find a clear relationship between the shares of fixed line activities and empirical asset betas. This led us to conclude there was no strong

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[30] TalkTalk (January 2019), Business Connectivity Market Review, TalkTalk submission, pp.76-78.

[31] BT (25 January 2019), Response to Ofcom's consultations on the Physical Infrastructure and the Business Connectivity Markets, Annexes 2-6, pp.18-20.

[32] NERA (11 October 2018), Cost of Capital: Beta and Gearing for the 2019 BCMR, Section 5, pp.47-50.

[33] NERA (March 2016), Update of the Equity Beta and Asset Beta for BT Group and Comparators – for Ofcom, Link: https://www.ofcom.org.uk/__data/assets/pdf_file/0028/97039/annex_31.pdf, p.44f.

[34] NERA (November 2017), The Evidence for Differences in Risk for Fixed vs Mobile Telecoms, Link: https://www.ofcom.org.uk/__data/assets/pdf_file/0020/112457/Annex-16-NERA-Report-The-Evidence-for-Differences-in-Risk-for-Fixed-vs-Mobile-Teleco.pdf, p.17.

evidence that mobile telecoms businesses had higher or lower systematic risk than fixed line businesses;[35]

▪ In our October 2018 report we conducted a relative risk analysis based on operational leverage and volume risk for leased lines against copper access and BT as a whole. While we found evidence supporting the view that copper access is likely to have lower systematic risk than leased lines, we found no strong evidence that leased lines had a significantly different exposure to systematic risk than OUKT activities.[36]

While both TalkTalk and BT point that leased lines are not exposed to the same level of systematic risk as activities in the OUKT group, neither of them provides strong evidence supporting those claims:

▪ TalkTalk states that OUKT is a group of several different activities, but provides no supporting evidence for the view that leased lines are less risky than those activities;

▪ TalkTalk further states that the beta for leased lines should be set in line with betas for other regulated entities such as Heathrow, NATS and Network rail based on demand risk, but provides no evidence to support this assessment;

▪ BT's argument that leased lines have higher operational leverage is based on a qualitative argument and no data is provided to support this point.[37] Based on our analysis of available data in the October 2018 report, we concluded that there was no strong evidence that leased lines had higher or lower operational leverage than BT as a whole or OUKT;[38] and

▪ BT provides analysis of volume risk exposure by looking at variation of mobile revenues to UK's GDP.[39] However, it does not provide any quantitative analysis which shows that leased lines demand varies more than mobile demand and revenues.

In summary, we consider that our conclusions that there is no strong evidence that leased lines face higher or lower systematic risk than OUKT remains appropriate. Moreover, the fact that both stakeholders provide opposing views on the relative positioning of leased lines, supports our view that there is no conclusive evidence pointing in either direction.

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[35]   NERA (11 October 2018), Cost of Capital: Beta and Gearing for the 2019 BCMR, p.48.

[36]   NERA (11 October 2018), Cost of Capital: Beta and Gearing for the 2019 BCMR, pp.48-50.

[37]   BT (25 January 2019), Response to Ofcom's consultations on the Physical Infrastructure and the Business Connectivity Markets, Annexes 2-6, p.18, para 2.62.

[38]   Our previous analysis compared leased lines to BT. Ideally, we would want to compare leased lines to OUKT per se, but we do not have sufficient data to remove Openreach copper access and the "Rest of BT" components from the figures for BT. The conclusions we can draw based on this comparison are therefore limited.

[39]   BT (25 January 2019), Response to Ofcom's consultations on the Physical Infrastructure and the Business Connectivity Markets, Annexes 2-6, pp.18-19, paras 2.63 to 2.65.

4.4. The Correct Reference Index for Non-Euro Currency Comparators (BT)

4.4.1. BT's view on the reference index for non-euro currency comparators

BT considers that, out of the European Telecoms comparator sample, the asset betas for the three companies which are listed in countries which do not use the euro (Telenor, Swisscom and Tele2) should be estimated against a local index (Oslo Bors index, Swiss Market index and OMX Stockholm 30 index). By doing so, BT presents higher asset betas, which result in a higher range for the EU Telecoms comparators.[40]

4.4.2. NERA's response

In our view, the use of local indices for estimating betas can be problematic in the context of countries with smaller equity markets. In the CAPM framework, the beta measures the risk added by an asset to a diversified portfolio. Given that a local index is restricted to companies in that country, the use of a local market index for a country with a small equity market may not offer the required level of diversification for an investor.

In practice, the equity beta formula reflects the correlation of the stock with the market index. If a particular stock accounts for a considerable part of the market index, this will result in a high correlation of the stock with the market, due to the perfect correlation of the stock with itself. This would then be reflected in high asset betas, which would not be an indication of high exposure to systematic risk but rather a high representation of the stock in the overall market index. This is a particular issue for Telenor, the Norwegian company, whose asset beta increases considerably when estimated against the local index. Telenor accounts for almost 10 per cent of the Oslo Bors Index (the Norwegian market index), which explains the higher asset beta observed.[41]

As explained in our January 2018 report for Ofcom, we consider the FTSE All Europe index represents an appropriate benchmark index for estimating betas for comparators from EU/EEA countries, given the level of integration of EU/EEA markets including capital markets.[42] The use of a Europe-wide index also addresses the issue of a low diversification of a local index (in particular for Norway).

An alternative to using a Europe-wide index benchmark would be to exclude these comparators from the European Telecoms comparator set. In Table 4.1, we present the asset beta ranges with and without these three non-euro currency comparators. The only effect of removing the non-euro currency comparators is to reduce the upper bound of the 2-year asset beta range by around 0.13, but the 5-year asset beta range is unchanged.

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[40]   BT (25 January 2019), Response to Ofcom's consultations on the Physical Infrastructure and the Business Connectivity Markets, Annexes 2-6, pp.20-22.

[41]   Source: https://www.oslobors.no/ob_eng/markedsaktivitet/#/details/OBX.OSE/overview.

[42]   NERA (January 2018), Update of the Equity Beta and Asset Beta for BT Group and Comparators, Appendix B.2; Link: https://www.ofcom.org.uk/__data/assets/pdf_file/0017/111536/Draft-statement-annex-31.pdf.

Table 4.1: 2Y and 5Y Asset Beta Ranges With and Without Non-Euro Currency Comparators

	2Y Asset Beta	5Y Asset Beta
EU Telecoms (full set)	0.35-0.78	0.39-0.67
EU Telecoms (excl. non-euro)	0.35-0.65	0.39-0.67

Notes: Cut-off date is 31 January 2019; reference index is FTSE All Europe.
Source: NERA analysis.

5.   Summary and Conclusions

This section summarises the changes in the empirical beta estimates evidence since July 2018 used as a cut-off date in our October 2018 report, as well as our recommendations on the asset beta for BT's leased lines business.

Table 5.1 and Table 5.2 present the asset beta ranges for BT and comparator companies presented in our October 2018 report (estimated using a July 2018 cut-off date) and the updated ranges presented in this report (using a January 2019 cut-off date), estimated against the local/regional index and the world index respectively. As discussed in Appendix A, we prefer to use local/regional indices, given the evidence of "equity home bias". However, for ICT comparators (the full sample, i.e. Tier 2), we recommend putting more weight on asset betas estimated against the world index, as we are comparing companies that operate in different jurisdictions.

Table 5.1: BT and Comparators Asset Beta Ranges Against Local/Regional index

Comparators	2Y (Jul 18)	2Y (Jan 19)	5Y (Jul 18)	5Y (Jan 19)
BT	0.51	0.46	0.71	0.68
UK Utilities (excl. SSE)	0.36-0.45	0.33-0.41	0.38-0.41	0.38-0.40
UK Telecoms - TalkTalk	0.51	0.50	0.63	0.60
UK Telecoms - Vodafone	0.65	0.64	0.68	0.66
European Telecoms	0.40-0.74	0.35-0.78	0.39-0.66	0.39-0.67
ICT Tier 2 (full sample)	0.26-0.86	0.31-0.94	0.57-1.15	0.63-1.12

Notes: Cut-off date is 31 January 2019; daily data.
Source: NERA analysis based on Bloomberg data.

