NERA
ECONOMIC CONSULTING

Cost of Capital: Beta and Gearing for the 2019 BCMR

Prepared for Ofcom

11 October 2018

[Redacted version]

Contents

List of Tables

List of Figures

1. Introduction

NERA has been commissioned by Ofcom to provide consulting support for its Business Connectivity Market Review (2019 BCMR), which includes the "Leased Lines Charge Control" (LLCC). The 2019 BCMR will set prices for BT's "leased lines business" for the period 1 April 2019 to 31 March 2021.

In this report, we provide advice regarding the asset beta and gearing for the purpose of estimating the weighted average cost of capital (WACC) of BT's leased lines business. We also review Ofcom's previous assumption for the debt beta, in light of recent regulatory precedent and evidence provided in the academic literature.

In its 2016 BMCR Statement, Ofcom decided to move from its previous two-way disaggregation of the BT Group WACC, which separated "Openreach copper access" from the "Rest of BT", to a three-way approach, which further breaks down the old "Rest of BT" into "Other UK Telecoms" and a new "Rest of BT". The "Openreach copper access" WACC applies to wholesale copper access services as well as duct and pole access (DPA). The new "Rest of BT" WACC applies to BT's riskier ICT activities, while the "Other UK telecoms" ("OUKT") WACC applies to other regulated and unregulated services, including leased lines.

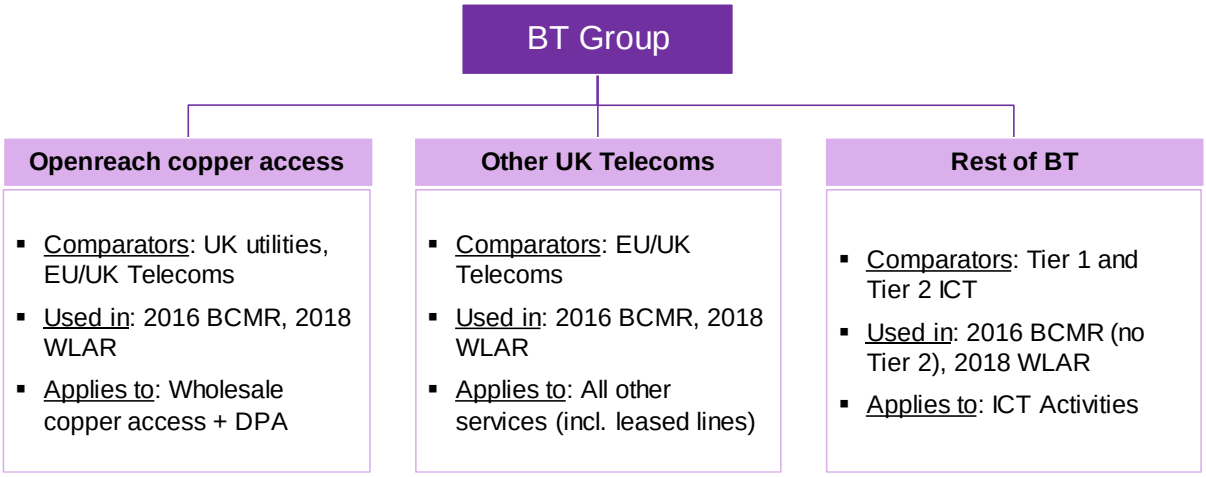
In its Statement for the 2016 BCMR, the "Other UK Telecoms" WACC was applied to leased line services. The asset beta for "Other UK telecoms" was informed by the empirical asset betas of telecoms comparators in the UK and the EU.[1] Ofcom maintained this disaggregation in its 2018 WLA Statement.[2]

Figure 1.1 illustrates the three-way disaggregation of BT Group, and the comparators considered in estimating betas for the respective components.

[1] Ofcom (28 April 2016), Business Connectivity Market Review 2016 – Final Statement, link: https://www.ofcom.org.uk/consultations-and-statements/category-1/business-connectivity-market-review-2016, accessed 7 August 2018, Annex 30.

[2] Ofcom (28 March 2018), Wholesale local access market review – statement, link: https://www.ofcom.org.uk/consultations-and-statements/category-1/wholesale-local-access-market-review, accessed 7 August 2018.

Figure 1.1: Overview of Ofcom's approach to disaggregating BT Group's WACC since 2016



Source: 2016 BCMR, 2018 WLA.

A key aspect of our work is to assess whether it remains appropriate to use the "Other UK Telecoms" category as a basis for setting the beta for BT's leased lines business.

The remainder of this report is structured as follows:

- Section 2 provides an overview of our methodology for estimating betas;
- Section 3 presents updated equity and asset beta estimates for BT Group and the comparator groups considered by Ofcom in previous reviews (UK utilities, UK telecoms, European telecoms, and ICT comparators);
- Section 4 provides recent regulatory precedent and other evidence as a basis for assessing the appropriate level of the debt beta for BT;
- Section 5 makes recommendations regarding the asset beta for leased lines;
- Section 6 makes a recommendation for setting BT's notional gearing level for the 2019 BCMR; and
- Section 7 concludes.

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

2. Methodology for Beta Estimation

In this section, we present our methodology for estimating equity and asset betas. We generally rely on the same methodology as in our recent updates, e.g. the reports we prepared for Ofcom in the context of the 2016 BCMR statement and our latest update in the context of the 2018 WLA review.[3]

Comparator selection

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

1. UK Utilities;
2. UK Telecoms;[4]
3. European Telecoms; and
4. ICT companies.

In previous updates, we also reported beta estimates for US telecoms comparators. However, given that these companies operate under regulatory regimes that are substantially different from those applying to UK and European telecoms companies, we do not consider them to be sufficiently relevant comparators. As Ofcom placed little weight on the US Telecoms results in its 2018 WLA Statement, we have not included them in this report.[5]

We note that in this report, "UK Telecoms" refers to the UK telecoms comparator sample, which does not include BT itself.

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 20 July 2018 as the cut-off date.

[3] 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; NERA (January 2018), 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/0017/111536/Draft-statement-annex-31.pdf.

[4] We have considered including CityFibre, a provider of wholesale full fibre network infrastructure, in our comparator sample for UK Telecoms. Whereas by the nature of its business, CityFibre could be a suitable comparator, we eventually decided not to include it in our comparator sample due to data limitations. CityFibre has only been public since 2014 and was taken private in June 2018, which means that we cannot estimate a beta as of our cut-off date, and generally have a very limited return series that is strongly affected by ownership changes.

[5] Ofcom (28 March 2018), Wholesale local access market review – statement, link: https://www.ofcom.org.uk/consultations-and-statements/category-1/wholesale-local-access-market-review, accessed 7 August 2018, para A20.179.

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 the stock market as a whole. Since both BT and the comparator sets are liquid, we prefer to use daily data.[6] In this report, the beta estimates we refer to are daily beta estimates, unless stated otherwise.

However, we estimate betas based on weekly data as a cross-check (see Appendix G).

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 the past, we have considered that for BT's regulated activities, a two-year estimation provides an appropriate balance of the two factors above. However, taking into account the most recent data, we observe that the Brexit referendum in June 2016 has had a strong effect on the betas of UK-focussed telecoms companies, including BT, whose betas have declined sharply since the referendum.

We present our analysis of the effect of the referendum on UK Telecoms betas in section 3.1.3 and Appendix A. Given the high degree of uncertainty around Brexit and how it will affect UK companies going forward, in this report we also recommend placing weight on the five-year beta estimates. The five-year estimation window captures both the time before the Brexit referendum and the time after, with approximately equal weight on both, and therefore complements the two-year estimation window, which only captures the period after the referendum.

[6] 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%. All stocks considered in this sample are liquid.

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.[7] Such bias would suggest that systematic risk, as quantified by 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.[8]

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.[9] 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.[10] Using a world

---

7 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.

8 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.

9 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. See 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 CAA Determination of the Cost of Capital for Q6 (2014-2019) used a local market index to estimate equity betas of international comparators. See the report from its Consultants, PWC (April 2013), Estimating the cost of capital in Q6 for Heathrow, Gatwick and Stansted, A report prepared for the Civil Aviation Authority (CAA), p.67.

10 Denominated in US dollars.

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.[11] 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.

Since the last update we prepared for Ofcom, we have revised one aspect of our methodology. Previously, we regressed European Telecoms companies' returns, most of which are denominated in Euros, against the FTSE All Europe index denominated in US dollars. Similar to our approach for the world index, we considered this to be appropriate given that there is evidence that currency risk is diversifiable.[12] Following further analysis, we have decided to use the FTSE All Europe index denominated in Euros instead, as the European Telecoms sample is dominated by companies with Euro-denominated returns and because we observe a non-negligible difference in the estimation results for some comparators. This also affects the European companies in the ICT comparator set.

As a cross-check, Appendix H shows the results under our previous approach, i.e. regressing European comparators' returns against the returns on the USD-denominated FTSE All Europe index. On average, we see that asset betas are only slightly higher when using the FTSE All Europe in Euros compared to the FTSE All Europe in US dollars (an average difference of around 0.06).

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 biased[13] and/or inefficient[14] (i.e. not minimum variance) beta estimates. We have visually inspected/ formally tested the following key assumptions:[15]

- *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

[11] 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.

[12] This assumption implies that Purchasing Power Parity (PPP) holds, which tends to be true in the long run. A summary of the evolution of the theory can be found in Taylor Alan M. and M.P Taylor (2004), "The Purchasing Power Parity Debate*", Journal of Economic Perspectives,* Vol 18, No.4, p135-158. In the short run, evidence on PPP is mixed – see for example Caporale, Maria Guglielmo et al, (2013), "On the linkages between stock prices and exchange rates: Evidence from the banking crisis of 2007-2010", Working Paper no 13-07, 19(4), pp.7-16 and Campbell, John Y., (May 2010), "Global Currency Hedging", Harvard University/Arrostreet Capital L.P. Paper, *Journal of Finance*, 2010.

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

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

[15] 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.

- *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.[16]

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).

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.[17]

Debt beta

As explained in section 4 below, we consider that Ofcom's previous assumption for the debt beta of 0.1 remains appropriate. In this report, all asset beta values quoted are calculated using a debt beta of 0.1, unless stated otherwise.

In Appendix F, we present asset beta estimates using debt betas of 0, 0.05, 0.1 and 0.2, to illustrate the impact of the debt beta assumption.

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

[17] 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.

3. July 2018 Update of the Equity and Asset Betas for BT Group and Comparators

In this section, we present equity betas, gearing, and asset betas for each of the comparator groups, and compare them to our estimates for BT. Our key assumptions for estimating betas are summarised in Table 3.1, as discussed in detail in section 2.

Table 3.1: Overview of assumptions for beta estimation in this section

Comparator groups	UK utilities, UK Telecoms, European Telecoms, ICT comparators
Reference index	local/regional index, world index
Sampling frequency	daily, weekly as cross-check (Appendix G)
Time horizon	1 year, 2 years, 5 years
Debt beta assumption	0.1
(Re-)levering formula	Miller
Cut-off date	20 July 2018

Source: NERA analysis.

3.1. UK Utilities and UK Telecoms

3.1.1. Equity betas

Table 3.2 and Table 3.3 show the equity betas for BT Group, 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 20 July 2018.

Table 3.2: BT and UK Utilities Equity Beta against the FTSE All Share

	FTSE All Share		
	OLS/GLS*		
	Beta (Jul 18)	**SE (Jul 18)**	**Beta (Sep 17)**
BT			
1Y*	0.83	0.12	0.61
2Y*	0.72	0.12	1.03
5Y	0.94	0.05	n.a.
National Grid			
1Y	0.83	0.09	0.59
2Y	0.76	0.07	0.53
5Y*	0.66	0.03	n.a.
Severn Trent			
1Y	0.79	0.12	0.44
2Y	0.65	0.08	0.59
5Y	0.69	0.03	n.a.
Pennon			
1Y	0.74	0.13	0.53
2Y	0.69	0.09	0.63
5Y	0.68	0.04	n.a.
United Utilities			
1Y	0.84	0.13	0.40
2Y	0.68	0.09	0.59
5Y*	0.72	0.04	n.a.
SSE			
1Y	0.79	0.09	0.34
2Y	0.65	0.07	0.86
5Y*	0.80	0.03	n.a.
Utilities average			
1Y	**0.80**		**0.46**
2Y	**0.69**		**0.64**
5Y	**0.71**		**n.a.**
Utilities average (excl. SSE)			
1Y	**0.80**		**0.49**
2Y	**0.69**		**0.59**
5Y	**0.69**		**n.a.**

Source: NERA analysis based on Bloomberg data. Note: Cut-off date is 20 July 2018, daily data.

Table 3.3: BT and UK Telecoms Equity Beta against the FTSE All Share

	FTSE All Share		
	OLS/GLS*		
	Beta (Jul 18)	**SE (Jul 18)**	**Beta (Sep 17)**
BT			
1Y*	0.83	0.12	0.61
2Y*	0.72	0.12	1.03
5Y	0.94	0.05	n.a.
TalkTalk			
1Y	1.00	0.27	0.13
2Y	0.74	0.18	0.79
5Y	0.81	0.07	n.a.
Sky			
1Y	0.25	0.14	0.52
2Y	0.43	0.12	0.89
5Y	0.75	0.05	n.a.
Vodafone			
1Y	1.09	0.09	1.04
2Y	1.04	0.07	0.97
5Y	1.04	0.03	n.a.
Telecoms average (excluding BT)			
1Y	**0.78**		**0.56**
2Y	**0.73**		**0.88**
5Y	**0.87**		**n.a.**
Telecoms average (excluding Sky and BT)			
1Y	**1.04**		**0.58**
2Y	**0.89**		**0.88**
5Y	**0.92**		**n.a.**

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018; Note: Daily data.

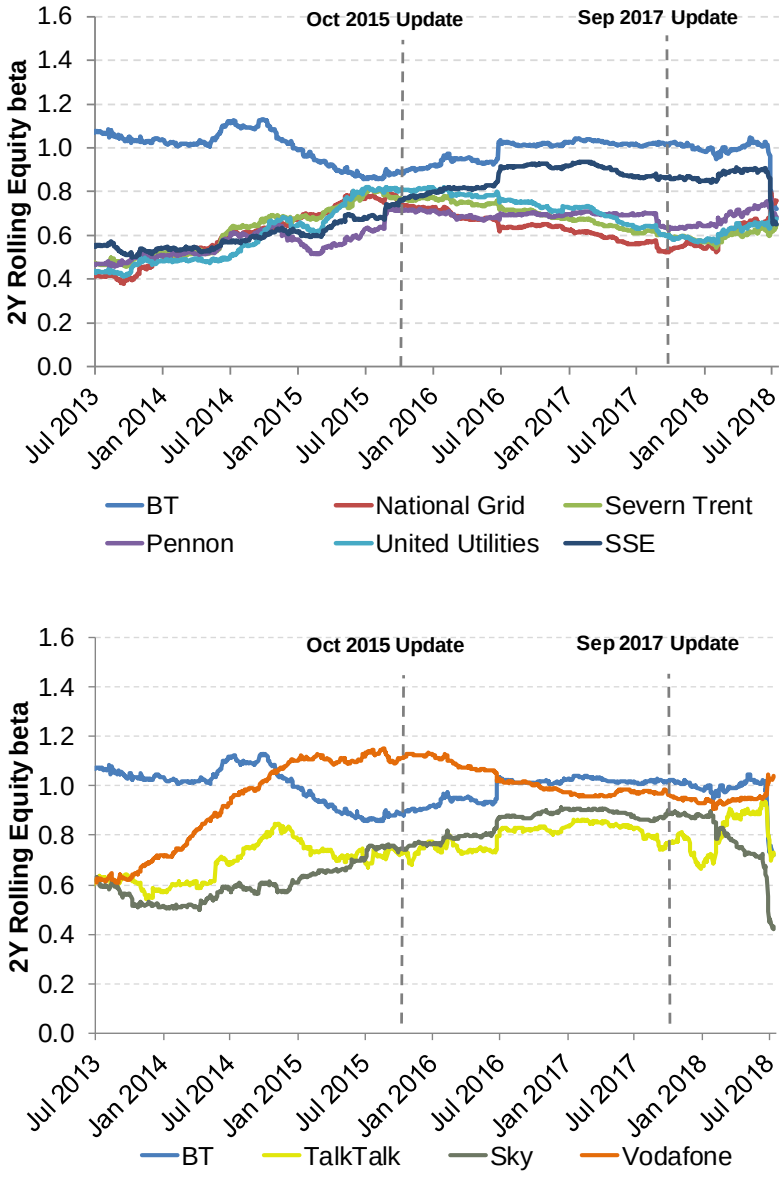
The updated equity betas for BT, other UK telecoms and UK utilities estimates against the FTSE All Share index are as follows:

- BT's 2-year daily equity beta dropped substantially compared to September 2017 (from 1.03 to 0.72). This is attributed to the effect of the dates around the Brexit referendum falling out of the 2-year estimation window. We explore this effect in detail in section 3.1.3 and Appendix A;
- The equity betas in the UK utilities sample have generally increased compared to our September 2017 update for both the 1-year and the 2-year daily estimation windows (the 2-year daily average equity beta increased from 0.64 to 0.69). Unlike BT, UK utility betas were not affected by the "referendum effect", due to their defensive characteristics (explained further in section 3.1.3);
- The UK Telecoms average equity beta for the 2-year sample has decreased substantially, from 0.88 to 0.73. However, this reduction is heavily influenced by a reduction in Sky's

equity beta, most likely driven by the recent news about various takeover bids.[18] If we remove Sky from the sample (which leaves us with only two comparators, TalkTalk and Vodafone), we observe a slight increase in the equity betas (from 0.88 to 0.89).