Table 5.2: BT and Comparators Asset Beta Ranges Against FTSE All World

Comparators	2Y (Jul 18)	2Y (Jan 19)	5Y (Jul 18)	5Y (Jan 19)
BT	0.38	0.20	0.68	0.57
UK Utilities (excl. SSE)	0.19-0.28	0.13-0.18	0.32-0.35	0.28-0.31
UK Telecoms - TalkTalk	0.42	0.42	0.64	0.59
UK Telecoms - Vodafone	0.46	0.37	0.59	0.53
European Telecoms	0.38-0.63	0.22-0.65	0.43-0.74	0.40-0.75
ICT Tier 2 (full sample)	0.56-1.19	0.61-1.52	0.61-1.25	0.65-1.27

Notes: Cut-off date is 31 January 2019; daily data.
Source: NERA analysis based on Bloomberg data.

With regard to the **2-year asset betas**, our key conclusions from the updated empirical evidence are as follows:

▪ **BT**'s 2-year asset beta estimated against FTSE All Share has fallen from 0.51 in July 2018 to 0.46 in January 2019. The reduction is primarily driven by a lower correlation of the BT stock with the overall market, which may potentially be explained by a series of BT specific events, including BT's announcement of better than expected results in November 2018 and a new investor raising the possibility of spinning off Openreach;

- With regard to **UK telecoms comparators**, asset betas of both TalkTalk and Vodafone estimated against FTSE All Share have remained broadly unchanged since July 2018, with only a c. 0.01 decline for both. While in our October 2018 report, we concluded **BT**'s beta was at the lower bound of the **UK Telecoms** range (0.51 vs 0.51-0.65 in July 2018), the decrease in **BT**'s asset beta since July 2018 now places it below the **UK Telecoms** range (0.46 vs 0.5-0.64 in January 2019);

- The asset betas estimated against the FTSE All Share of **UK Utilities** have declined slightly from 0.36-0.45 in July 2018 to 0.33-0.41 January 2019, with the average asset beta falling by c.0.03. This reduction is likely to be to be driven by the defensive" nature of utility stocks in times of increased market volatility as well as on-going price control reviews in water and energy, which may have contributed to the decline in asset betas. Consistent with our October 2018 report, **BT**'s 2-year asset beta continues to lie above the **UK Utilities** asset beta range (0.46 vs 0.33-0.41 based on our January 2019 update);

- The **European Telecoms** asset beta range estimated against the FTSE All Europe has widened, from 0.4-0.74 in July 2018 to 0.35-0.78 in January 2019, although most comparators saw their asset betas decline over this period and the average beta for the comparator set has fallen by c.0.03. We find that **BT**'s 2-year asset beta continues to lie towards the bottom end of the **European Telecoms** asset beta range (0.46 vs 0.35-0.78 in January 2019 update);

- For the **ICT comparators** estimated against the FTSE All World, we find asset betas have increased for most of the comparators, with the overall range increasing from 0.56-1.19 in July 2018 to 0.61-1.52 in January 2019. As a result of these increases, **BT**'s 2-year asset beta now lies closer to the lower bound of the **ICT comparators** range (0.46 vs 0.31-0.94 based on our January 2019 update);

For the **5-year asset betas**, our key conclusions from the updated empirical evidence are as follows:

- The 5-year asset betas movements are generally in the same direction as those of the 2-year asset betas, but with a lower magnitude, which is not surprising given the longer estimation window and higher number of observations used;

- The ranges for the 5-year asset betas are generally narrower than the 2-year ranges;

- The 5-year asset betas are generally higher than the 2-year asset betas, with the exception of some of the ICT comparators, whose recent increases in volatility have led to higher 2-year asset betas, as recent observations have relatively more weight in a 2-year estimation window compared to a 5-year estimation window;

- When using a 5-year estimation window, BT's asset beta of 0.68 lies some way above the range for UK Utilities, close to that of UK Telecoms and EU Telecoms comparators, and towards the lower bound of the ICT comparators' asset beta range. [43]

In our October 2018 report we argued that it was prudent to place weight on the 5-year asset betas, as we had seen a considerable increase in the 2-year asset beta standard errors and, consequently, a widening in the 2-year asset betas confidence intervals due to ongoing

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[43] We note that when using a consistent index, FTSE All World, BT's 5-year asset beta of 0.57 lies close to the midpoint of the EU Telecoms range (0.40-0.75) and below the lower bound of the ICT comparators range (0.65-1.27).

uncertainty around Brexit. As discussed in section 4.1, TalkTalk had recommended relying only on 2-year asset betas due to changes in market expectations following the EU referendum, while BT supported 5-year betas, but argued that risk around changes in exchange rate warrants an estimate above a mid-point. Having updated the confidence intervals for our comparator set, as shown in Appendix B and discussed in section 4.1, we find that the 2-year confidence intervals remain wider in the most recent period after the EU referendum, while the 5-year confidence intervals are considerably narrower. Given the ongoing uncertainty regarding Brexit and whether market fundamentals (including the change rate) would change back to "normal", we recommended putting weight on the 5-year betas, which reflect observations from both periods: before and after the EU referendum. Thus, we recommend continuing to put weight on the **5-year asset beta** results.

A further point raised by the stakeholders was whether leased lines faced higher or lower risk than other activities in the OUKT segment. Having reviewed the arguments presented by both stakeholders, we do not find them to provide a basis for moving away from our October 2018 report conclusions: There is no conclusive evidence pointing to a higher/lower systematic risk faced by leased lines relative to OUKT activities. Moreover, the fact that the stakeholders provide opposing views on the relative risk of leased lines supports the view that it is not clear that leased lines have a different exposure to systematic risk than OUKT.

We have also considered the responses to Ofcom's 2018 BCMR Consultation provided by stakeholders on the topic of beta estimation and gearing and conclude the following:

- We consider it remains appropriate to place weight on 5-year asset beta estimates, to account for the higher standard errors of the 2-year asset betas and the ongoing uncertainty associated with the impact of Brexit going forward.

- We confirm our conclusions from our October 2018 report that we find no strong evidence that leased lines face a higher or lower systematic risk than OUKT.

- We consider it is appropriate to estimate asset betas for European Telecoms comparators operating in countries which do not use the euro currency using the European index as the benchmark index.

- We consider that it is appropriate to set a forward-looking gearing for BT by looking at the wider set of telecom comparators, while gearing for UK utilities should be considered as an upper bound only, given utilities face lower risk exposure compared to telecoms.

Given the above evidence, we conclude that there is no strong evidence for changing the OUKT asset beta range proposed by Ofcom in its 2018 BCMR Consultation of 0.55 to 0.75, as most betas have not changed significantly since July 2018, the cut-off date used in our October 2018 report.[44] However, given that we observe slight reductions in both 2-year and 5-year asset betas for all comparator sets with the exception of the ICT comparators we would not recommend using an asset beta in the upper part of the range.

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[44] Ofcom (19 December 2018), Business connectivity market review, Annex 21, p.237.

Given limited changes in gearing for BT and its comparators, we conclude that the forward-looking gearing range of 25 to 50 per cent proposed by Ofcom in the 2018 BCMR Consultation remains appropriate.[45]

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[45]   Ofcom (19 December 2018), Business connectivity market review, Annex 21, pp.226 and 227.