Figure 3.1 and Figure 3.2 show the 2-year and 5-year rolling equity betas of BT and the UK comparator set against the FTSE All Share index, over the period July 2013 to July 2018.

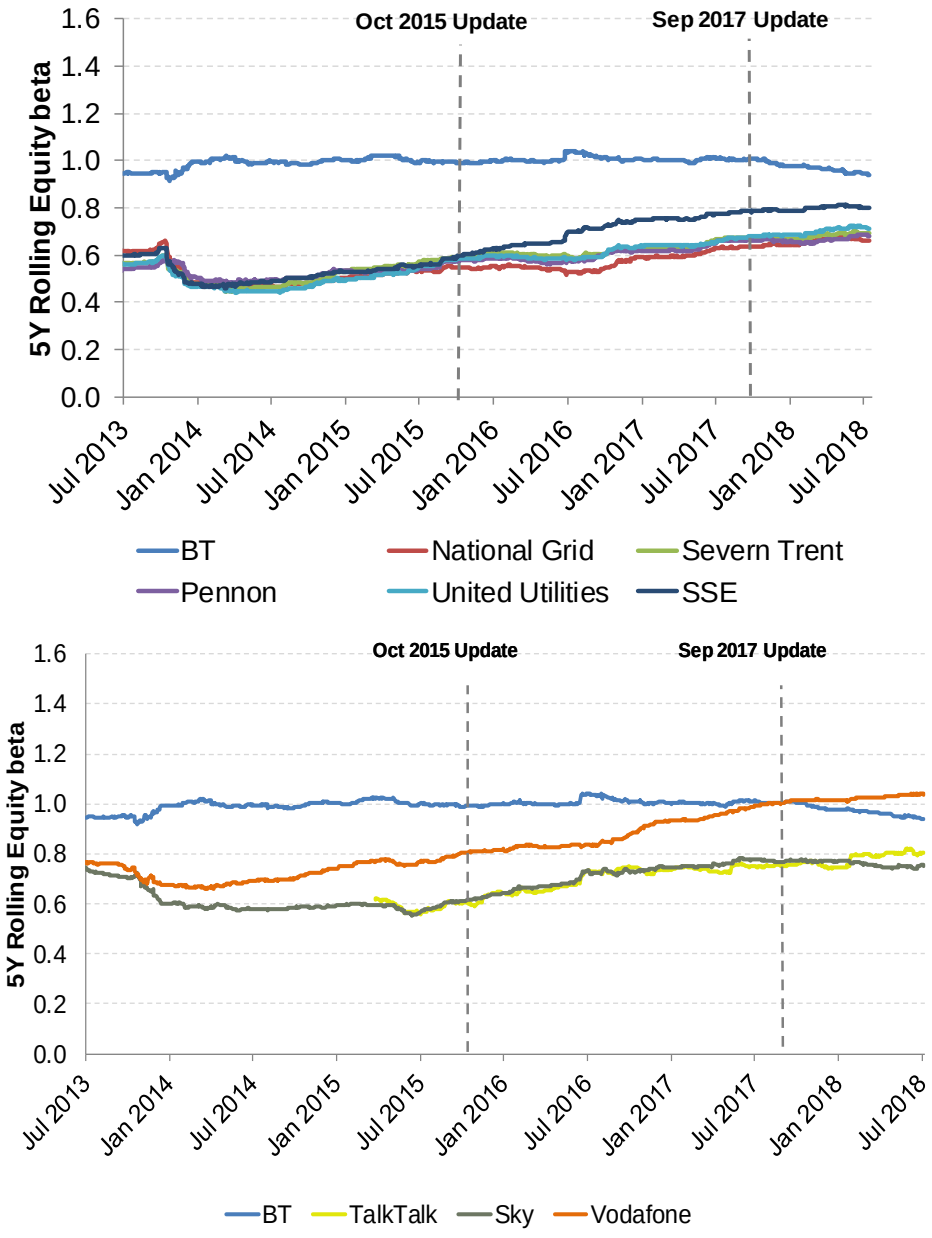
Figure 3.1: BT and UK Utilities/Telecoms 2Y Rolling Equity Beta against FTSE All Share



Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.Note: Daily data, 2-year estimation window; FTSE All Share as reference index.

[18] See for example: Sky Website (15 June 2018), *Comcast's £22.1bn Sky takeover bid cleared by European Commission*, Link: https://news.sky.com/story/comcasts-221bn-sky-takeover-bid-cleared-by-european-commission-11405997.

Figure 3.2: BT and UK Utilities/Telecoms 5Y Rolling Equity Beta against FTSE All Share



Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.Note: Daily data, 5-year estimation window; FTSE All Share as reference index.

Figure 3.3 shows the equity beta for BT and average equity betas for the UK comparator sets, UK Telecoms and UK Utilities. We also present the averages excluding Sky (which is affected by ongoing takeover news) and SSE (which has a large proportion of generation and non-regulated activities, and is hence different from traditional utilities[19]), respectively.

[19] In FY2016/2017, SSE derived only about 4% of its total revenues from regulated network activities (electricity transmission and distribution). The largest share of SSE's revenues came from generation activities (60%), followed by energy supply (22%). 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

In the remainder of this report, we present ranges for UK Telecoms betas including and excluding Sky. This is because recent trends in Sky's empirical betas are likely to be related to the high degree of speculation around a potential takeover of the company. In general, it is not unusual for telecoms companies to be subject to some degree of bid speculation, and we consider a moderate degree of bid speculation to be part of normal business risk. Sky, however, has seen a takeover battle in the recent past that goes beyond what we would consider a normal degree of bid speculation. In 2016, Sky accepted a takeover bid submitted by 21st Century Fox.[20] After several instances of regulatory investigation, the CMA published provisional findings in January 2018 which stated that the deal was not in the public interest on media plurality grounds.[21,22]

Following the CMA's provisional finding, Comcast submitted a bid for Sky in February 2018,[23] which lead to several months of intense speculation about which of the two firms might end up acquiring Sky. This is likely to be reflected in Sky's beta, and in particular the fact that the correlation between the returns on Sky shares and market returns has decreased in recent months (see Figure A.2 in Appendix A). As shown in Figure 3.1, Sky's 2-year equity beta decreased considerably starting in early 2018, and had decreased by about 0.2 even prior to the sharp decrease in mid-2018 which is related to the "referendum effect". The empirical evidence therefore supports the view that Sky's most recent beta estimates may be driven by Sky-specific events, which raises concerns about comparability. Even though Sky's 5-year beta is based on a longer estimation window and hence less affected by recent events than the 2-year beta, it still reflects the period of intense bid speculation and should hence be treated with caution. For this reason, we present ranges for UK telecoms including and excluding Sky for both the 2-year and the 5-year betas in the remainder of this report.

others also includes electrical contracting and private energy networks, and accounted for around 1.4% of SSE's revenues in FY2016/2017. See SSE Annual report for FY2016/2017 (p.117-118).

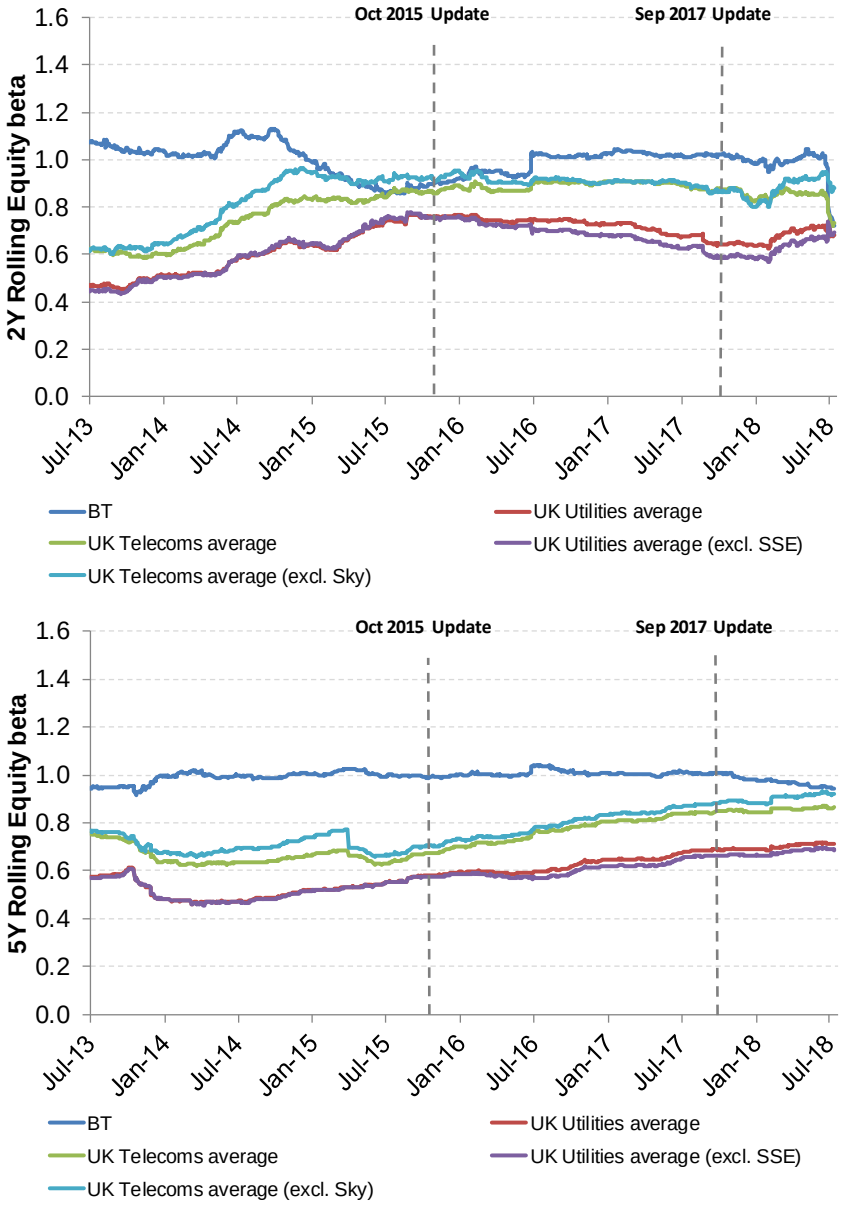
[20] See for example BBC (15 December 2016): "Sky and 21st Century Fox agree to £18.5bn takeover deal", https://www.bbc.co.uk/news/business-38326530.

[21] CMA (23 January 2018): "CMA provisionally finds Fox/Sky deal not in the public interest", https://www.gov.uk/government/news/cma-provisionally-finds-foxsky-deal-not-in-the-public-interest.

[22] These findings were confirmed in the CMA's final report in May 2018, where the CMA maintained that this deal was not in the public interest on media plurality grounds. On the other hand, the CMA found that the deal was not expected to operate against the public interest with regard to broadcasting standards. See CMA (1 May 2018): 21st Century Fox, Inc and Sky Plc, p.7.

[23] Reuters (27 February 2018): "Fox, Disney and now Comcast – a timeline of Sky takeover proposals", https://www.reuters.com/article/us-sky-m-a-timeline/fox-disney-and-now-comcast-a-timeline-of-sky-takeover-proposals-idUSKCN1GB2HG.

Figure 3.3: BT vs UK Telecoms / Utilities Average – 2Y and 5Y Equity Beta against the FTSE All Share



Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.Note: Daily data, 2-year and 5-year estimation window; FTSE All Share as reference index.

Figure 3.1 and Figure 3.3 show the effect of the Brexit referendum on three of the telecoms betas (BT, Sky, TalkTalk) and SSE. When the referendum date falls out of the 2-year estimation window in June 2018, these companies' 2-year equity betas drop sharply (referred to in the remainder of this report as the "referendum effect"). UK utilities other than SSE, on the other hand, have seen a reversal of their downward trend in recent months, and do not exhibit a "referendum effect".

If we exclude Sky from the average of UK Telecoms comparators, we observe a steep decline in the average around June 2018, driven by TalkTalk's exposure to the "referendum effect".[24]

For the 5-year betas we do not see such steep changes, as it uses a longer estimation window and as a result each outlier has less weight in the equity beta estimate. BT's 5-year equity beta has been slightly declining since 2016, while the average equity betas of utilities and telecoms have been slightly increasing.

3.1.2. Gearing and asset betas

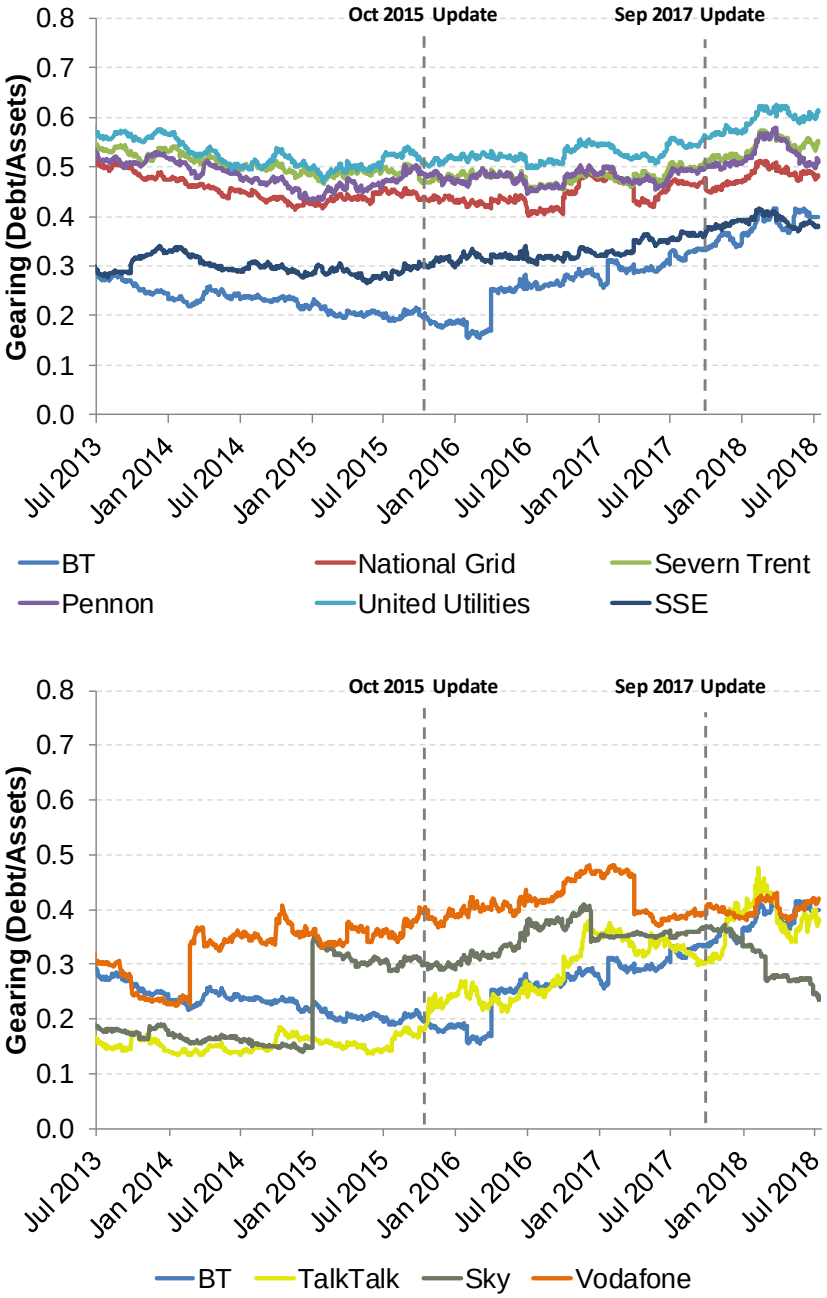
In this section, we show asset betas and gearing for UK comparators. We calculate asset betas based on the Miller formula as described in section 2. We define gearing as the total (gross) value of debt to enterprise value calculated as the sum of (gross) debt and market capitalisation, based on data provided by Bloomberg.[25]

Figure 3.4 shows the evolution of gearing for UK comparators from July 2013 to July 2018.