Appendix A.   Methodology

In this section, we present our methodology for estimating equity and asset betas. We generally rely on the same methodology as in our October 2018 report and other previous reports for Ofcom such as the one prepared in the context of the 2018 WLA review.[46]

Comparator selection

We calculate betas for four comparator groups, which comprise the same companies as presented in our previous reports:

1. UK Utilities;

2. UK Telecoms;

3. European Telecoms; and

4. ICT companies.

In previous reports we have also reported beta estimates for Sky. In our October 2018 report, we pointed out that Sky was involved in a takeover battle, which made its beta estimate less relevant as a comparator. Sky was acquired on 9th October 2018 by Comcast and delisted on 7 November 2018.[47] For this reason, we exclude Sky from our UK Telecoms comparator set. We note that in this report, "UK Telecoms" refers to the UK telecoms comparator sample, which does not include BT itself.

As in our October 2018 report, we have not reported the asset betas for US Telecoms as these operate under substantially different regulatory regimes and Ofcom placed little weight on the US Telecoms results in its 2018 WLA Statement.[48]

Data sourcing and frequency

For each of the four comparator groups listed above, we source data on stock returns, index returns and gearing from Bloomberg, using 31 January 2019 as the cut-off date.

Our preferred approach is to use daily log-returns to estimate company betas (as opposed to less granular, i.e. weekly or monthly data). The benefit of using daily data is that a greater number of data points are available for estimation, which increases the robustness of the regression results by lowering the standard errors. However, the use of daily data is only appropriate in the case of liquid stocks which trade with similar frequency as the average market portfolio. Liquid stocks are not likely to suffer from asynchronous trading biases that arise if there is a difference between the speed with which new information is reflected in the share price of the stock in question relative to the speed of assimilation of new information in

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[46] NERA (January 2018), Update of the Equity Beta and Asset Beta for BT Group and Comparators, Link: https://www.ofcom.org.uk/__data/assets/pdf_file/0017/111536/Draft-statement-annex-31.pdf
NERA (11 October 2018), Cost of Capital: Beta and Gearing for the 2019 BCMR.

[47] London Stock Exchange (9 October 2018), Sky plc ("Sky") Cancellation of Listing and Directorate Changes; link: https://www.londonstockexchange.com/exchange/news/market-news/market-news-detail/SKY/13822214.html

[48] Ofcom (28 March 2018), Wholesale local access market review – statement.

the stock market as a whole. Since both BT and the comparator sets are liquid, we prefer to use daily data.[49] In this report, the beta estimates we refer to are daily beta estimates.

Estimation window

We estimate betas for three estimation windows: 1 year, 2 years, and 5 years.

Since the risk profile of a company can change over time, the time horizon over which the beta is measured can be a key driver of the beta estimate. A short-run average is more likely to reflect current systematic risk and may be more appropriate if a company's activities or the regulatory system have changed recently such that estimates based on longer averaging periods may not reflect the current riskiness of the business or the regulatory regime.

On the other hand, a longer estimation window provides two key benefits:

- **Greater reliability of the beta estimate**: Using a longer estimation window provides more data points for estimating the beta than using a short-run average. This increases the statistical reliability of the beta estimate.

- **Less volatile beta estimate**: Using a longer estimation window means that the beta estimate is less affected by single one-off market events. The beta estimate exhibits less volatility than a short-run estimate, providing greater regulatory stability and certainty.

In our October 2018 report, we recommended placing weight on the 5-year beta estimates due to the significant increase in standard errors for the 2-year asset betas following the referendum on the membership of the EU, which lead to a considerable widening of the 2-year confidence intervals. As shown in Appendix B, it remains the case that 5-year confidence intervals are considerably narrower than the 2-year confidence intervals. We therefore continue to recommend putting weight on the 5-year asset beta estimates.

Reference index

From an investor's perspective, the cost of capital should be estimated with reference to the financial market that best represents their investment opportunity set, as the cost of capital for any single investment is defined by the entire portfolio of investment opportunities to which an investor has access. This "set" is commonly referred to as the "market portfolio".

The appropriate reference market index depends on the level of integration of individual capital markets. Despite wider global integration across financial markets in recent years, the academic literature still finds a general consensus that equity markets are less integrated than bond or money markets, and that there is still a significant "equity home bias", i.e. the observation that equity investors have a preference for domestic assets, despite the wider benefits of diversification.[50] Such bias would suggest that systematic risk, as quantified by

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[49] To test liquidity, we use the average bid-ask spread for each stock over a 2-year period and check whether that exceeds the threshold of 1 per cent. All stocks considered in this sample are liquid.

[50] See for example: Carrieri, Francesca, Ines Chaieb and Vihang Errunza, (2013), *"Do Implicit Barriers Matter for Globalization?",* Review of Financial Studies, vol 26, no 7, p1694 – 1793; Schmidt et al (2011). See Peter S. Schmidt, Urs von Arx, Andreas Schrimpf, Alexander F. Wagner, Andreas Ziegler (2011), *"On the Construction of Common Size, Value and Momentum Factors in International Stock Markets: A Guide with Applications",* Working Paper No. 670, National Centre of Competence in Research Financial Valuation and Risk Management.

the asset beta parameter, is more appropriately captured by the stock correlations with a domestic or regional market portfolio.

In this report, we report beta estimates against the relevant local/regional indices and also against a world index to allow for comparisons. More specifically, we use the following local/regional market indices:

▪ the FTSE All-Share reflecting all stocks trading on the London Stock Exchange, used to estimate betas for UK comparators;

▪ the FTSE All Europe, reflecting stocks traded in Europe, used to estimate betas for European comparators;

▪ the S&P 500, a US stock index used to estimate betas for ICT comparators located in the US; and

▪ the S&P/TSX Composite, a broad index of major stocks traded on the Toronto Stock Exchange for ICT comparators located in Canada.[51]

Due to the "equity home bias" discussed above, we consider the local/regional index to produce more relevant estimates of beta risk, while also noting that UK regulators, including Ofcom, have generally used domestic indices when setting price controls.[52] However, in comparing betas for companies from different jurisdictions, Ofcom may also want to consider using a consistent index for all companies, i.e. the FTSE All World index.[53] Using a world index reflects the systematic risk contribution of the given stock to a globally diversified portfolio, available to international investors with free access to stocks from all jurisdictions.[54] For this reason, we place more weight on the results against the world index for the ICT comparator sample, which includes companies operating in Europe, the US, and Canada.

Statistical testing of CAPM assumptions

The Ordinary Least Squares (OLS) method is generally the most widely used method for estimating CAPM betas, under the Classical Normal Linear Regression Model (CNLRM). However, this method is based on a set of assumptions, which when violated, results in

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[51] For more information on the S&P/TSX Composite see S&P Dow Jones Indices, *S&P/TSX Canadian Indices Methodology*, link: https://us.spindices.com/documents/methodologies/methodology-sp-tsx-canadian-indices.pdf.

[52] As examples: the CMA in its Final Determination for Northern Ireland Electricity used the FTSE All Share Index as a proxy for the market portfolio when estimating equity beta for GB utility comparators. (Source: Competition Commission (March 2014), Northern Ireland Electricity Limited Price Determination – A reference under Article 15 of the Electricity (Northern Ireland) Order 1992, Final determination, Appendix 13.3). Similarly, the most recent Ofgem consultation for RIIO-2 relies equity beta estimates by Indepen, which were estimated against the FTSE All Share (Source: Ofgem (18 December 2018), RIIO-2 Sector Specific Methodology Annex: Finance, Section 3, p.39-40 and Indepen (December 2018), Ofgem Beta Study – RIIO-2 Final, Main Report, Section 5, p.45 and Appendices A to D).

[53] Denominated in US dollars.

[54] For example, a potential investor in telecoms stocks may compare BT's beta with that of Orange against a consistent world index to assess the relative riskiness of the two companies.

biased[55] and/or inefficient[56] (i.e. not minimum variance) beta estimates. We have visually inspected and formally tested the following key assumptions:[57]

- *The error terms of the regression are normally distributed around a zero mean value;*

- *The error terms are homoscedastic,* i.e. the error terms have constant variance across the sample; and

- *The error terms are not autocorrelated,* i.e. there is no systematic dependence across the error terms.

Failure of the normality assumption above can bias the beta estimates (e.g. if the distribution of the error term is not symmetric) and may require alternative methods of estimation which can capture non-normality (e.g. the Third-moment CAPM method). On the other hand, the presence of autocorrelation and /or heteroscedasticity does not bias the beta estimates, but affects the confidence intervals (and therefore statistical inferences) around those estimates.

As in our previous work for Ofcom, we carry out standard statistical tests to assess whether the statistical assumptions above are satisfied within the respective comparator samples. In the presence of heteroscedasticity and/or autocorrelation, we report estimates based on the Generalised Least Squares (GLS) method (whenever reported estimates are a result of GLS we insert "*" next to the sample window, i.e. 1Y*, 2Y* and 5Y*), an alternative estimation method to the standard OLS which can address both of these issues.[58]

Asset beta formula

Equity betas are affected not only by the underlying structural, systematic risk of the business but also by financial risk, which depends on the level of debt obligations incurred by the business. We de-lever equity betas to control for the embedded financial risk element and arrive at asset beta estimates that are comparable across companies with different capital structures. To de-lever the equity betas we use the standard Miller 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/Assets).

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[55]   In statistics, an unbiased estimate refers to the property that the sample statistic converges to its true "population" value in repeated samples.

[56]   In statistics, an efficient estimate is an estimate/sample statistic that has the minimum variance, i.e. lowest uncertainty surrounding that estimate/sample statistic.

[57]   See for example Damodar N. Gujarati and Dawn C. Porter: *Basic Economics*, Chapter 3 and 4. The model also includes the following assumptions: (1) the model is linear in the parameters (2) the errors and the independent variable (in this case the market return) are independent, i.e. have zero covariance; and (3) the number of observations is greater than the number of parameters to be estimated within the model.

[58]   See standard textbook on Damodar N. Gujarati and Dawn C. Porter: *Basic Economics*, Chapter 11.

Gearing

We calculate gearing, defined as the total (gross) value of debt to assets, based on data provided by Bloomberg, consistent with our approach in previous reports.[59]

Debt beta

As in our previous October 2018 report, we use a debt beta assumption of 0.1. In this report, all asset beta values quoted are calculated using a debt beta of 0.1, unless stated otherwise.

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[59]   Bloomberg provides gearing data based on the book value of debt and the market value of equity. Debt also includes finance leases. Cash is not netted off.

Appendix B.   Confidence Intervals for Beta Estimates

To assess the uncertainty around the updated beta estimates presented in this report, we calculate confidence intervals for each of our comparators, as shown in Figure B.1 to Figure B.3 below. These figures show the 95 per cent confidence intervals for the 2-year asset betas, and the 5-year asset betas estimated using the 31 January 2019 cut-off date. We show confidence intervals for the estimates based on our preferred reference indices (i.e. local/regional indices for utilities and telecoms, and the world index for ICT comparators).

We also present the 2-year confidence estimated using the 31 January 2019 cut-off relative to the estimates from our previous reports in 2017 and 2018, as shown in Figure B.4 to Figure B.6.

Overall, we find that:

▪ the 5-year confidence intervals are considerably narrower than the 2-year intervals. On the one hand, this is due to the longer estimation window, i.e. the larger number of observations which reduces the standard errors. On the other hand, this also reflects the fact that standard errors had been increasing since the Brexit referendum, which affects the 2-year estimates more than the 5-year estimates;

▪ in most cases, we find that the current 5-year point estimate lies within the current 2-year confidence interval; and

▪ the 2-year confidence intervals remain wider in the most recent period, reflecting the fact that standard errors had been increasing since the Brexit referendum.

Figure B.1: Confidence Intervals of Asset Beta Estimates for BT and UK Comparators
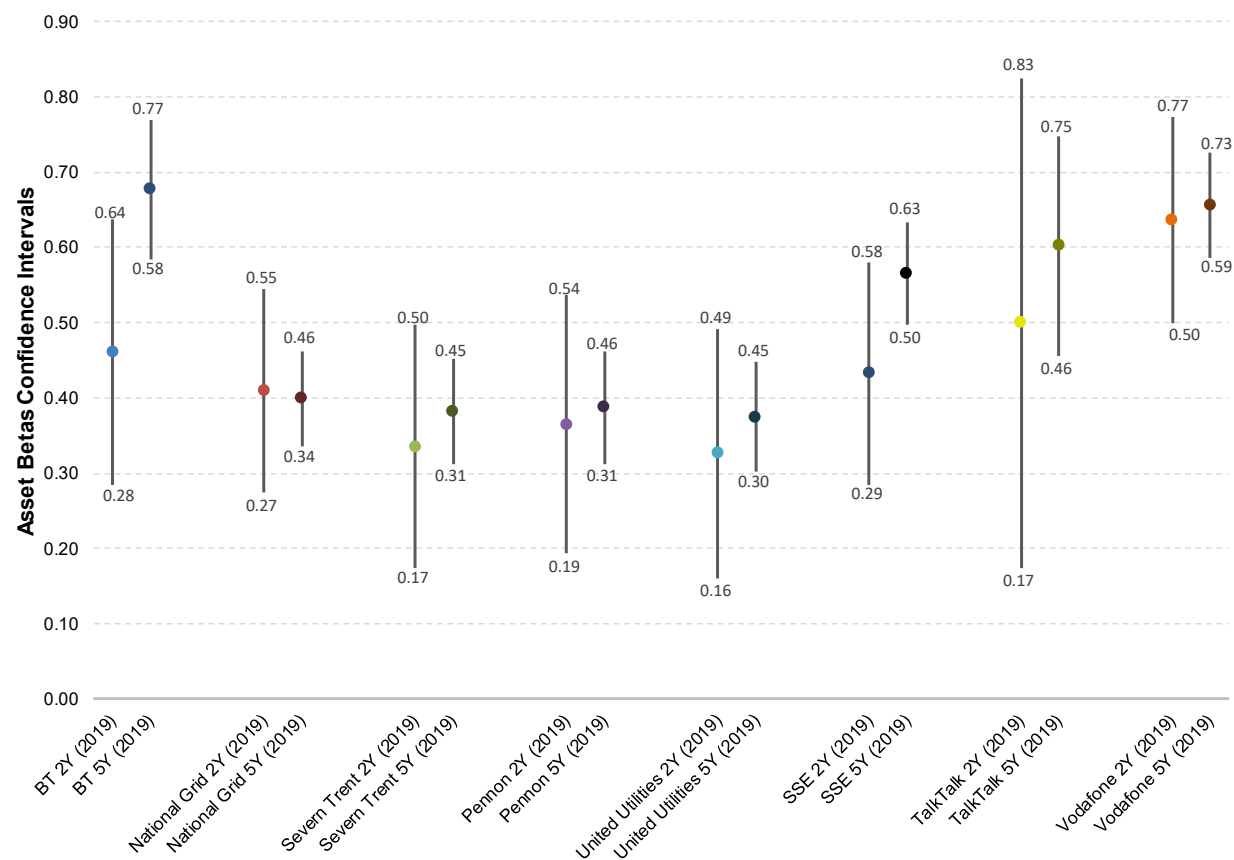
Notes: Cut-off date is 31 January 2019; daily data; 95 per cent confidence intervals; local/regional reference index (FTSE All Share).
Source: NERA analysis based on Bloomberg data.