[24] Vodafone's lower exposure to the "referendum effect" can be attributed to their international diversification, as discussed in section 3.1.3.

[25] 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.

Figure 3.4: BT and UK Telecoms / Utilities Gearing



Source: NERA analysis based on Bloomberg data. Note: Cut-off date is 20 July 2018, daily data, 2-year rolling averages.

BT's gearing has seen an upward trend since 2015 and is currently at around 40%, up from 33% in September 2017.[26] Similarly, gearing for UK Telecoms has also experienced a small increase since our last update, standing at 41% if we exclude Sky, which has experienced a considerable drop in gearing since our last update, due to an increase in the stock price following takeover bids.[27] Gearing for UK Utilities has also increased since our last update and this remains the comparator group with the highest gearing levels (in line with their lower relative riskiness).

We use the average gearing estimated over the same estimation window as the equity betas to de-lever the equity betas.

Table 3.4 and Table 3.5 below show the asset betas for BT and UK comparators (UK Utilities and UK Telecoms, respectively) estimated against the FTSE All Share using a debt beta of 0.1. Figure 3.5 to Figure 3.7 show 2-year and 5-year rolling asset betas for BT and UK comparators against the FTSE All Share index.

[26] 2016 debt increase due to acquisition of EE and associated debt (as per BT's 2016 AR p.102); subsequent increases in D/E a result of the falling share price since early 2017.

[27] We note that the spike in TalkTalk's gearing around February 2018 and subsequent periods is due to considerable declines in the stock price, resulting from overall uncertainty about the company's future. (TalkTalk Telecom Group PLC placing announcement on London Stock Exchange (08 02 2018): https://m.londonstockexchange.com/exchange/mobile/news/detail/13525625.html.) We note that TalkTalk is the only UK comparator that does not currently have an investment-grade credit rating.See for example: Reuters UK (2017), Fitch affirms TalkTalk Telecom at "BB-", link: https://uk.reuters.com/article/fitch-affirms-talktalk-telecom-at-bb-out/fitch-affirms-talktalk-telecom-at-bb-outlook-stable-idUKFit210LDG.

Table 3.4: BT and UK Utilities Asset Betas against the FTSE All Share

		FTSE All Share	
		Asset beta (Jul 18)	Asset beta (Sep 17)
	Gearing	Debt beta=0.1	Debt beta=0.1
BT			
1Y	37%	0.56	0.46
2Y	33%	0.51	0.78
5Y	27%	0.71	n.a.
National Grid			
1Y	48%	0.48	0.36
2Y	47%	0.45	0.34
5Y	46%	0.41	n.a.
Severn Trent			
1Y	53%	0.42	0.27
2Y	51%	0.37	0.36
5Y	50%	0.40	n.a.
Pennon			
1Y	52%	0.41	0.32
2Y	50%	0.39	0.38
5Y	49%	0.40	n.a.
United Utilities			
1Y	59%	0.41	0.24
2Y	56%	0.36	0.33
5Y	54%	0.38	n.a.
SSE			
1Y	38%	0.52	0.26
2Y	36%	0.46	0.61
5Y	33%	0.57	n.a.
Utilities average			
1Y	50%	**0.45**	**0.29**
2Y	48%	**0.41**	**0.40**
5Y	46%	**0.43**	**n.a.**
Utilities average (excl. SSE)			
1Y	53%	**0.43**	**0.30**
2Y	51%	**0.39**	**0.35**
5Y	50%	**0.40**	**n.a.**

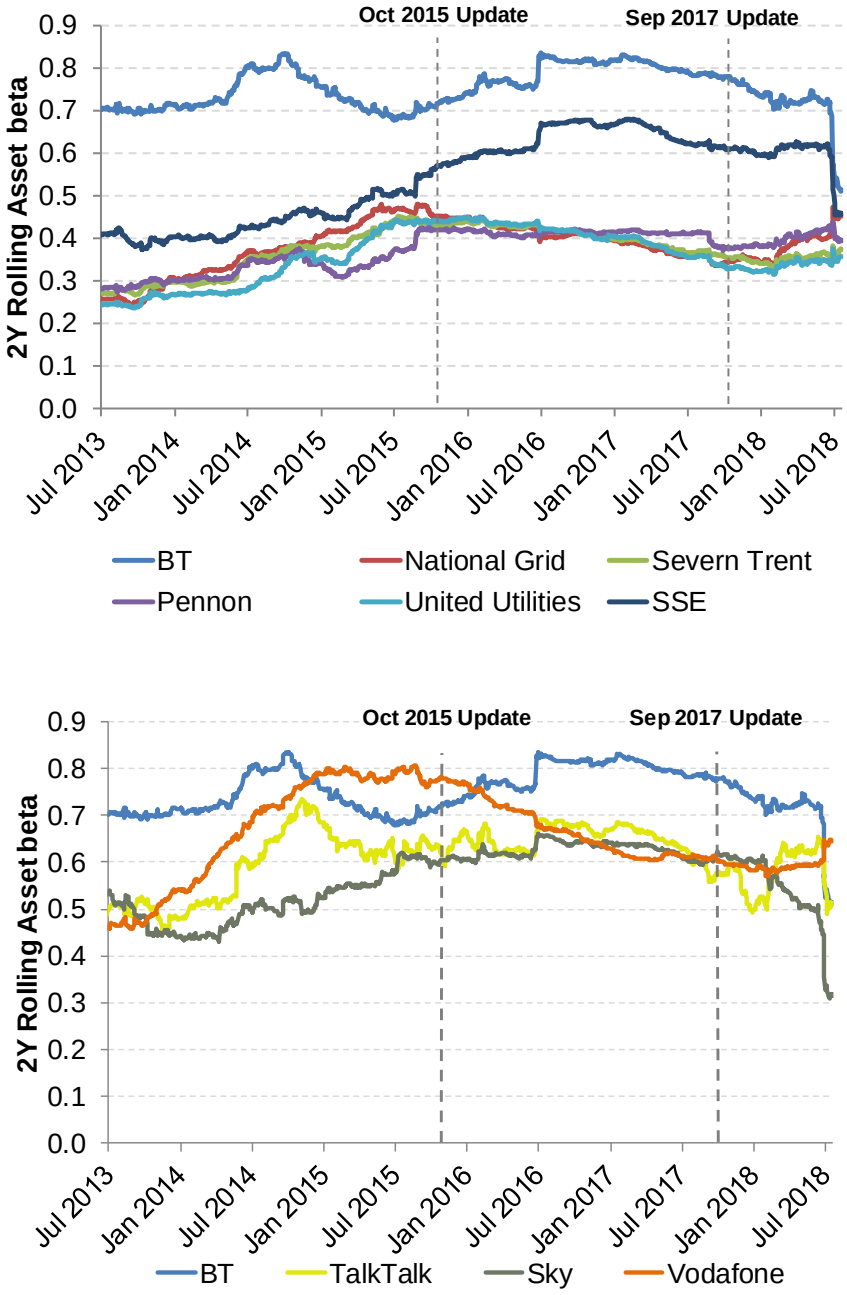
Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.Note: Daily data.

Table 3.5: BT and UK Telecoms Asset Betas against the FTSE All Share

		FTSE All Share	
		Asset beta (Jul 18)	Asset beta (Sep 17)
	Gearing	Debt beta=0.1	Debt beta=0.1
BT			
1Y	37%	0.56	0.46
2Y	33%	0.51	0.78
5Y	27%	0.71	n.a.
TalkTalk			
1Y	37%	0.66	0.12
2Y	35%	0.51	0.59
5Y	26%	0.63	n.a.
Sky			
1Y	32%	0.20	0.37
2Y	34%	0.32	0.62
5Y	29%	0.56	n.a.
Vodafone			
1Y	40%	0.70	0.64
2Y	42%	0.65	0.60
5Y	38%	0.68	n.a.
Telecoms average (excluding BT)			
1Y	36%	**0.52**	**0.38**
2Y	37%	**0.49**	**0.60**
5Y	31%	**0.62**	**n.a.**
Telecoms average (excluding Sky and BT)			
1Y	39%	**0.68**	**0.38**
2Y	38%	**0.58**	**0.60**
5Y	32%	**0.66**	**n.a.**

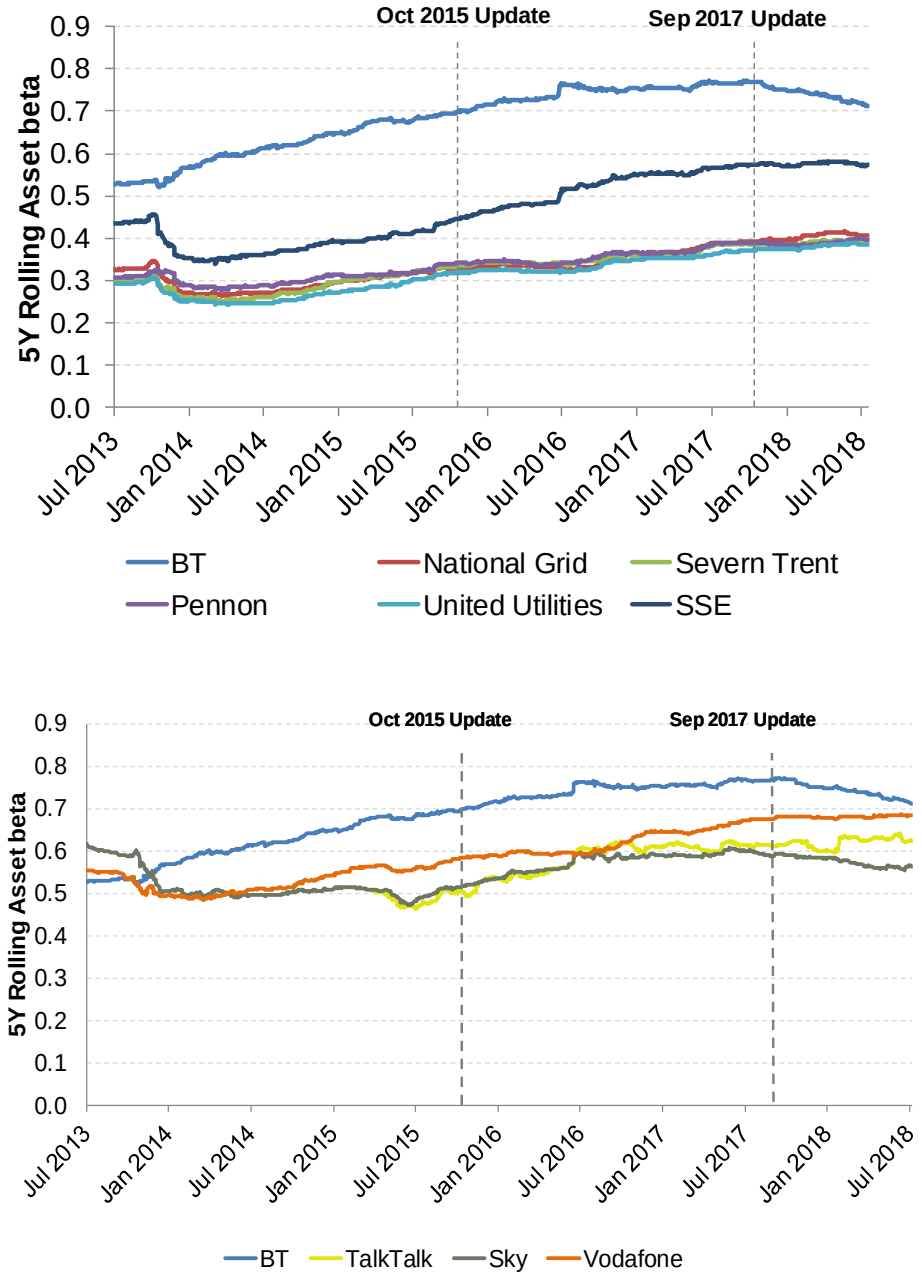
Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.Note: Daily data.

Figure 3.5: BT and UK Utilities/Telecoms 2Y Rolling Asset Beta against FTSE All Share



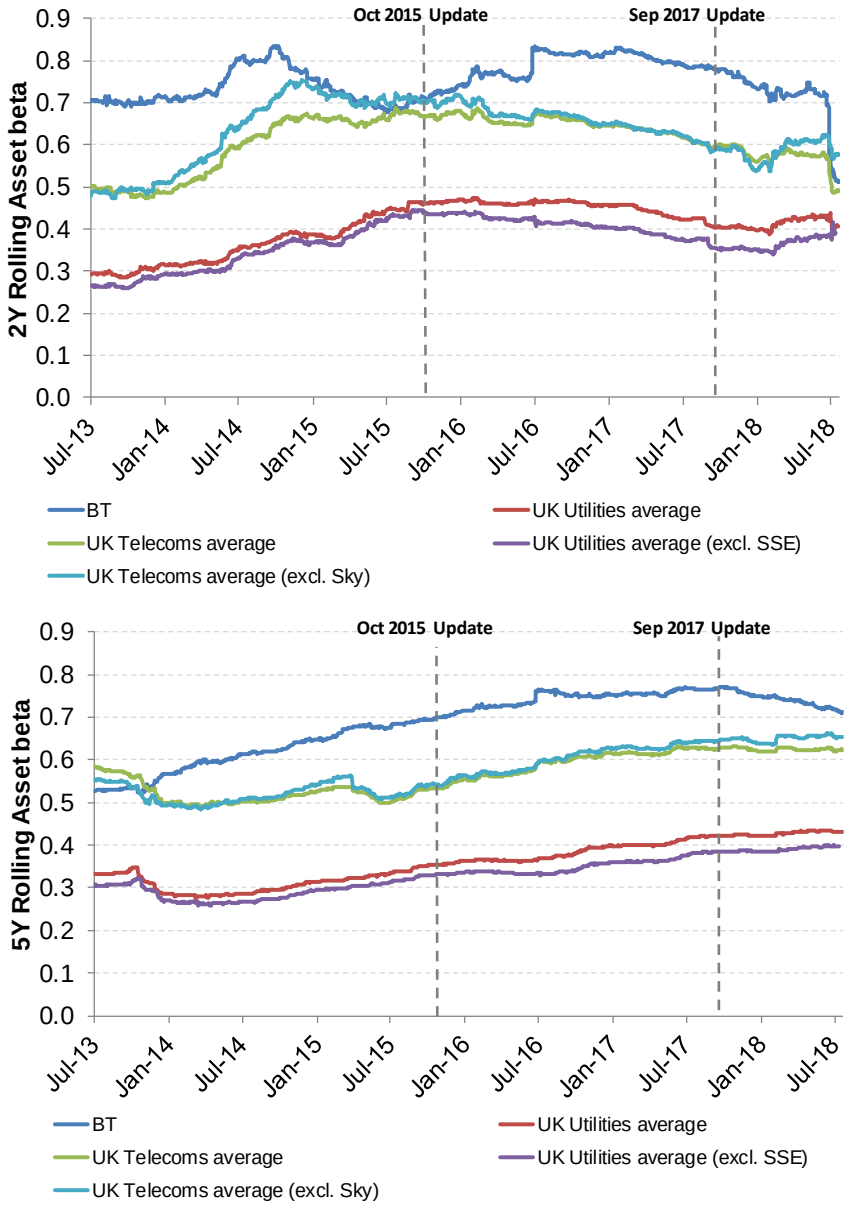
Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018. Note: Daily data, 2-year estimation window, FTSE All Share as reference index.