Figure B.2: Confidence Intervals of Asset Beta Estimates for European Telecoms Comparators
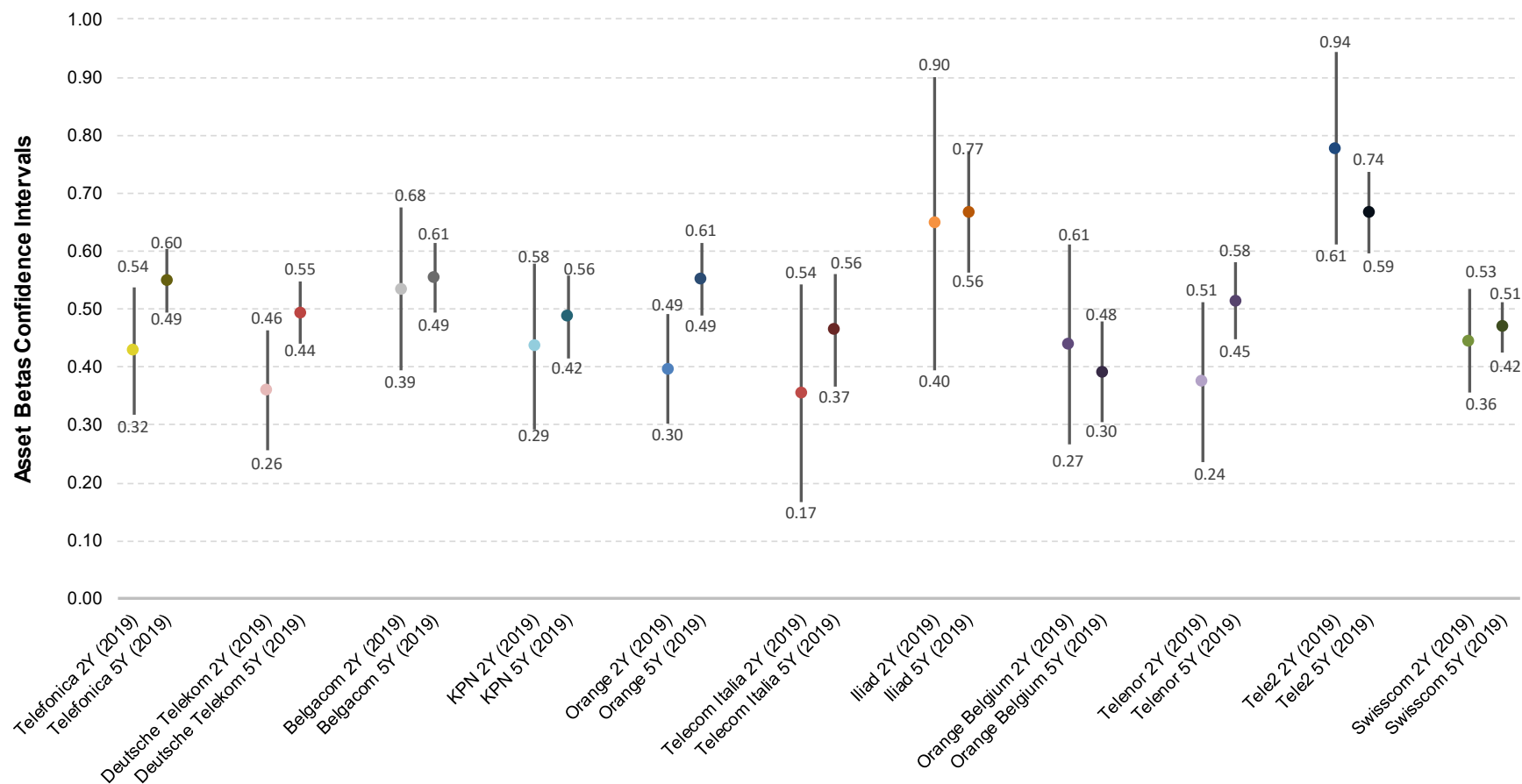
Notes: Cut-off date is 31 January 2019; daily data; 95 per cent confidence intervals; local/regional reference index (FTSE All Europe).
Source: NERA analysis based on Bloomberg data.

Figure B.3: Confidence Intervals of Asset Beta Estimates for ICT Comparators

Notes: Cut-off date is 31 January 2019; daily data; 95 per cent confidence intervals; global reference index (FTSE All World).
Source: NERA analysis based on Bloomberg data.

Figure B.4: 2-Year Confidence Intervals of Asset Beta Estimates for BT and UK Comparators

Notes: *Cut-off dates are 31 January 2019, 20 July 2018 and 29 September 2017; daily data; 95 per cent confidence intervals; local/regional reference index (FTSE All Share).*
Source: *NERA analysis based on Bloomberg data.*

Figure B.5: 2-Year Confidence Intervals of Asset Beta Estimates for European Telecoms Comparators
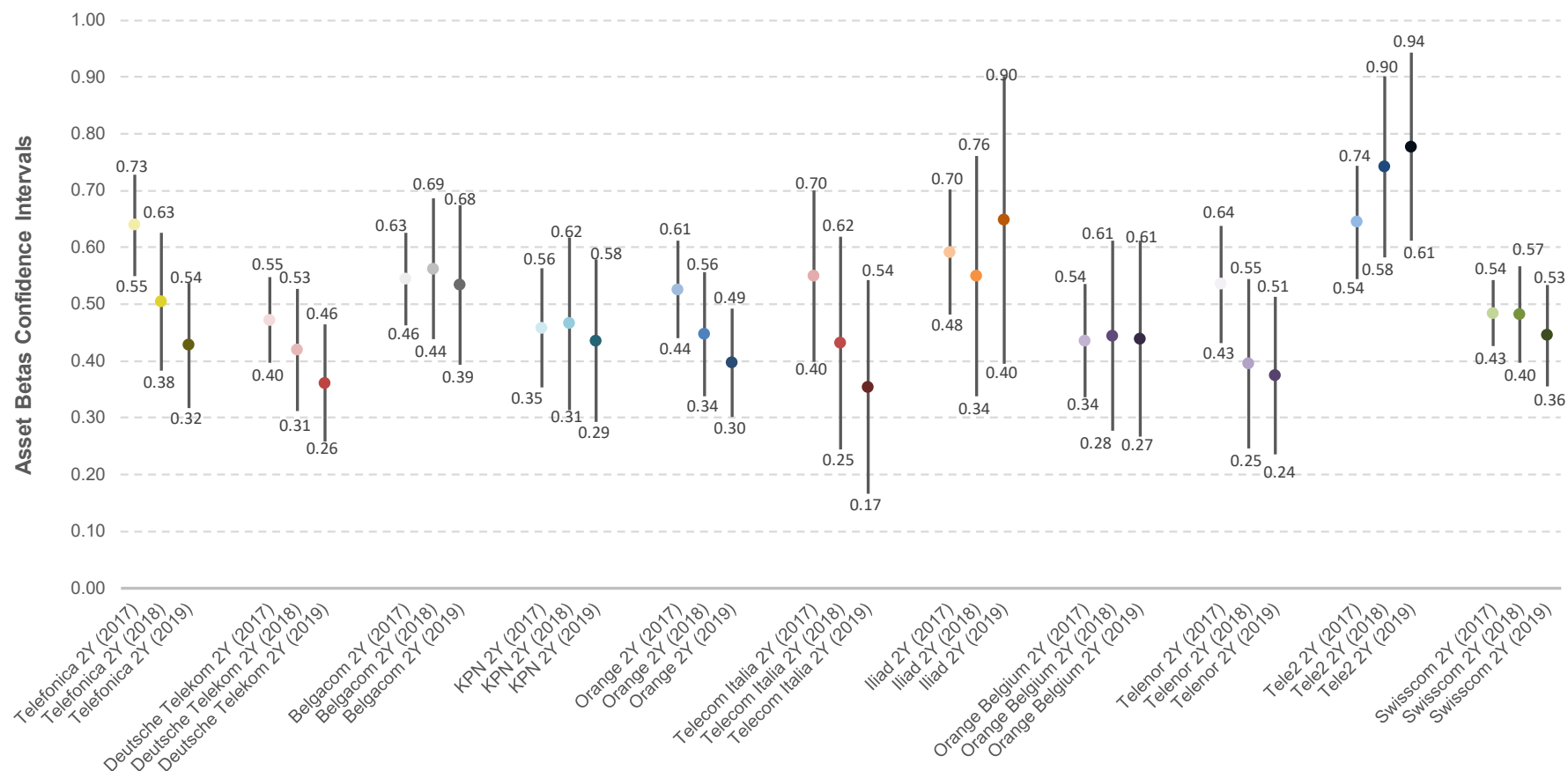
Notes: Cut-off dates are 31 January 2019, 20 July 2018 and 29 September 2017; daily data; 95 per cent confidence intervals; local/regional reference index (FTSE All Europe).
Source: NERA analysis based on Bloomberg data.

Figure B.6: 2-Year Confidence Intervals of Asset Beta Estimates for ICT Comparators
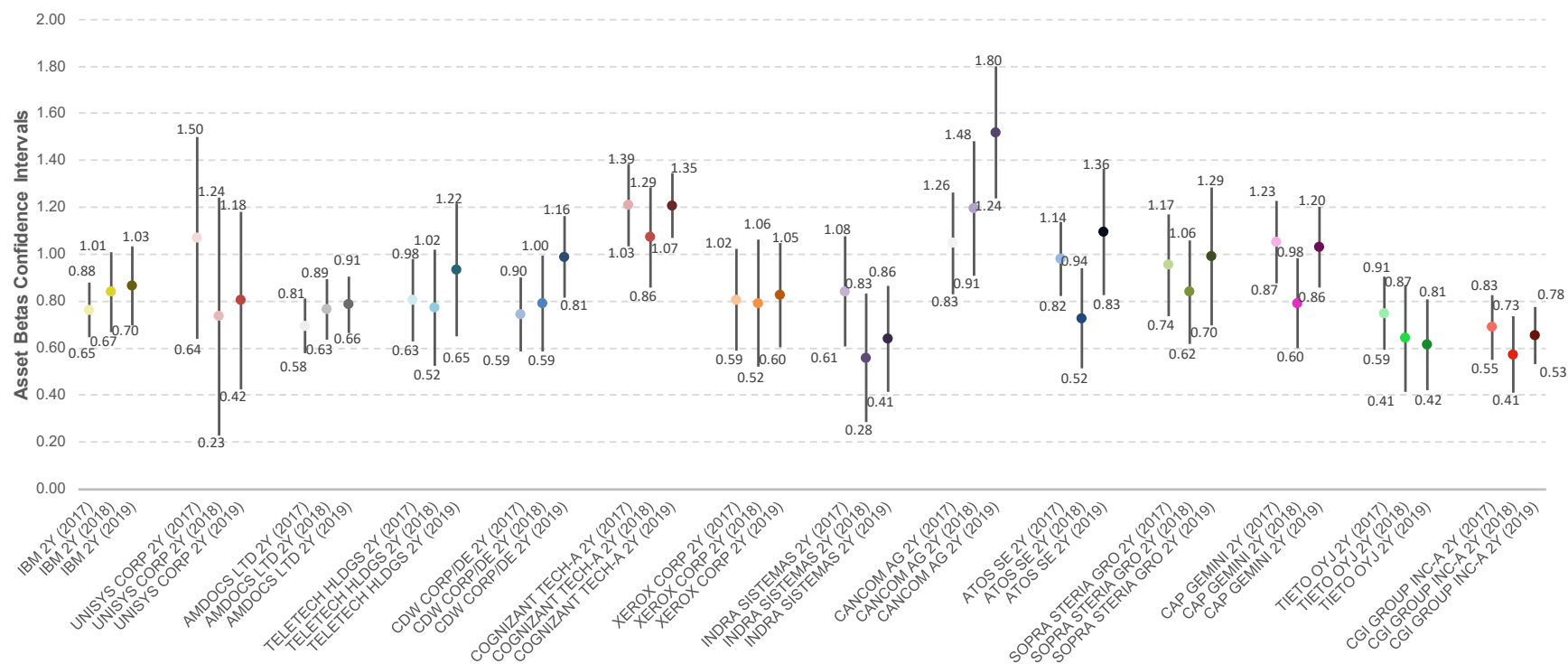
Notes: *Cut-off dates are 31 January 2019, 20 July 2018 and 29 September 2017; daily data; 95 per cent confidence intervals; global reference index (FTSE All World).*
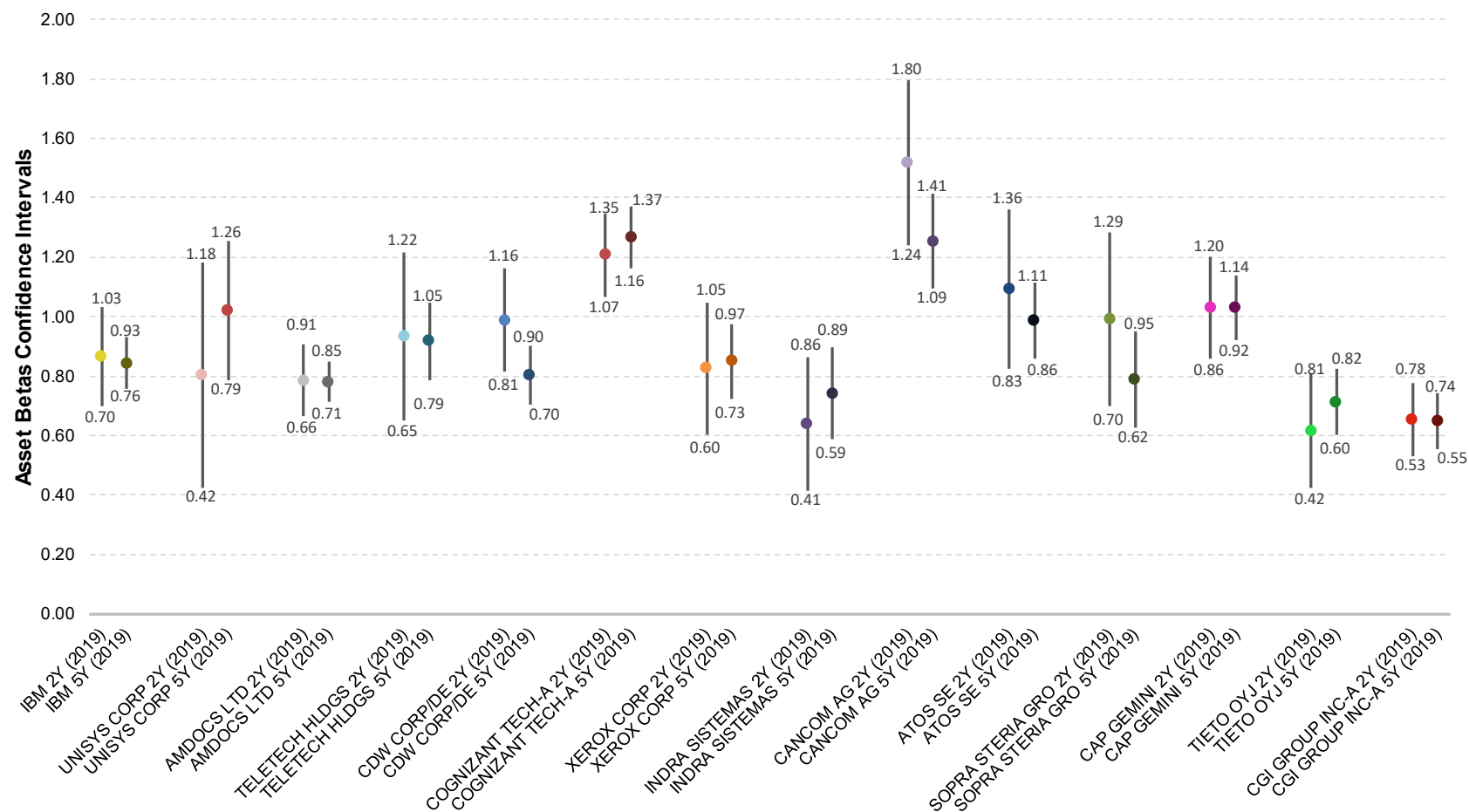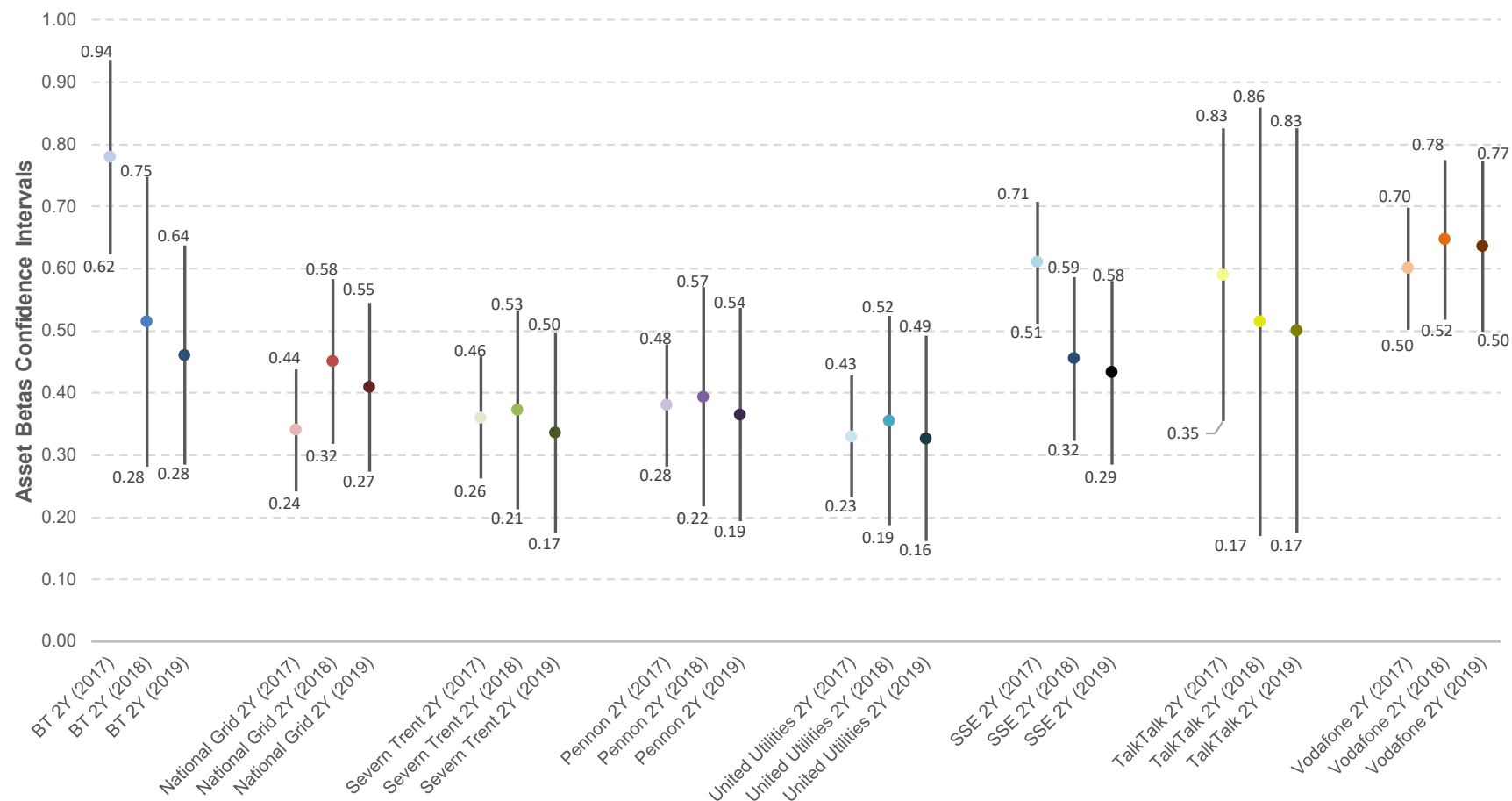Source: *NERA analysis based on Bloomberg data.*