Figure 3.6: BT and UK Utilities/Telecoms 5Y Rolling Asset Beta against FTSE All Share



Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018. Note: Daily data, 5-year estimation window, FTSE All Share as reference index.

Figure 3.7: BT vs UK Utilities/Telecoms Average – 2Y and 5Y Asset Beta against FTSE All Share



Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018. Note: Daily data, 2-year and 5-year estimation window, FTSE All Share as reference index.

The most recent asset beta estimates (assuming a 0.1 debt beta) for BT, other UK telecoms and UK utilities estimated against the FTSE All Share index are as follows:

- BT's current 2-year asset beta is 0.51, and the 5-year asset beta is 0.71;
- UK Telecoms's current average 2-year asset beta is 0.49 (0.58 if we exclude Sky), and the average 5-year asset beta is 0.62 (0.66 if we exclude Sky);
- UK Utilities current average 2-year asset beta is 0.41 (0.39 if we exclude SSE), and the average 5-year asset beta is 0.43 (0.40 if we exclude SSE).

As shown in Table 3.4, Table 3.5 and Figure 3.5 and Figure 3.7, BT has seen its 2-year asset beta fall by c.0.27, which we attribute to the "referendum effect" (as further explained below). Similarly, the average 2-year asset beta of UK Telecoms has fallen by c.0.11 (and by c.0.02 if we exclude Sky) since our last update. By contrast, the average 2-year asset beta of UK Utilities has increased by c.0.04, if we exclude SSE (i.e. the only utility comparator for which the asset beta has decreased since the last update).

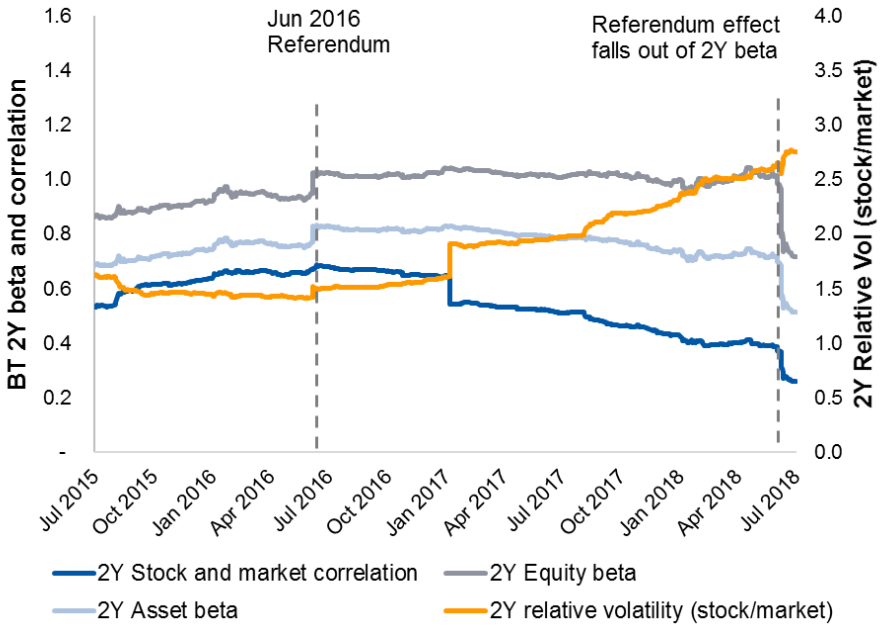
As shown in Figure 3.6, BT's 5-year asset beta has been decreasing since our last September 2017 update. In contrast, both UK Telecoms and Utilities comparators have seen their average 5-year asset betas increase slightly, as shown in Figure 3.7.

3.1.3. The "referendum effect"

In Appendix A, we present a detailed analysis of what we refer to as the "referendum effect", i.e. the effect of the UK referendum date falling out of our 2-year estimation window, as well as the wider trends in asset betas of UK-focused companies following the Brexit referendum. In this section, we present a summary of our main findings.

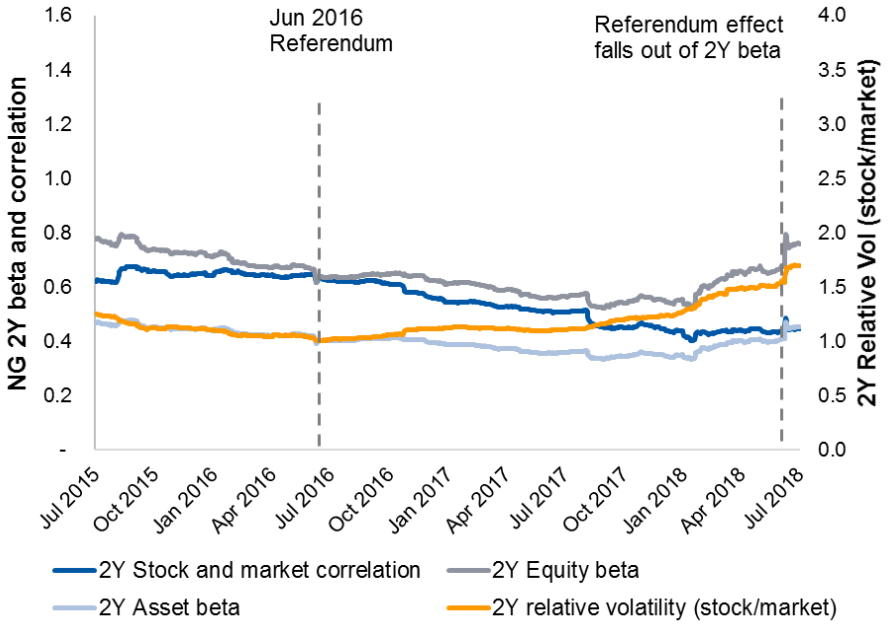
Overall, we see a steep reduction in the betas for BT, SSE, TalkTalk and Sky, while betas of traditional utility comparators and Vodafone do not appear to be affected by this referendum effect. As a first step of understanding these changes, we decompose the UK benchmarks' equity betas into the product of the stock-market correlation and the relative stock volatility (stock/market volatility). This analysis shows that BT and the other stocks affected by the referendum saw a reduction in the stock - market correlation after the referendum data falls out of the sample (as shown in Figure 3.8), while traditional utilities and Vodafone do not exhibit a significant change in correlations (as shown for National Grid in Figure 3.9).

Figure 3.8: BT beta decomposition



Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018. Note: Daily data, 2-year estimation window, FTSE All Share as reference index.

Figure 3.9: National Grid beta decomposition



Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018. Note: Daily data, 2-year estimation window, FTSE All Share as reference index.

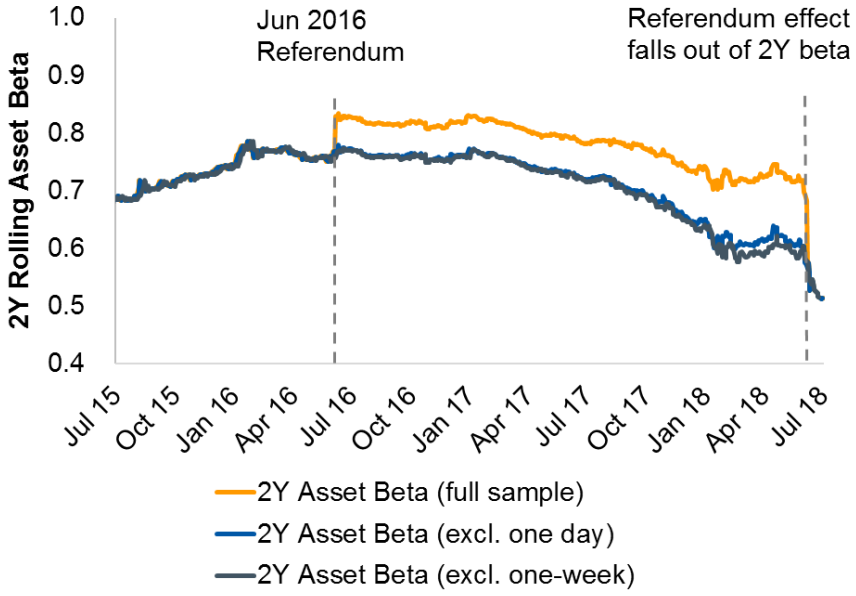
We consider two possible explanations for these observations:

- **Relative riskiness**: Traditional utilities are "defensive" stocks, offering stable returns in times of uncertainty, while returns for other riskier firms are typically more affected by general market movements during these times. This might explain why the beta estimates for SSE (which has a large proportion of generation and non-regulated activities), BT, and UK telecoms have followed a different trajectory to the betas of UK utilities.
- **Foreign earnings effect:** Figure 3.10 shows that the reduction in BT's asset beta following the Brexit referendum is not sensitive to the inclusion/exclusion of the data points where we observe extreme daily return movements following the referendum, which suggests a potential shift in systematic risk. We find a similar pattern for SSE, TalkTalk, and Sky, which are all UK-focused companies. This "foreign earnings effect" represents a potential explanation for these medium-term changes. As suggested by the Bank of England in its inflation report,[28] the FTSE All Share Index outperformed UK-focused companies in the months after the referendum, which would likely imply a lower correlation between the returns on the FTSE All Share Index and the returns on UK-focussed stocks. This is illustrated in Figure 3.11, where we show the correlation between the FTSE All Share Index (which includes companies with large shares of foreign earnings) and the FTSE Local UK Index (which only includes companies that generate at least 70% of their earnings in the UK). The declining return correlation between UK-focused companies and the FTSE All Share, i.e. the foreign earnings effect, offers a potential explanation for why the stock-to-market correlation is decreasing for

[28] Bank of England (November 2016): Inflation report, p.6. Link: https://www.bankofengland.co.uk/inflation-report/2016/november-2016.

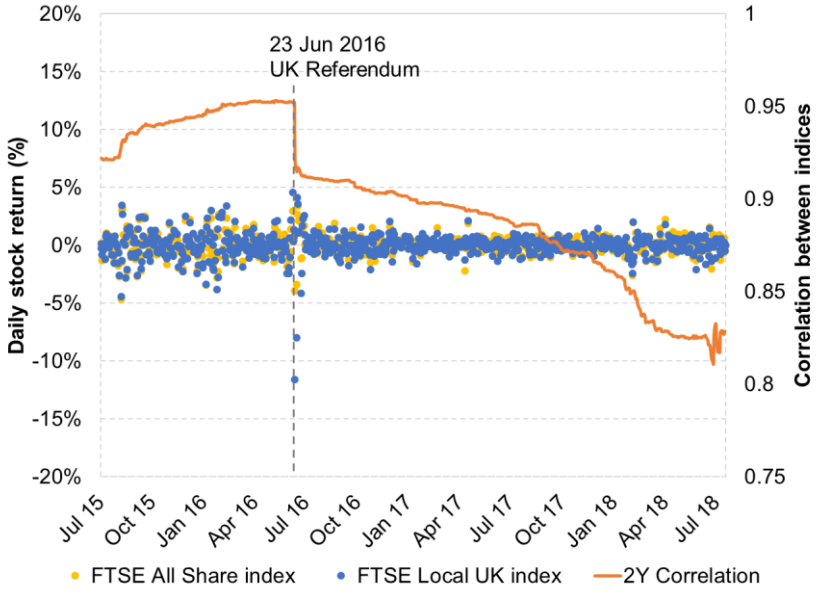
UK-focused telecoms companies (i.e. BT, TalkTalk and Sky), but remains relatively unchanged for Vodafone, which is more internationally diversified.[29]

Figure 3.10: BT's hypothetical asset beta



Source: NERA analysis based on Bloomberg and FactSet data. Cut-off date is 20 July 2018.
Note: Daily data, 2-year estimation window, FTSE All Share as reference index.

Figure 3.11: FTSE Local UK and FTSE All Share correlation and daily returns



Source: NERA analysis based on Bloomberg and FactSet data. Cut-off date is 20 July 2018;
Note: UK-focused FTSE Local UK index had large negative returns following the Referendum in June 2016, in contrast to the FTSE All Share index.

[29] BT, Sky and TalkTalk derive most of their revenues from the UK (respectively, 80%, 70% and 100%), while Vodafone derives revenues from a broader range of countries (Germany with around 22%, UK with 15% and Italy with 13% are the most represented). This breakdown is also shown in Appendix D.

3.1.4. Discussion of the UK asset beta results

Table 3.6 summarises our previous and current asset beta ranges, estimated against the FTSE All Share index.[30] Table 3.7 shows the equivalent ranges when using the FTSE All World index as reference index.[31]

Table 3.6: BT and UK Utilities/Telecoms Asset Beta ranges against FTSE All Share

Comparators	2Y (Sep 2017)	2Y (Jul 18)	5Y (Jul 18)
BT	0.78	0.51	0.71
UK Utilities (excl. SSE)	0.33-0.38	0.36-0.45	0.38-0.41
UK Telecoms (excl. Sky)[32]	0.59-0.60	0.51-0.65	0.63-0.68
UK Telecoms (incl. Sky)	0.59-0.62	0.32-0.65	0.56-0.68

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.

Table 3.7: BT and UK Utilities/Telecoms Asset Beta ranges against FTSE All World

Comparators	2Y (Sep 2017)	2Y (Jul 18)	5Y (Jul 18)
BT	0.86	0.38	0.68
UK Utilities (excl. SSE)	0.28-0.37	0.19-0.28	0.32-0.35
UK Telecoms (excl. Sky)	0.52-0.61	0.42-0.46	0.59-0.64
UK Telecoms (incl. Sky)	0.52-0.7	0.20-0.46	0.55-0.64

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.

As shown in Table 3.6, the 2-year asset beta range for UK Utilities comparators (excluding SSE) against the FTSE All Share index has increased to 0.36 to 0.45, up from 0.33 to 0.38 in our September 2017 update. This reflects asset beta increases across all utility comparators (see purple line in Figure 3.7, first chart). BT's asset beta still lies above the upper end of the range, but it is now relatively closer to the upper end than it was previously (delta of c.0.05 compared to previous delta of c.0.4), mostly because BT's 2-year asset beta has decreased substantially since the Brexit referendum in June 2016. By contrast, BT's 5-year asset beta remains substantially above the upper end of the 5-year range for UK utilities (0.71 vs utilities range of 0.38-0.41).

When regressed against the FTSE All World index, we obtain a considerably lower range for UK Utilities than previously. However, as BT's beta has fallen sharply, we can draw similar conclusions regarding the position of BT's beta relative to the UK Utilities range (i.e. BT's beta is much closer to the upper end of the UK Utilities range than in September 2017).

[30] We have also prepared beta estimates using weekly data, as a cross-check. We present these estimates in Appendix G. In general, we obtain consistent results using weekly data (though slightly higher ranges).

[31] We present these estimates in Appendix D.

[32] As stated in section 2, "UK telecoms" refers to the UK telecoms comparator sample which does not include BT.

For UK Telecoms, if we exclude Sky from the sample, we are left with only two comparators (TalkTalk and Vodafone). For the estimates against the FTSE All Share Index, the 2-year range has become wider compared to September 2017 (0.51-0.65 compared to 0.59-0.60), which places BT at the lower end of the updated UK Telecoms range. If we include Sky, we get a much wider range relative to September 2017 (0.32-0.65 compared to 0.59-0.62), which places BT closer to the midpoint of the range. However, as we explain in section 3.1.1, the large decrease in Sky's beta is likely to be related to an exceptional degree of takeover speculation in the past year (in addition to the "referendum effect"). Figure 3.7 illustrates the recent changes in BT's and UK Telecoms comparators' 2-year asset betas.

By contrast, BT's 5-year beta remains above the upper end of the 5-year range for UK Telecoms with and without Sky (0.71 vs 0.56-0.68 and 0.71 vs 0.63-0.68, respectively), as shown in Table 3.6. Whereas the 5-year beta for Sky also reflects the decreasing trend in the last year, it is based on a longer estimation window and is hence less affected by the recent bid speculation than Sky's 2-year beta. As shown in Table 3.7, we can draw similar conclusions on BT and UK Telecoms when using the FTSE All World index.