Appendix C.   Equity and Asset betas Against FTSE All World

In this appendix, we present equity and asset beta estimates for UK and European comparators estimated against the FTSE All World instead of our preferred local/regional indices.

As shown in Table C.1 to Table C.4, we obtain the following results:

- BT's 2-year asset beta declined from 0.38 in July 2018 to 0.20 in January 2019. Its 5-year asset beta declined from 0.68 in July 2018 to 0.57 in January 2019;

- The 2-year asset beta range for UK Utilities (excl. SSE) has decreased from 0.19-0.28 in July 2018 to 0.13-0.18 in January 2019. The 5-year asset beta range declined from 0.32-0.35 in July 2018 to 0.28-0.31 in January 2019; and

- The 2-year asset beta range for UK Telecoms' decreased from 0.42-0.46 in July 2018 to 0.37-0.42 in January 2019. Its 5-year asset beta range declined 0.59-0.64 in July 2018 to 0.53-0.59 in January 2019.

The results for European Telecoms comparators are presented in Table C.5 and Table C.6. They show that the 2-year asset beta range for European Telecoms has widened from 0.38-0.63 in July 2018 to 0.22-0.65 in January 2019. The 5-year asset beta range for this comparator sample slightly widened from 0.43-0.74 in July 2018 to 0.4-0.75 in January 2019.

Table C.1: BT and UK Utilities Equity Beta Against the FTSE All World

		FTSE All World		
		OLS/GLS*		
		Beta (Jan 19)	SE (Jan 19)	Beta (Jul 18)
BT				
	1Y	0.19	0.13	0.52
	2Y*	0.26	0.10	0.52
	5Y*	0.76	0.06	0.89
National Grid				
	1Y	0.17	0.11	0.40
	2Y	0.19	0.08	0.38
	5Y*	0.44	0.04	0.51
Severn Trent				
	1Y	0.17	0.12	0.35
	2Y	0.19	0.09	0.35
	5Y*	0.51	0.05	0.59
Pennon				
	1Y	0.20	0.13	0.45
	2Y	0.27	0.10	0.46
	5Y*	0.51	0.05	0.59
United Utilities				
	1Y	0.13	0.13	0.26
	2Y	0.16	0.10	0.30
	5Y*	0.51	0.05	0.58
SSE				
	1Y	0.23	0.11	0.37
	2Y	0.22	0.09	0.35
	5Y*	0.69	0.05	0.75
Utilities average				
	1Y	**0.18**		**0.37**
	2Y	**0.21**		**0.37**
	5Y	**0.53**		**0.60**
Utilities average (excl. SSE)				
	1Y	**0.17**		**0.36**
	2Y	**0.20**		**0.37**
	5Y	**0.49**		**0.57**

Notes: Cut-off date is 31 January 2019; daily data.
Source: NERA analysis based on Bloomberg data.