In Appendix B (Figure B.1), we show confidence intervals for BT and UK comparators. For BT, the most recent 2-year confidence interval (0.28-0.75) is considerably wider than the confidence interval for both the 2-year estimate in September 2017 (0.62-0.94) and the 5-year estimate (0.62-0.80). This reflects the large increase in standard errors since the Brexit referendum, as well as the fact that the 5-year estimates are based on more than twice as many observations and are hence more statistically robust.

For UK Utilities and UK Telecoms we see similar results, i.e. the 2-year confidence intervals have become considerably wider compared to September 2017 (the average increases in width are 57% and 49%, respectively). Again, this reflects the increase in standard errors which is likely to be related to the ongoing uncertainty around Brexit. On the other hand, the 5-year confidence intervals are relatively narrow, which shows that there is less uncertainty around these estimates. This evidence supports our recommendation to consider both the 2-year and the 5-year beta estimates in the upcoming review.

3.2. European Telecoms

3.2.1. Equity betas

Table 3.8 below summarises our equity beta estimates for the European Telecoms sample, against the FTSE All Europe index. In summary, we find that the average 2-year equity beta for this sample has fallen compared to our September 2017 update (from 0.84 to 0.75), but we see mixed trends for individual comparators.

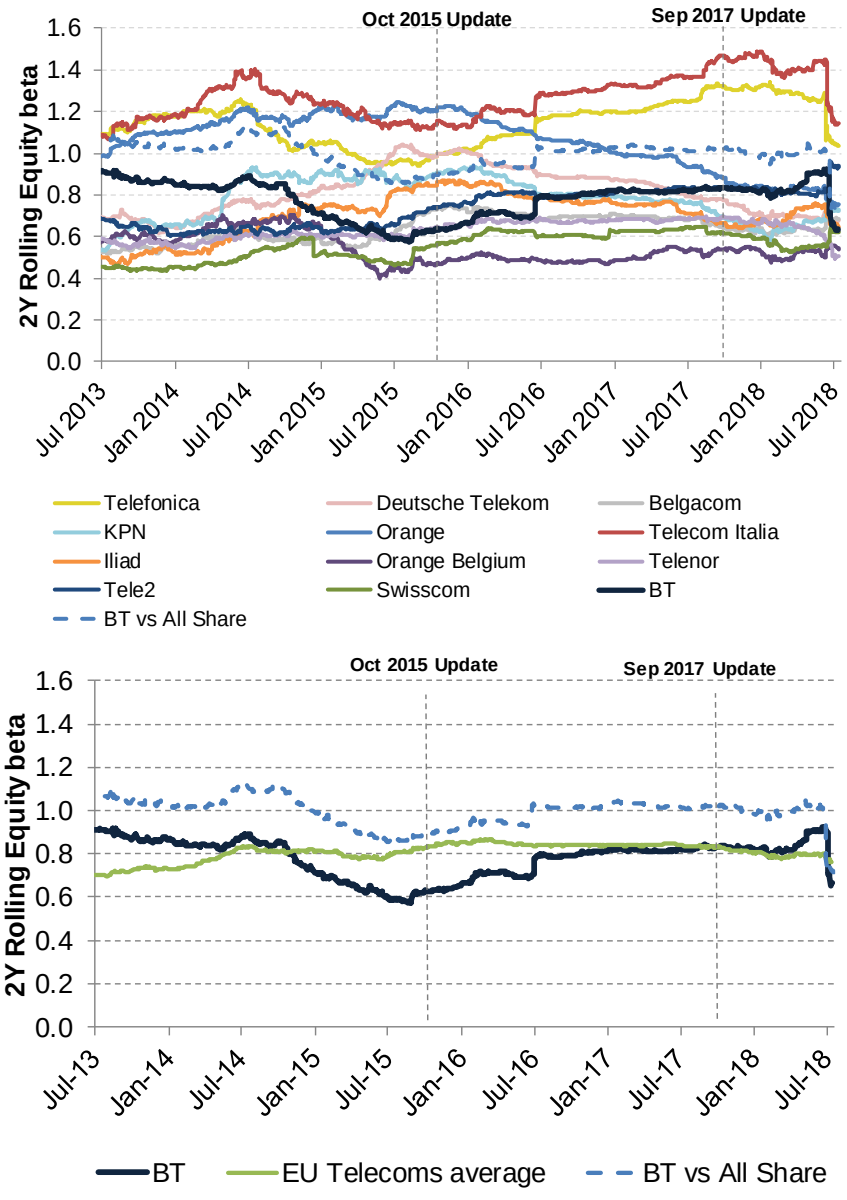
Table 3.8: BT and European Telecoms Equity Beta against the FTSE All Europe

	FTSE All Europe		
	OLS/GLS*		
	Beta (Jul 18)	SE (Jul 18)	Beta (Sep 17)
BT			
1Y*	0.86	0.11	0.41
2Y	0.63	0.11	0.83
5Y	0.75	0.04	n.a.
Telefonica			
1Y	0.94	0.08	1.11
2Y	1.04	0.06	1.34
5Y*	1.13	0.03	n.a.
Deutsche Telekom			
1Y*	0.64	0.08	0.71
2Y*	0.69	0.06	0.78
5Y	0.86	0.03	n.a.
Belgacom			
1Y*	0.75	0.09	0.67
2Y	0.68	0.06	0.65
5Y	0.68	0.03	n.a.
KPN			
1Y	0.71	0.10	0.67
2Y	0.71	0.08	0.70
5Y*	0.79	0.04	n.a.
Orange			
1Y*	0.72	0.06	0.78
2Y	0.75	0.06	0.90
5Y	1.02	0.03	n.a.
Telecom Italia			
1Y*	1.07	0.13	1.08
2Y*	1.13	0.10	1.47
5Y*	1.27	0.05	n.a.
Iliad			
1Y	0.65	0.19	0.74
2Y*	0.64	0.11	0.67
5Y	0.74	0.05	n.a.
Orange Belgium			
1Y	0.66	0.13	0.54
2Y	0.55	0.09	0.55
5Y*	0.52	0.05	n.a.
Telenor			
1Y*	0.50	0.10	0.55
2Y*	0.50	0.08	0.70
5Y*	0.65	0.03	n.a.
Tele2			
1Y	1.01	0.13	0.87
2Y	0.93	0.08	0.82
5Y*	0.79	0.04	n.a.
Swisscom			
1Y	0.70	0.07	0.52
2Y	0.62	0.04	0.62
5Y*	0.60	0.02	n.a.
EU Comparators Avg.			
1Y	**0.76**		**0.75**
2Y	**0.75**		**0.84**
5Y	**0.82**		**n.a.**

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018; Notes: daily data; previous results have been updated to reflect the currency adjustment for the FTSE All Europe.

Figure 3.12 shows the evolution of the 2-year equity betas of the European Telecoms comparators and BT against the FTSE All Europe index, over the period July 2013 to July 2018. In the first chart, we can see that the most noticeable difference since our September 2017 update is the fall in the equity betas of Telecom Italia and Telefonica. The second chart shows a moderate declining trend for the average equity beta for European Telecoms since our September update, which is currently higher than BT's equity beta.

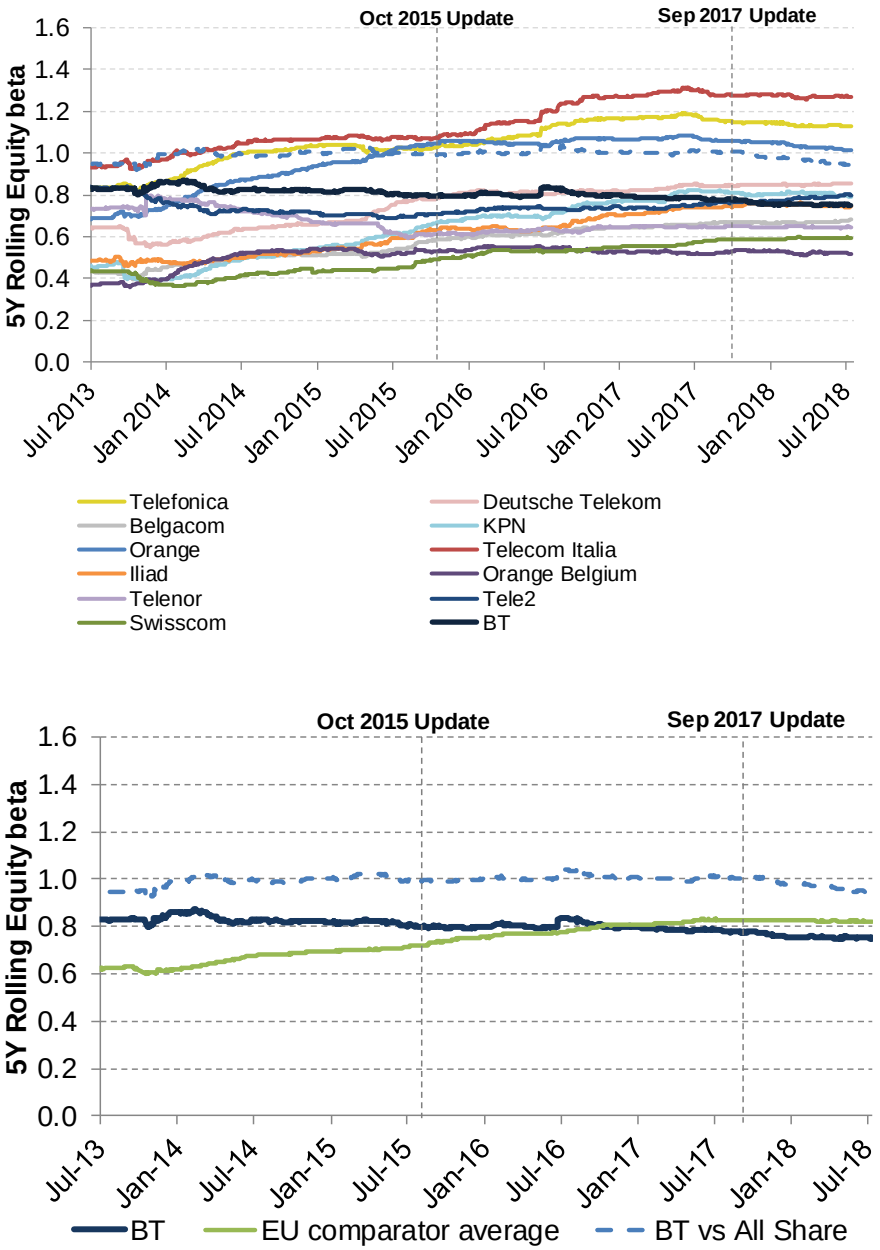
Figure 3.12: BT and European Telecoms – 2Y Rolling Equity Beta against FTSE All Europe



Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018; Note: Daily data, 2-year estimation window, FTSE All Europe as reference index.

Figure 3.13 shows the evolution of the 5-year equity betas for European Telecom comparators and BT against the FTSE All Europe index, over the period July 2013 to July 2018. Compared to the 2-year results, we see that the 5-year equity betas are relatively more stable. The average of the 5-year betas for European Telecoms has not changed much in recent years, and BT's 5-year beta has only decreased slightly since our September 2017 update.

Figure 3.13: BT and European Telecoms – 5Y Rolling Equity Beta against FTSE All Europe

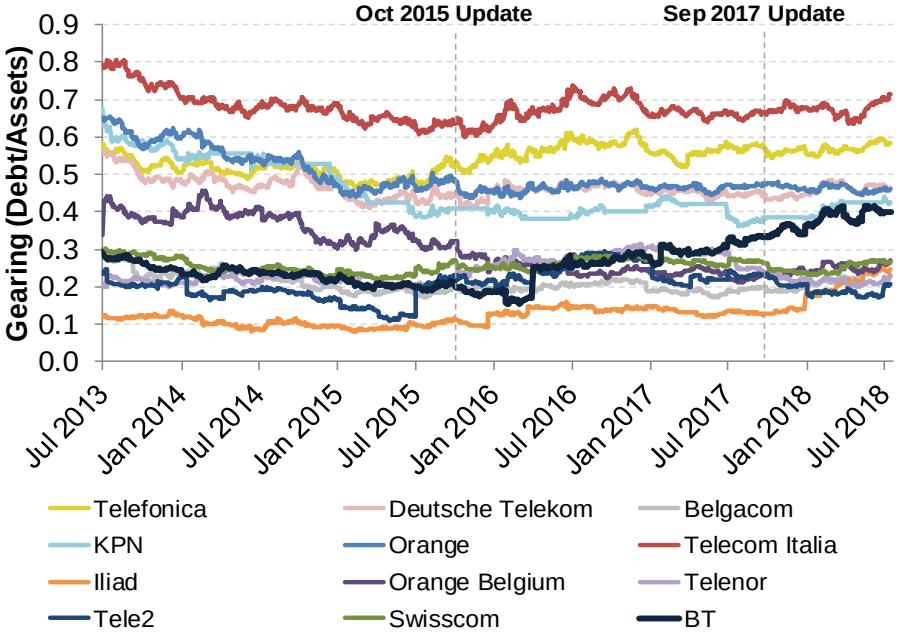


Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018; Note: Daily data, 5-year estimation window, FTSE All Europe as reference index.

3.2.2. Gearing and asset betas

Figure 3.14 shows the rolling gearing levels of the European Telecoms comparators, over the period July 2013 to July 2018. Overall, gearing for the European Telecoms comparator set has not changed significantly since our September 2017 update, although we see an increasing trend for Telecom Italia and Iliad.[33]

Figure 3.14: BT and European Telecoms Gearing



Source: NERA analysis based on Bloomberg data. Note: Cut-off date is 20 July 2018, daily data, 2-year rolling averages.

Table 3.9 below reports asset betas for the set of European Telecom comparators.

[33] Telecom Italia is the only European telecoms comparator that does not currently have an investment grade rating. We expect this to be at least partially driven by its high gearing, compared to the rest of the sample. See Telecom Italia Group Website (2018), Investors – Rating, link: http://www.telecomitalia.com/tit/en/investors/financial-profile/rating.html (accessed 5 September 2018).

Table 3.9: BT and European Telecoms Asset Beta against the FTSE All Europe

		FTSE All Europe	
		Asset beta (Jul 18)	Asset beta (Sep 17)
	Gearing	Debt beta=0.1	Debt beta=0.1
BT			
1Y	37%	0.58	0.32
2Y	33%	0.45	0.64
5Y	27%	0.57	n.a.
Telefonica			
1Y	57%	0.46	0.54
2Y	57%	0.50	0.64
5Y	54%	0.57	n.a.
Deutsche Telekom			
1Y	46%	0.39	0.43
2Y	46%	0.42	0.47
5Y	46%	0.51	n.a.
Belgacom			
1Y	21%	0.61	0.56
2Y	21%	0.56	0.54
5Y	21%	0.56	n.a.
KPN			
1Y	40%	0.47	0.44
2Y	40%	0.47	0.46
5Y	47%	0.47	n.a.
Orange			
1Y	46%	0.43	0.46
2Y	47%	0.45	0.53
5Y	50%	0.56	n.a.
Telecom Italia			
1Y	67%	0.42	0.42
2Y	68%	0.43	0.55
5Y	68%	0.47	n.a.
Iliad			
1Y	18%	0.55	0.65
2Y	16%	0.55	0.59
5Y	13%	0.66	n.a.
Orange Belgium			
1Y	24%	0.53	0.44
2Y	24%	0.44	0.44
5Y	31%	0.39	n.a.
Telenor			
1Y	22%	0.41	0.42
2Y	26%	0.40	0.54
5Y	24%	0.51	n.a.
Tele2			
1Y	20%	0.83	0.69
2Y	23%	0.74	0.64
5Y	21%	0.65	n.a.
Swisscom			
1Y	25%	0.54	0.41
2Y	26%	0.48	0.48
5Y	26%	0.47	n.a.
EU Comparators Avg.			
1Y	35%	**0.51**	**0.50**
2Y	36%	**0.50**	**0.53**
5Y	36%	**0.53**	**n.a.**

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018; Note: daily data, previous results have been updated to reflect the currency adjustment for the FTSE All Europe.

The average 2-year asset beta has decreased slightly to 0.50 against the FTSE All Europe (vs 0.53 in the September 2017 update). Given the rather stable gearing, this decrease is largely due to the decline in average equity betas.

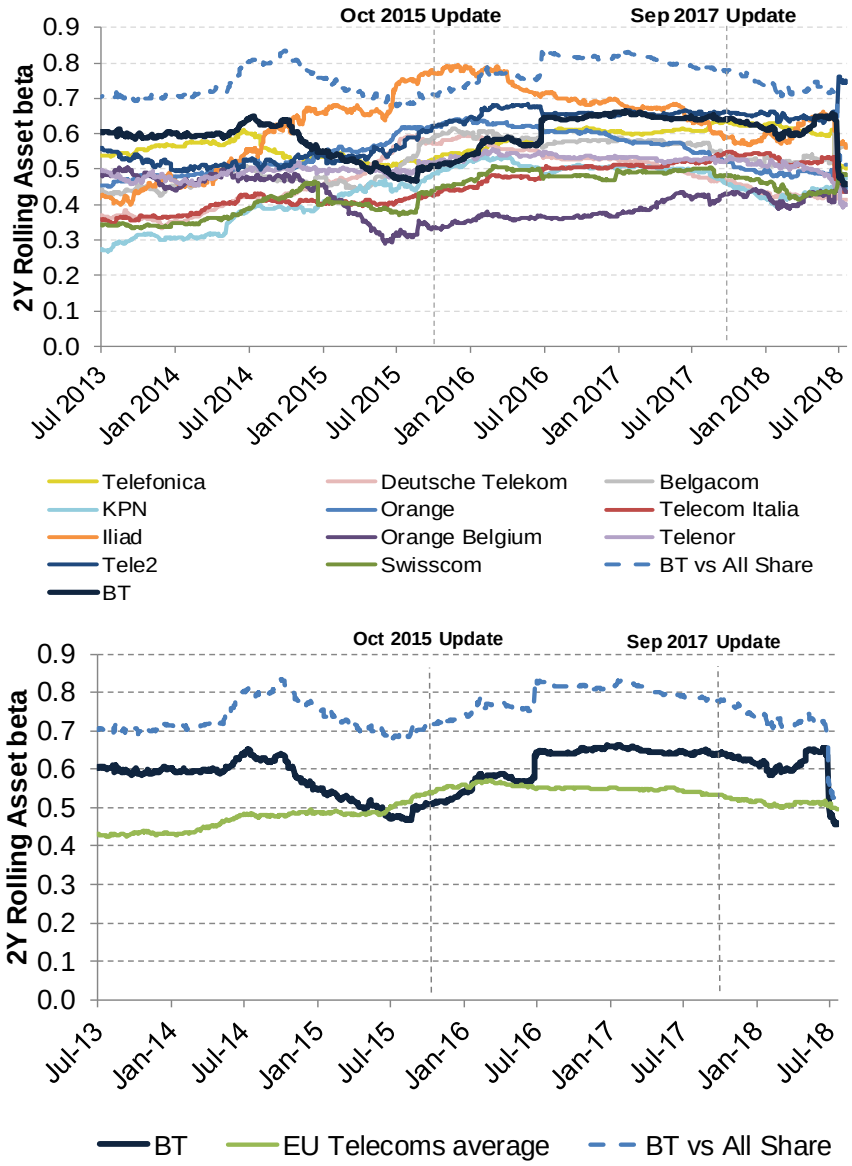
The average 5-year asset beta estimates for the European Telecoms is slightly higher than both the 1-year and the 2-year asset beta.

A direct comparison between BT and the EU Telecom's average shows the following:

- The 2-year asset beta of BT is lower than the average 2-year asset beta for the EU Telecom's estimated against the FTSE All Europe (0.45 vs 0.50);
- The 5-year asset beta of BT is higher than the average 5-year asset beta for EU Telecom's average against the FTSE All Europe (0.57 vs 0.53). This is mainly because the 5-year beta also captures the time before the Brexit referendum.

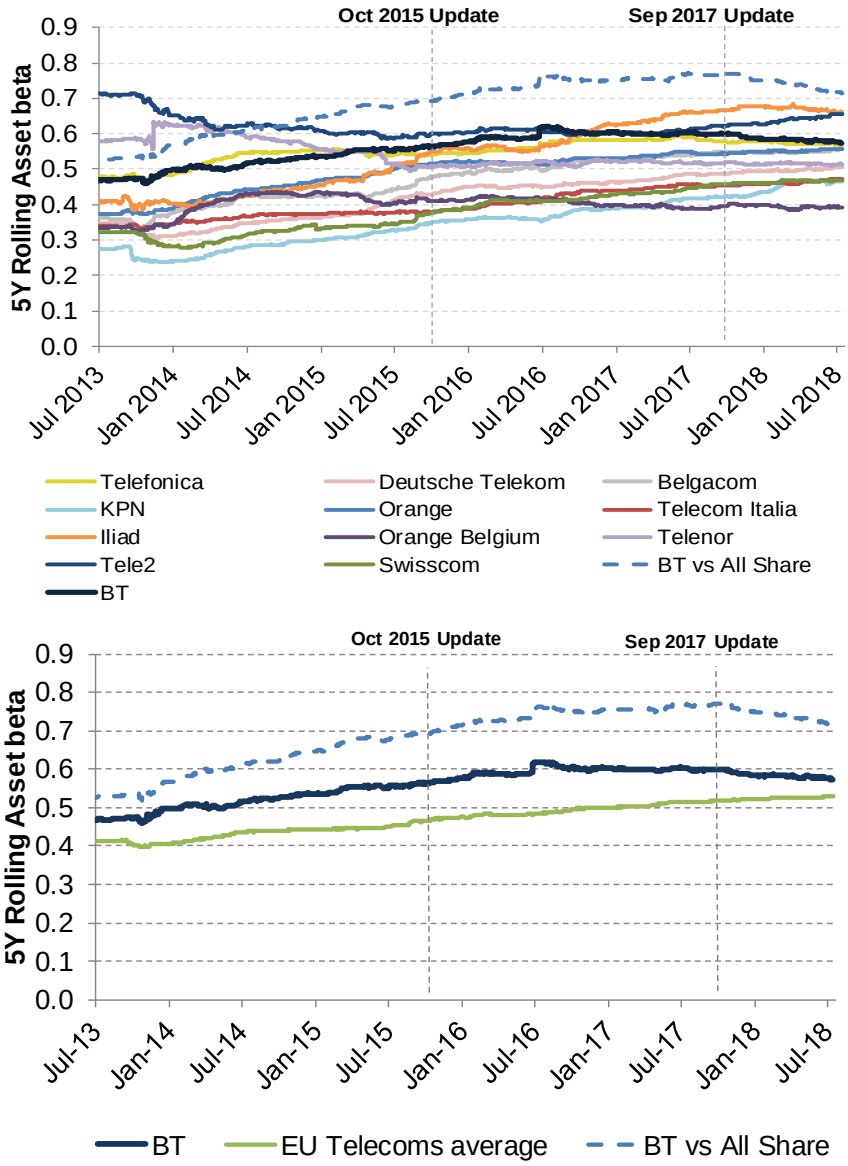
A more detailed view of the evolution of the 2-year asset betas is shown in Figure 3.15, while the 5-year asset beta evolution is shown in Figure 3.16.

Figure 3.15: BT and European Telecoms – 2Y Rolling Asset Beta against FTSE All Europe



Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018; Note: Daily data, 2-year estimation window, FTSE All Europe as reference index.

Figure 3.16: BT and European Telecoms – 5Y Rolling Asset Beta against FTSE All Europe



Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018; Note: Daily data, 5-year estimation window, FTSE All Europe as reference index.

3.2.3. Discussion of asset beta results for European telecoms comparators

Using 2-year asset betas, we obtain a range for European Telecoms of 0.40-0.74 (previously 0.44-0.64) against the FTSE All Europe index. While the FTSE All Europe range has become wider especially with regard to the upper end, this is not indicative of a general increase in asset betas (the average asset beta for European Telecoms decreased by c.0.03; the upper-end increase is due to the substantial increase in Tele2's asset beta).

BT's updated 2-year asset beta against FTSE All Europe of 0.45 lies closer to the lower end of the European telecoms range, unlike in our September 2017 update, where it was equal to the upper end of this range (0.64 asset beta compared to 0.44-0.64 European telecoms range). Given the relatively stable nature of this range (without Tele2, the current upper end would be 0.56) and the large decrease in BT's beta since the Brexit referendum, it is not surprising that BT's beta is now closer to the lower end of the European Telecoms range.

In contrast, the current 5-year asset beta of BT against FTSE All Europe (0.57) is higher than the current 2-year beta, and lies in the upper half of the 5-year European Telecoms range (0.39-0.66).

Table 3.10 presents the updated asset betas estimated against the FTSE All Europe.[34] We also show asset beta ranges using the FTSE All World as reference index (in Table 3.11), which shows the same trends and relative results.[35]

Table 3.10: European Telecoms Asset Beta ranges against FTSE All Europe

Comparators	2Y (Sep 2017)	2Y (Jul 18)	5Y (Jul 18)
BT (against FTSE All Europe)	0.64	0.45	0.57
European Telecoms	0.44-0.64	0.40-0.74	0.39-0.66

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018. Note: Results for September 2017 have been re-estimated using the FTSE All Europe denominated in Euros.

Table 3.11: European Telecoms Asset Beta ranges against FTSE All World

Comparators	2Y (Sep 2017)	2Y (Jul 18)	5Y (Jul 18)
BT	0.86	0.38	0.68
European Telecoms	0.51-0.86	0.38-0.63	0.43-0.74

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.

In Appendix B (Figure B.2), we present confidence intervals for the asset betas of the EU Telecoms comparators. We see a similar trend for EU Telecoms as for BT and UK comparators (see section 3.1.4): the width of the 2-year confidence intervals has increased considerably compared to September 2017 (they are on average 49% wider), reflecting an increase in standard errors in recent years. By contrast, the 5-year intervals are relatively narrow, both because the 5-year estimates are based on a larger number of observations (and are hence more statistically robust), and because they are less affected by the recent increase in standard errors. Again, this evidence supports our recommendation to consider both the 2-year and the 5-year beta estimates in the upcoming review.

3.3. ICT Comparators

3.3.1. BT's ICT Service and Product Offering

BT offers a diversified portfolio of ICT products and services, which we group as follows:

[34] We have also prepared beta estimates using weekly data, as a cross-check. We present these estimates in Appendix G. In general, we obtain consistent results using weekly data (but slightly higher ranges).

[35] We present these estimates in Appendix D.

- **Managed Networked IT Services and Security** is the largest segment under the Global Services (GS) umbrella, and covers:
  - Managed networked services, offered under the *BT Connect* brand; BT Connect comprises the largest source of revenue within GS[36], and offers a range of network and connectivity solutions to large corporate clients, including set-up and management of secure IP, Ethernet and internet virtual private network services; and
  - The cyber security services, offered under the *BT Security* brand; BT Security covers a range of products and services to protect clients from cyber threats, including firewalls, web security, intrusion prevention etc.
- **Unified Communications and IT Infrastructure** covers:
  - Collaborative communications, offered under the *BT One* brand; BT One offers integrated connectivity solutions for corporate clients, including integrated conferencing and collaboration services, Cisco off-the-shelf solutions, managed IP telephony etc.; and
  - IT infrastructure services, offered under the BT Compute brand; BT Compute offers a range of services from traditional tele-housing and colocation to public, private and hybrid cloud solutions.
- **Professional Services and IT Consulting** covers:
  - Professional advisory services, offered under the *BT Advise* brand; BT Advise includes IT Consulting and integration services; and
  - Outsourced client relationship management services, offered under the BT Contact brand.

We provide more detail on the type of activity within each segment in Table 3.12 below.

[36] BT's segmental accounts for 2011 report that 66% of GS revenues came from managed solutions. BT has since discontinued the segmental revenue reporting, but BT's Annual Reports continue to discuss the managed network services as the dominant line of business within GS.

Table 3.12: BT's ICT Product and Service Offering

(1) Managed Networked IT Services	(2) Unified Comms / IT Infrastructure		(3) Professional Services/ IT Consulting (CRM / BPM)	
BT Connect (& Security)	BT One	BT Compute	BT Contact	BT Advise
A range of managed network solutions – including secure IP, Ethernet, and internet VPNs – provided through different access technologies: - Access choices (e.g. Ethernet via fiber or copper) - Application performance management - Dedicated Services - Internet services - IP address management - Managed network services - Virtual Private Network services A range of **security solutions,** including firewalls, web security, intrusion prevention and threat monitoring.	**Unified Connectivity,** provides integrated communication channels: - Conferencing and Collaboration services (e.g. cloud unified communications) - Hosted Unified Communications Services (e.g. Cisco Unified Communications) - Managed IP Telephony - Voice VPN (own corporate telephone networks) **Calls and lines,** provides: - Business exchange lines - Call & lines packages - Analytics	Provides **reliable and flexible IT platforms and services** for business apps, data storage and security: - Traditional telehousing and colocation centres; - Latest public, private and hybrid cloud solutions; - Professional Services for IT (infrastructure assessment and optimization)	**Outsourced Client Relationship management,** including: - Cloud contact centres - Contact recording and analytics - Inbound services - Onsite contact centres - Self-service and queue management platforms	**Professional advisory**, including: - CRM Professional services (e.g. BT Contact Centre Efficiency Quick Start assess contact center operations) - IT professional services (infrastructure assessment, optimization, storage design and data management) - Mobility professional services

Source: NERA analysis based on BT's annual reports.

3.3.2. Asset Beta Estimates

Table 3.13 and Table 3.14 report the 2-year and 5-year asset beta estimates, respectively, of our sample of ICT comparators, indicating whether each comparator is active in each of BT's ICT product and service lines discussed above.[37]

Based on the product and service lines coverage in Table 3.12, we categorise the sample of comparators into two tiers[38] and address the changes since our September 2017 update, namely:

- *Tier 1* – includes companies that are active across all three main ICT product and service lines offered by BT. The average 2-year asset beta of this group has fallen against the local index, from 0.67 to 0.53, while against the world index it has fallen from 0.89 to 0.8; and
- *Tier 2* – includes companies that are active (at least) across two of the three main ICT product and service lines offered by BT. All ICT comparators meet this requirement, and hence Tier 1 is a subsample of Tier 2. As is the case with Tier 1, the average 2-year asset beta for the sample as a whole (i.e. Tier 2) has fallen against the local index, from 0.68 in our last September 2017 update to 0.56. The average 2-year asset beta against the world index has also decreased, from 0.89 to 0.79.

For the 5-year values, we see that gearing is relatively close to that of the 2-year values, whereas equity and asset betas are generally higher against both indices and in both tiers.

[37] The sample of companies does not report segmental accounts on a consistent basis – hence a consistent breakdown of revenues into GS equivalent business areas is not readily available.

[38] Tier 1 is a subset of Tier 2.