Table C.2: BT and UK Telecoms Equity Beta Against the FTSE All World

		FTSE All World		
		OLS/GLS*		
		Beta (Jan 19)	SE (Jan 19)	Beta (Jul 18)
BT				
	1Y	0.19	0.13	0.52
	2Y*	0.26	0.10	0.52
	5Y*	0.76	0.06	0.89
TalkTalk				
	1Y*	0.75	0.20	0.85
	2Y*	0.60	0.18	0.60
	5Y*	0.78	0.09	0.82
Vodafone				
	1Y	0.53	0.12	0.74
	2Y	0.57	0.09	0.72
	5Y*	0.83	0.05	0.89
Telecoms average (excluding BT)				
	1Y	**0.64**		**0.79**
	2Y	**0.58**		**0.66**
	5Y	**0.80**		**0.86**

Notes: Cut-off date is 31 January 2019; daily data.
Source: NERA analysis based on Bloomberg data.

Table C.3: BT and UK Utilities Asset Betas Against the FTSE All World

		FTSE All World	
	Gearing (Jan 19)	Asset beta (Jan 19)	Asset beta (Jul 18)
		Debt beta=0.1	Debt beta=0.1
BT			
1Y	40%	0.15	0.37
2Y	36%	0.20	0.38
5Y	29%	0.57	0.68
National Grid			
1Y	50%	0.13	0.26
2Y	48%	0.15	0.25
5Y	46%	0.28	0.32
Severn Trent			
1Y	56%	0.13	0.22
2Y	53%	0.14	0.22
5Y	51%	0.30	0.34
Pennon			
1Y	53%	0.15	0.27
2Y	51%	0.18	0.28
5Y	49%	0.31	0.35
United Utilities			
1Y	61%	0.11	0.16
2Y	58%	0.13	0.19
5Y	54%	0.28	0.32
SSE			
1Y	42%	0.18	0.27
2Y	39%	0.17	0.26
5Y	34%	0.49	0.54
Utilities average			
1Y	52%	**0.14**	**0.23**
2Y	50%	**0.15**	**0.24**
5Y	47%	**0.33**	**0.37**
Utilities average (excl. SSE)			
1Y	55%	**0.13**	**0.23**
2Y	52%	**0.15**	**0.24**
5Y	50%	**0.29**	**0.33**

Notes: Cut-off date is 31 January 2019; daily data.
Source: NERA analysis based on Bloomberg data.

Table C.4: BT and UK Telecoms Asset Betas Against the FTSE All World

		FTSE All World		
		Gearing (Jan 19)	**Asset beta (Jan 19)**	**Asset beta (Jul 18)**
			Debt beta=0.1	**Debt beta=0.1**
BT				
	1Y	40%	0.15	0.37
	2Y	36%	0.20	0.38
	5Y	29%	0.57	0.68
TalkTalk				
	1Y	38%	0.50	0.57
	2Y	36%	0.42	0.42
	5Y	28%	0.59	0.64
Vodafone				
	1Y	45%	0.33	0.48
	2Y	43%	0.37	0.46
	5Y	41%	0.53	0.59
Telecoms average (excluding BT)				
	1Y	42%	**0.42**	**0.53**
	2Y	40%	**0.39**	**0.44**
	5Y	34%	**0.56**	**0.62**

Notes: Cut-off date is 31 January 2019; daily data.
Source: NERA analysis based on Bloomberg data.

Table C.5: BT and European Telecoms Equity Beta Against the FTSE All World

		FTSE All World		
		OLS/GLS*		
		Beta (Jan 19)	SE (Jan 19)	Beta (Jul 18)
BT				
	1Y	0.19	0.13	0.52
	2Y*	0.26	0.10	0.52
	5Y*	0.76	0.06	0.89
Telefonica				
	1Y	0.56	0.08	0.81
	2Y	0.70	0.07	1.04
	5Y*	1.26	0.05	1.40
Deutsche Telekom				
	1Y*	0.51	0.07	0.86
	2Y*	0.61	0.06	0.96
	5Y*	1.09	0.04	1.23
Belgacom				
	1Y	0.29	0.12	0.58
	2Y	0.41	0.09	0.63
	5Y*	0.71	0.05	0.79
KPN				
	1Y*	0.44	0.11	0.51
	2Y*	0.46	0.09	0.71
	5Y	0.88	0.06	0.94
Orange				
	1Y	0.38	0.07	0.66
	2Y*	0.51	0.06	0.78
	5Y*	1.05	0.05	1.20
Telecom Italia				
	1Y*	0.49	0.17	0.61
	2Y*	0.61	0.13	0.97
	5Y*	1.31	0.08	1.43
Iliad				
	1Y	0.78	0.23	0.74
	2Y	0.82	0.15	0.71
	5Y	0.89	0.08	0.84
Orange Belgium				
	1Y	0.38	0.14	0.62
	2Y	0.44	0.11	0.62
	5Y*	0.53	0.07	0.58
Telenor				
	1Y*	0.19	0.10	0.35
	2Y*	0.26	0.08	0.48
	5Y*	0.72	0.05	0.81
Tele2				
	1Y	0.50	0.14	0.62
	2Y	0.62	0.11	0.79
	5Y*	0.84	0.06	0.87
Swisscom				
	1Y	0.28	0.08	0.59
	2Y	0.35	0.06	0.60
	5Y*	0.63	0.04	0.71
EU Comparators Avg.				
	1Y	**0.44**		**0.63**
	2Y	**0.53**		**0.75**
	5Y	**0.90**		**0.98**

Notes: Cut-off date is 31 January 2019; daily data.
Source: NERA analysis based on Bloomberg data.

Table C.6: BT and European Telecoms Asset Beta Against the FTSE All World

		FTSE All World	
	Gearing (Jan 19)	Asset beta (Jan 19)	Asset beta (Jul 18)
		Debt beta=0.1	Debt beta=0.1
BT			
1Y	40%	0.15	0.37
2Y	36%	0.20	0.38
5Y	29%	0.57	0.68
Telefonica			
1Y	58%	0.29	0.40
2Y	57%	0.36	0.50
5Y	55%	0.62	0.69
Deutsche Telekom			
1Y	47%	0.32	0.51
2Y	46%	0.38	0.57
5Y	46%	0.63	0.71
Belgacom			
1Y	24%	0.24	0.48
2Y	22%	0.34	0.52
5Y	21%	0.58	0.65
KPN			
1Y	43%	0.29	0.34
2Y	41%	0.31	0.46
5Y	44%	0.54	0.54
Orange			
1Y	47%	0.25	0.40
2Y	47%	0.32	0.46
5Y	48%	0.60	0.65
Telecom Italia			
1Y	71%	0.21	0.27
2Y	69%	0.26	0.38
5Y	68%	0.49	0.52
Iliad			
1Y	32%	0.56	0.63
2Y	24%	0.65	0.61
5Y	17%	0.75	0.74
Orange Belgium			
1Y	26%	0.31	0.50
2Y	25%	0.36	0.49
5Y	29%	0.40	0.43
Telenor			
1Y	22%	0.17	0.29
2Y	24%	0.22	0.38
5Y	24%	0.57	0.64
Tele2			
1Y	18%	0.43	0.52
2Y	20%	0.52	0.63
5Y	20%	0.69	0.71
Swisscom			
1Y	26%	0.23	0.46
2Y	26%	0.28	0.47
5Y	25%	0.50	0.55
EU Comparators Avg.			
1Y	38%	**0.30**	**0.44**
2Y	36%	**0.36**	**0.50**
5Y	36%	**0.58**	**0.62**

Notes: Cut-off date is 31 January 2019; daily data.
Source: NERA analysis based on Bloomberg data.

NERA
ECONOMIC CONSULTING

NERA Economic Consulting
Marble Arch House
66 Seymour Street
London, UK W1H 5BT
+44 207 659 8500
www.nera.com