Table 3.13: 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	20%	0.90	0.06	1.02	0.09	0.74		0.84		✓
UNISYS CORP	US	Y	Y	Y	S&P 500	49%	1.28	0.20	1.35	0.26	0.70		0.73		✓
AMDOCS LTD	US	Y	Y	Y	S&P 500	1%	0.67	0.05	0.77	0.07	0.66		0.76	*	✓
TELETECH HLDGS	US	Y	Y	Y	S&P 500	13%	0.71	0.10	0.87	0.13	0.63		0.77	*	✓
CDW CORP/DE	US	N	Y	Y	S&P 500	26%	0.91	0.08	1.03	0.10	0.70	*	0.79		
COGNIZANT TECH-A	US	N	Y	Y	S&P 500	2%	0.87	0.08	1.10	0.11	0.86		1.07		
XEROX CORP	US	N	Y	Y	S&P 500	43%	1.06	0.11	1.32	0.14	0.64		0.79		
INDRA SISTEMAS	SP	Y	Y	Y	FTSE All Europe	39%	0.75	0.10	0.85	0.14	0.29		0.56		✓
CANCOM AG	GE	Y	Y	Y	FTSE All Europe	5%	1.00	0.11	1.25	0.15	0.45	*	1.19	*	✓
ATOS SE	FR	Y	Y	Y	FTSE All Europe	13%	0.94	0.08	0.82	0.11	0.26		0.73		✓
SOPRA STERIA GRO	FR	N	Y	Y	FTSE All Europe	23%	1.03	0.08	1.06	0.11	0.44		0.84		
CAP GEMINI	FR	N	Y	Y	FTSE All Europe	18%	0.92	0.07	0.95	0.10	0.36		0.79		
TIETO OYJ	FI	N	Y	Y	FTSE All Europe	9%	0.77	0.08	0.70	0.12	0.48	*	0.64		
CGI GROUP INC-A	CA	N	Y	Y	S&P/TSX Composite	8%	0.62	0.06	0.62	0.08	0.57		0.57		
Average (Jul 2018)															
Tier 1						**20%**	**0.89**		**0.99**		**0.53**		**0.80**		
Tier 2 (all comparators)						**19%**	**0.89**		**0.98**		**0.56**		**0.79**		
Average (Sep 17)															
Tier 1						**19%**	**1.00**		**1.13**		**0.67**		**0.89**		
Tier 2 (all comparators)						**20%**	**0.98**		**1.12**		**0.68**		**0.89**		

*Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018; Note: Previous results have been updated to reflect the currency adjustment for the FTSE All Europe; daily data; two-year estimation window; *GLS reported where regression diagnostics show heteroscedasticity or autocorrelation.*

Table 3.14: 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	18%	0.91	0.03	0.98	0.04	0.76	*	0.82	*	✓
UNISYS CORP	US	Y	Y	Y	S&P 500	38%	1.47	0.10	1.61	0.12	0.95		1.04		✓
AMDOCS LTD	US	Y	Y	Y	S&P 500	1%	0.73	0.03	0.78	0.03	0.72		0.77	*	✓
TELETECH HLDGS	US	Y	Y	Y	S&P 500	10%	0.90	0.05	0.96	0.06	0.82	*	0.88	*	✓
CDW CORP/DE	US	N	Y	Y	S&P 500	33%	0.93	0.04	1.03	0.05	0.66		0.72		
COGNIZANT TECH-A	US	N	Y	Y	S&P 500	2%	1.17	0.04	1.28	0.05	1.15	*	1.25	*	
XEROX CORP	US	N	Y	Y	S&P 500	41%	1.22	0.05	1.36	0.06	0.76		0.85	*	
INDRA SISTEMAS	SP	Y	Y	Y	FTSE All Europe	38%	0.98	0.05	1.21	0.08	0.64		0.79		✓
CANCOM AG	GE	Y	Y	Y	FTSE All Europe	7%	0.95	0.06	1.30	0.08	0.89	*	1.22	*	✓
ATOS SE	FR	Y	Y	Y	FTSE All Europe	12%	0.88	0.03	1.00	0.05	0.78	*	0.89	*	✓
SOPRA STERIA GRO	FR	N	Y	Y	FTSE All Europe	25%	0.72	0.05	0.90	0.07	0.57	*	0.70	*	
CAP GEMINI	FR	N	Y	Y	FTSE All Europe	17%	1.03	0.03	1.17	0.06	0.88	*	0.99	*	
TIETO OYJ	FI	N	Y	Y	FTSE All Europe	9%	0.70	0.04	0.78	0.06	0.64	*	0.71	*	
CGI GROUP INC-A	CA	N	Y	Y	S&P/TSX Composite	13%	0.67	0.05	0.68	0.05	0.59		0.61		
Average (Jul 2018)															
Tier 1						**18%**	**0.97**		**1.12**		**0.80**		**0.92**		
Tier 2 (all comparators)						**19%**	**0.95**		**1.07**		**0.77**		**0.87**		

*Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018; Note: Previous results have been updated to reflect the currency adjustment for the FTSE All Europe; daily data; two-year estimation window; *GLS reported where regression diagnostics show heteroscedasticity or autocorrelation.*

3.3.3. Discussion of asset beta results for ICT comparators

Table 3.15 and Table 3.16 present the ranges for the 2-year and 5-year beta estimates for BT and ICT comparators, estimated against the FTSE All World and the local/regional indices, respectively.[39] As explained in section 2, we put relatively more weight on the world index estimates for ICT comparators, as we are comparing beta estimates of companies that operate in different jurisdictions and under different regulatory regimes.

Table 3.15: ICT Comparators Asset Beta ranges against FTSE All World

Comparators	2Y (Sep 2017)	2Y (Jul 18)	5Y (Jul 18)
BT	0.86	0.38	0.68
ICT - Tier 1	0.69-1.07	0.56-1.19	0.77-1.22
ICT - Tier 2 (all comparators)	**0.69-1.21**	**0.56-1.19**	**0.61-1.25**

NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.

Table 3.16: ICT Comparators Asset Beta ranges against local/regional indices

Comparators	2Y (Sep 2017)	2Y (Jul 18)	5Y (Jul 18)
BT	0.78	0.51	0.71
ICT - Tier 1	0.27-1.06	0.26-0.74	0.64-0.95
ICT - Tier 2 (all comparators)	**0.27-1.24**	**0.26-0.86**	**0.57-1.15**

NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018. Note: ICT results for September 2017 have been re-estimated using the FTSE All Europe denominated in Euros.

Whereas the lower end of the 2-year range for ICT comparators (against the world index) has decreased since our September 2017 update (0.56 vs 0.69 previously), most changes in beta estimates are moderate compared to what we see for some telecoms comparators. Moreover, unlike for UK comparators and European Telecoms comparators, the width of the confidence intervals for the ICT betas is not substantially different from what it was in September 2017 (as shown in Appendix B, Figure B.3). Whereas we observe wider 2-year intervals compared to September 2017 (on average 25% wider), the increase in the confidence intervals is smaller than for UK comparators and European Telecoms comparators.

In September 2017, BT's 2-year asset beta against the world index (0.86) was relatively close to the midpoint of the 2-year range for ICT comparators (0.69 – 1.21). Since then, BT's 2-year beta (0.38 against the world index, 0.51 against FTSE All Share) has seen a substantial decline and currently lies below the lower end of the ICT range (against the FTSE All World), despite the decrease in the lower end of this range relative to September 2017. This change in BT's relative position is largely driven by what we call the referendum effect (see Appendix A).

Unlike BT's 2-year asset beta, BT's current 5-year asset beta falls within the updated 5-year range for ICT comparators (0.61 to 1.25). However, its current value is closer to the lower end of the five-year range, which also reflects the referendum effect.

[39] As a cross-check, we have also prepared beta estimates using weekly data. We present these estimates in Appendix G. In general, we obtain consistent results using weekly data (ranges for weekly data tend to be slightly higher, except for the upper end of the 5-year range, which is lower than when using daily data).

4. Debt Beta

To assess whether Ofcom's previous approach to setting the debt beta remains appropriate, we have reviewed UK regulatory precedent, academic evidence, as well as guidelines that practitioners have relied on.

In summary, we find that Ofcom's previous assumption of 0.1 is in line with this evidence. We have also analysed how sensitive our asset beta estimates are with regard to the debt beta assumption, and find that they are not very sensitive for moderate changes. We present the results of this analysis in Appendix F.

4.1. Regulatory precedent and academic evidence

The debt beta captures the degree of correlation between the returns to debt-holders and the broader economy, analogous to the equity beta which captures systematic risk for equity-holders. Under standard corporate finance theory, both quantities are needed to obtain the asset beta, a measure of business risk which removes the effect of leverage (i.e. quantifies systematic risk as if the company had no debt). We use the standard Miller formula to un-lever and re-lever equity beta estimates:[40]

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

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).

As this formula shows, the debt beta assumption affects the re-levered cost of equity only to the extent that the empirical leverage of comparators differs from the notional assumption for BT. If the empirical leverage is the same as the notional leverage and consistent debt betas are used for un-levering and re-levering, there is no impact on the re-levered cost of equity. The CMA recognised this in the 2015 Bristol Water appeal, where it assumed a debt beta of zero, noting that the debt beta has very little impact on the overall cost of capital, as Bristol Water's notional gearing level was similar to the gearing levels of the comparator companies.[41]

[40] The formula presented is the so-called "Miller formula", which assumes that the capital structure of the firm is constant, or in other words that the firm pursues a target capital structure and rebalances its debt and equity constantly towards its target. This is consistent with Ofcom's approach of setting a notional gearing for BT.

[41] Source: CMA (06 10 2015): Bristol Water Plc Final Determination, Section 10. Cost of Capital, p.325, para 10.150.

As shown in sections 3.1.2 and 3.2.2, the empirical gearing levels of BT's various comparators tend to be different from the notional gearing level Ofcom set for BT at the last review (30%)[42]. In general, the current ranges are relatively wide: 35% to 60% for UK utilities and telecoms (excluding Sky, see Figure 3.14), and 20% to 70% for European telecoms (see Figure 3.14). We therefore assess whether Ofcom's previous assumption for the debt beta (0.1) is in line with regulatory precedent, academic evidence, and guidelines provided by practitioners.

Table 4.1 shows that in recent publications, the debt beta assumptions made by UK regulators have ranged from 0 to 0.1. Ofgem, in its recent consultation for the next regulatory period (RIIO-2), has used a debt beta of zero, while Ofwat proposed a debt beta assumption of 0.1 in its most recent price review (PR19). Ofcom's current assumption of 0.1 is consistent with the 0 to 0.1 range. Recent publications by CEPA (who advise Ofgem on RIIO-2) and PwC (who advised the CAA on the most recent Heathrow price control review) make debt beta assumptions of 0 and 0.05, respectively, following the relatively low assumptions proposed by the CMA for NIE and Bristol of 0.05 and 0 respectively. If anything, recent UK regulatory precedent points to a decreasing trend in debt beta assumptions for regulated sectors in the UK.[43]

Table 4.1: UK regulatory precedent on debt beta assumption

Regulatory Precedent	Decision/consultation	Date	Debt Beta
Ofgem RIIO-T1	Decision	2012	no debt beta
Ofgem RIIO-GD1	Decision	2012	no debt beta
Ofgem RIIO ED1	Decision	2014	no debt beta
Ofgem/CEPA RIIO-2	Consultation	2018	0
CAA Heathrow/Gatwick Q6	Decision	2014	0.1
CAA/PwC H7	Consultation	2017	0.05
CMA NIE	Decision	2014	0.05
CMA Bristol	Decision	2015	0
Ofwat PR14	Decision	2014	0
Ofwat PR19 final methodology	Early view	2017	0.1
Ofcom (BC market review)	Decision	2013	0.15
Ofcom (FA market review)	Decision	2014	0.1
Ofcom (MCT market review)	Decision	2015	0.1
Ofcom (BC market review)	Decision	2016	0.1
Ofcom (WLA market review)	Decision	2018	0.1

Source: NERA analysis of regulatory documents.

In addition to regulatory precedent, we also take into account estimates provided by academics and practitioners, as shown in Table 4.2.

[42] Source: Ofcom (28 03 2018): WLA market review Statement annexes 17-27, p.112, para A20.141-A20.144.

[43] PwC (November 2017), Estimating the cost of capital for H7 - A report prepared for the Civil Aviation Authority (CAA), p.81.

Table 4.2: Academic and other evidence on debt beta

Authors	Date	Rating	Debt Beta
Fama & French	2002	BBB	0.22
		A	0.21
		AA	0.20
Schaefer & Strebulaev	2008	-	0.04
Damodaran	2012	A	0.125
Brealey & Myers	2013	-	0.00 - 0.20
Brattle Group	2016	BBB+ to BBB-	0.10
		AAA to A-	0.05

Source: Fama, E and French, K (1993): "Common risk factors in the returns on stocks and bonds", Journal of Financial Economics, Vol. 33, No.1, pp. 3-56; Schaefer, S and Strebulaev, I (2008): "Structural models of credit risk are useful: Evidence from hedge ratios on corporate bonds", Journal of Financial Economics, Vol. 90, No.1, pp. 1-19; Damodaran, A (2012): "Investment Valuation – Tools and Techniques for Determining the Value of any Asset", p411; Allen F., Brealey R., Myers S. (2013): Principles of Corporate Finance 11th Edition, page 436; Brattle Group (2016) report for the European Commission: Review of approaches to estimate a reasonable rate of return for investments in telecoms networks in regulatory proceedings and options for EU harmonization, Section VI.G, page 88.

In theory, debt betas can be estimated in the same way as equity betas by regressing bond returns against a relevant reference market index, but in practice, the low trading frequency for many bonds leads to illiquidity issues that make the estimation of a debt beta particularly difficult and subject to distortions that do not provide robust estimates.

This may explain why we see a relatively wide range of values in Table 4.2. Whereas in 2002, Fama & French suggested that a debt beta assumption around 0.2 may be appropriate (regardless of the credit rating), more recent estimates are lower and largely support the range of 0 to 0.1 derived from regulatory precedent. We note that Ofcom's previous assumption of 0.1 is equal to the midpoint of the range provided by Brealey & Myers.

Some authors recommend a simple rule of thumb that sets the debt beta based on the company's credit rating, without relying on empirical estimates. For example, Brattle suggests a range of 0.05 to 0.1, consistent with the upper end of the range we obtain based on UK regulatory precedent. Ofcom's previous approach of assuming a debt beta of 0.1 for BT, which currently has a BBB rating, is in line with Brattle Group's recommendation of using a debt beta of 0.1 for BBB-rated companies.[44]

4.2. Conclusion on debt beta

Overall, we consider that Ofcom's previous assumption of 0.1 for BT's debt beta remains appropriate for the purpose of 2019 BCMR. It is consistent with the upper end of recent regulatory determinations in the UK and with the more recent evidence provided by academics and practitioners.

[44] See for example: Moody's website (2018), *BT Group Plc*., link: https://www.moodys.com/credit-ratings/BT-Group-Plc-credit-rating-600064833; Reuters (2018), *S&P cuts BT Group's credit rating*; link: https://uk.reuters.com/article/bt-group-ratings/sp-cuts-bt-groups-credit-rating-idUKL4N1TE569.

We also note that a moderate change in the debt beta assumption would have a relatively small effect on the asset beta estimates. As shown in Appendix F, decreasing the debt beta from 0.1 to 0.05 would reduce asset betas by around 0.02.

5. Beta for BT's Leased Lines Business

In this section, we present our recommendations on the beta for leased lines for the 2019 BCMR.

In summary, we consider that Ofcom's previous approach, i.e. setting the leased lines asset beta in line with its assumption for OUKT, remains appropriate (see sections 5.2 and 5.3). Drawing on the latest empirical evidence for BT and comparators, we conclude that Ofcom may consider setting a somewhat wider range for the asset beta for OUKT/leased lines, compared to its 2018 WLA market review, as set out in section 5.4.

5.1. Overview of Ofcom's previous approach

As noted previously, in its 2018 WLA market review, Ofcom determined the asset beta and gearing for leased lines using a three-way decomposition of BT Group.

In the 2018 WLA market review, Ofcom started by estimating an asset beta for Openreach copper access, arguing that this should lie above the utility betas (i.e. above the average of 0.4)[45] but below the BT Group 2-year asset beta of 0.78[46] at the time. Ofcom used the midpoint of this range, after confirming that this midpoint is lower than the average for UK telecoms comparators (0.6 at the time), and hence arrived at an asset beta of 0.59 for Openreach copper access.[47]

For OUKT, Ofcom argued that this part of BT's business is riskier than Openreach copper access,[48] but less risky than ICT.[49] Combining this with evidence from UK and European Telecoms providers, Ofcom initially arrived at a range of 0.55 to 0.75. Taking into account the evolution of the beta for the relevant comparators, and that the weighted sum of the disaggregated betas must sum to BT's Group beta of 0.78, Ofcom arrived at an estimate of 0.73 for OUKT.[50]

For the Rest of BT, Ofcom considered that the asset beta could be no higher than the upper end of the range for ICT (0.7 to 1.25). Taking into account that the weighted sum of the disaggregated betas must sum to BT's Group beta of 0.78, Ofcom concluded that using the upper end of this range (1.25) for the Rest of BT was appropriate.[51]

At the previous review for leased lines, i.e. the 2016 BCMR, Ofcom applied the same decomposition and a similar logic and set the beta for leased lines based on the beta of Other UK Telecoms.

We consider that this general approach remains appropriate, as discussed in the following sections.

---

45 Ofcom (28 03 2018): WLA market review Statement annexes 17-27, p.118, para A20.168.

46 Ofcom (28 03 2018): WLA market review Statement annexes 17-27, p.111, para A20.139.

47 Ofcom (28 03 2018): WLA market review Statement annexes 17-27, p.124-126, para A20.189-A20.191.

48 Ofcom (28 03 2018): WLA market review Statement annexes 17-27, p.129, para A20.204.

49 Ofcom (28 03 2018): WLA market review Statement annexes 17-27, p.128, para A20.201.

50 Ofcom (28 03 2018): WLA market review Statement annexes 17-27, p.131-133, para A20.212-A20.217.

51 Ofcom (28 03 2018): WLA market review Statement annexes 17-27, p.131-133, para A20.216-A20.217.

5.2. Systematic risk of OUKT and the leased lines business

With regard to the 2019 BCMR, we first address the question of whether it remains appropriate to set the asset beta for leased lines based on the point estimate/range determined for OUKT.

In theory, we can assess the systematic risk of the leased lines business relative to other products and services included in OUKT (e.g. mobile services, Pay TV) based on key determinants of beta risk such as:

- **Demand/volume and revenue risk:** Taking into account the elasticity of demand for different types of services including exposure to different customer types (domestic vs. business), types of and duration of contracts and exposure to volume risk, the impact of the price control mechanism (e.g. in case of leased lines);
- **Operational leverage**: Operating leverage is a measure of the cost fixity of a business, and is analogous to the impact of financial leverage on a company's beta. In fact, in the same way that higher levels of debt increase the volatility of returns to equity, businesses with higher proportion of fixed costs face greater volatility in (net) cash flows in the event of shocks. For this reason, operating leverage is widely recognised in the literature as a key determinant of the beta risk of a business;
- **Bad debt cost risk**: Economic downturns are likely to be accompanied with higher levels of non-paid bills and accentuate the impact of a downturn on risk and increase beta as a result;
- **Competition/stranding risk**: Exposure to competitive threats may expose companies to risk of stranded assets; and
- **Input price risks**: degree to which key input prices are correlated with the business cycle.

In practice, we do not have sufficient data to assess most of these factors quantitatively. We present some indicative results on operational leverage and volume risk in the following section, but due to data limitations, we consider these as a high-level cross-check only.

Drawing on our current analysis of the systematic riskiness of BT's products and services as well as previous work for Ofcom on these issues, we find the following:

- In its 2018 WLA Statement, Ofcom has considered the activities included in OUKT to be on average riskier than Openreach copper access; we consider that this assumption remains appropriate for leased lines, as the nature of the businesses has not changed in a material way. Our relative risk analysis supports this view (see section 5.3 and Appendix C);
- In our report to Ofcom from March 2016, we found that the empirical asset beta ranges for Pay TV (which is included in OUKT) were only slightly higher than the asset beta ranges of telecoms comparators in general, and that the Pay TV ranges were relatively

wide. This evidence did not provide a basis to conclude that BT's Pay TV business was substantially riskier than other OUKT activities such as leased lines;[52]

- In our report to Ofcom from November 2017 ("The Evidence for Differences in Risk for Fixed vs Mobile Telecoms"), we compared predominantly fixed and mobile telecoms businesses, and found no evidence of statistically significant difference in the betas of fixed vs mobile telecoms network operators.[53] We present the current shares of fixed line activities of BT and other telecoms comparators in Appendix E. In line with our previous findings, we do not see a clear relationship between the share of fixed line activities and the empirical asset betas, i.e. there is no basis to conclude that mobile telecoms businesses have higher or lower systematic risk than fixed line businesses. This further supports the view that the leased lines business is similar to other activities included in OUKT with regard to systematic riskiness;
- Many of the unregulated products included in OUKT are retail versions of regulated wholesale products. We would expect the difference in systematic riskiness between different categories of the same product to be moderate;
- With regard to the "Rest of BT", we find that the updated asset beta ranges for ICT comparators remain higher than the beta ranges for telecoms comparators, which supports the view that the "Rest of BT" has a higher systematic risk than OUKT.

Based on the above findings, we conclude that it remains appropriate to set the OUKT above the asset beta for Openreach copper access, but below the asset beta for the "Rest of BT". In the absence of evidence that indicates that leased lines may be less risky than other lines of business included in OUKT, we consider that it remains appropriate to set an asset beta for leased lines based on the estimate/range for OUKT.

5.3. Cross-check: relative risk analysis

As a cross-check, we have compared the relative riskiness of the leased lines business to Openreach copper access and BT Group as a whole, based on two determinants of systematic riskiness:

- **Operational leverage**: the higher the share of fixed cost, the larger the impact of fluctuations in revenue on the company's bottom line and hence the higher a company's systematic riskiness; and
- **Volume/demand risk**: higher demand volatility for a line of business may indicate higher systematic riskiness.[54]

---

52 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.

53 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.

54 The volume data available to use allows us to assess total volume risk, i.e. systematic and company-specific risk. By contrast, the beta in the CAPM is a measure of systematic risk only. Under the CAPM, investors are assumed to hold diversified portfolios and are hence only being compensated for systematic risk. Based on the data available to us, we cannot distinguish which part of the observed demand volatility is systematic. We therefore consider this analysis to be a cross-check only.

We consider the results of this analysis to be indicative only, given several data-related limitations. We provide more details on the analysis and its limitations in Appendix C.

Operational leverage

With regard to operational leverage, we compute two ratios that measure the degree of cost fixity:

- **Free Cash Flow (FCF)/Total Revenues**[55]: this is a cash-flow measure of operational leverage that incorporates capex-related outflows. The higher fixed opex and capex, the lower the FCF relative to total revenues (assuming equal variable costs). In the event of a negative revenue shock, this ratio will decrease more if the share of fixed cost (i.e. fixed opex and capex) is higher (conversely, it will increase more in the event of a positive revenue shock); thus, this ratio reflects the fact that higher cost fixity leads to higher volatility in cash flow;[56] and
- **Capex/Mean Capital Employed (MCE):** this is a straightforward measure of operational leverage, which focuses on capex (as opposed to fixed opex). Given the fixed nature of capex, a higher ratio is indicative of a higher level of cost fixity (all else equal); a higher Capex/MCE ratio therefore indicates higher operational leverage, which in turn indicates higher cash flow volatility.

In general, the higher the cost fixity of a business, the lower its ability to absorb adverse developments (i.e. revenue shocks). We find that the data supports a view that leased lines tend to have higher operational leverage and hence higher risk than BT's copper access business, which is consistent with Ofcom's previous approach of setting a higher beta for leased lines (which are included in OUKT) than for Openreach Copper Access.

Table 5.1 summarises the results for the most recent two years. We estimate the ratios for BT's copper lines segment using information on fixed access markets provided in BT's regulatory financial statements, from which we remove ISDN and fibre services.[57]

Table 5.1: Operational Leverage ratios for Leased Lines vs Fixed Access

	Direction	BCM (2017)	Copper access* (2017)	BCM (2016)	Copper access* (2016)
FCF/Total Revenues	Higher value, lower operating leverage	✂	✂	✂	✂
CAPEX/MCE	Higher value, higher operating leverage	✂	✂	✂	✂

*Source: NERA analysis of BT Regulatory Financial Statements. Note:*Copper access is a proxy based on removing ISDN and fibre from the Fixed Access Markets category.*

[55] The formula for Free Cash Flow (FCF) is: revenues – opex (excluding depreciation) – capex – change in net working capital (i.e. current assets – current liabilities) – taxes (+adjustments for non-cash items). Given data limitations, we calculate a proxy using the following formula: revenues – opex (excluding depreciation) – capex.

[56] If all costs were variable, FCF would decrease in proportion with revenues and the ratio would remain unchanged.

[57] We rely on the values reported in BT's 2017 RFS Section 5 – Summary of Market Performance and Ofcom's data on fibre and capex for different segments.

The table shows the following:

- In 2017, BT's leased lines business (BCM) had a lower FCF/Total Revenues ratio than copper access. This mainly reflects the fact that the leased lines business had higher capex relative to revenues than copper access, which indicates that the cost fixity of the leased lines business may be higher. In 2016, the capex to revenue for the leased lines business was also higher than for copper access. However, the difference was smaller, and the effect of higher capex was outweighed by the fact that copper access had a higher opex to revenues ratio. For opex, we do not have a breakdown into its variable and fixed components, and hence we cannot draw conclusions on cost fixity from the 2016 FCF/Total Revenues ratios.
- The Capex/MCE ratio shows higher operational leverage for leased lines in both years (as the ratio is higher for leased lines in both years). Despite data limitations, most of the evidence, especially based on the latest data, points to leased lines having higher operational leverage compared to copper access.

We have also compared operational leverage ratios for leased lines to BT Group as a whole, with mixed results across the two ratios (see Appendix C.1). Based on our indicative results, we have no reason to conclude that leased lines have a lower or higher operational leverage than BT as a whole or OUKT.[58]

We provide more details of our operational leverage analysis in Appendix C.1.

Volume Risk

We have also compared leased lines and copper access with regard to volume risk, using data provided by Ofcom. In principle, given that BT's regulated business operations are typically subject to price caps, volume variability represents an important indicator of systematic risk.

We analyse volume risk by looking at the monthly variability of BT's rental and call volume data and BT's volume forecast accuracy. For the former, we look at the ratio of maximum and minimum monthly variance for BT's actual rental and call volumes, while for the latter we look at the forecast volume variability against actual rental and call volumes.

We find that, both measures show that leased lines experience greater volume variability than copper access, indicating higher risk for leased lines compared to copper access. We provide more details on this analysis in Appendix C.2.

In summary, our cross-check based on our analysis of operational leverage and volume risk in this section supports the conclusion from the previous section that the systematic risk of leased lines is likely to be higher than that of copper access and broadly similar to other OUKT activities.

[58] 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 Group. The conclusions we can draw based on this comparison are therefore limited.

5.4. Recommendations regarding the asset beta for OUKT/Leased Lines

In the previous sections, we have concluded that the beta estimate for OUKT remains appropriate for estimating the beta for leased lines for the 2019 BCMR. Ofcom has also asked us to comment on whether the range used for OUKT of 0.55-0.75 used in its 2018 WLA review remains appropriate. To comment on this, we consider the changes in the empirical beta estimates since our last update, for which the cut-off date was September 2017.

Table 5.2 and Table 5.3 summarise the current asset beta estimates for BT and the four sets of comparators, for both the local/regional and the global reference indices.

Table 5.2: BT and comparators Asset Beta ranges against Local/Regional index

Comparators	2Y (Sep 2017)	2Y (Jul 18)	5Y (Jul 18)
BT	0.78	0.51	0.71
UK Utilities (excl. SSE)	0.33-0.38	0.36-0.45	0.38-0.41
UK Telecoms - TalkTalk	0.59	0.51	0.63
UK Telecoms - Vodafone	0.60	0.65	0.68
UK Telecoms - Sky	0.62	0.32	0.56
European Telecoms	0.44-0.64	0.40-0.74	0.39-0.66
ICT Tier 2 (overall)	0.27-1.24	0.26-0.86	0.57-1.15

Source: NERA analysis based on Bloomberg data. Cut-off date: 20 July 2018. Note: European Telecoms and ICT results for September 2017 have been re-estimated using the FTSE All Europe denominated in Euros.

Table 5.3: BT and comparators Asset Beta ranges against World index

Comparators	2Y (Sep 2017)	2Y (Jul 18)	5Y (Jul 18)
BT	0.86	0.38	0.68
UK Utilities (excl. SSE)	0.28-0.37	0.19-0.28	0.32-0.35
UK Telecoms - TalkTalk	0.61	0.42	0.64
UK Telecoms - Vodafone	0.52	0.46	0.59
UK Telecoms - Sky	0.70	0.20	0.55
European Telecoms	0.51-0.86	0.38-0.63	0.43-0.74
ICT Tier 2 (overall)	0.69-1.21	0.56-1.19	0.61-1.25

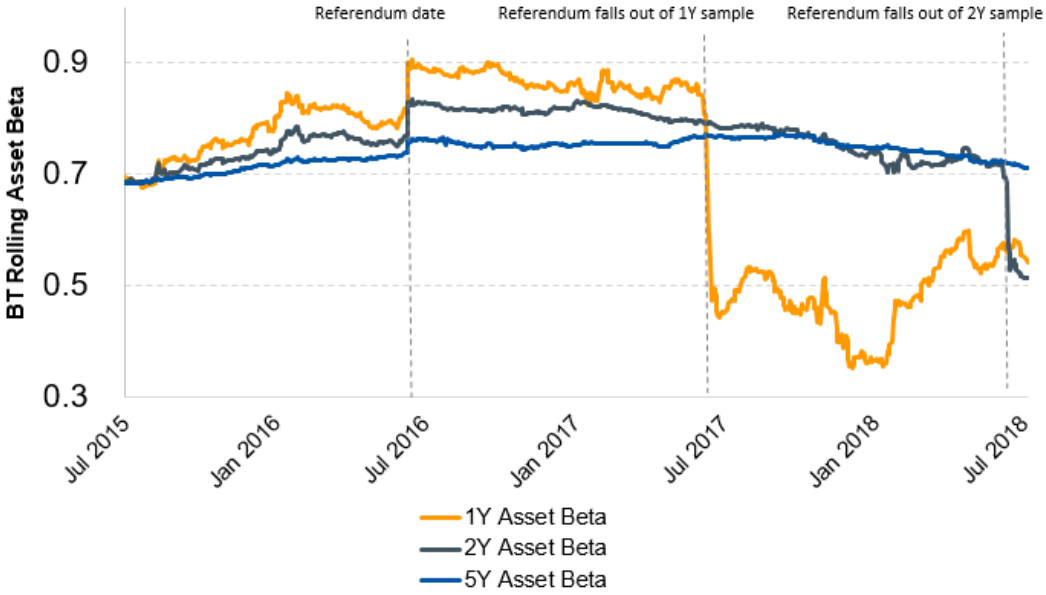
Source: NERA analysis based on Bloomberg data. Cut-off date: 20 July 2018. Note: European Telecoms and ICT results for September 2017 have been re-estimated using the FTSE All Europe denominated in Euros.

A key change in the empirical estimates relates to BT's asset beta for its listed stock, where the 2-year asset beta has fallen from 0.78 in September 2017 to 0.51 in July 2018. As shown in section 3.1.3 and Appendix A, the drop in BT's beta occurs when the Brexit referendum observations fall out of the 2-year estimation window.

In Appendix A, we show that the decrease in BT's asset beta is genuine and is not driven by a few outlier observations following the referendum date. Even when we remove these outlier observations from the sample, we see a clear downward trend in BT's asset beta and arrive at a similar value for the latest 2-year asset beta. Moreover, we observe a similar downward trend for other UK-focused comparators, including TalkTalk.

On the other hand, looking at the most recent evidence, we see an upward trend in BT's 1-year beta in recent months (see Figure 5.1). If this trend was to continue, the 2-year asset beta might increase over the coming months.

Figure 5.1: BT's asset beta for different estimation windows (1Y, 2Y and 5Y)



Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018

In addition to a reduction in BT's (and other UK-focussed comparators') betas following the Brexit referendum, we also observe an increase in standard errors of the beta estimates following the referendum. Whereas our beta estimates remain highly significant, the confidence intervals for the 2-year estimates have become considerably wider for most UK and European comparators (whereas we only see a small increase for ICT comparators), with some being more than 50% wider than in September 2017. We present the confidence intervals in Appendix B.

Given the high degree of uncertainty around Brexit and how it will affect BT's and other UK companies going forward, we recommend that in estimating the beta for OUKT/leased lines for the 2019 BCMR, Ofcom should place weight on the 5-year beta estimates, rather than only rely on the 2-year asset betas. As shown in Appendix B, the 5-year confidence intervals are considerably narrower than the 2-year intervals. This is partly driven by the longer estimation window, i.e. the larger number of observations which reduces standard errors, but also reflects the fact that standard errors have been increasing for BT as well as most UK utility and telecoms comparators since the referendum, which affects the 2-year estimates more than the 5-year estimates.

Drawing on the evidence presented in Table 5.1 and Table 5.2, we summarise our key observations as follows:

- For BT, the 5-year asset beta estimate (0.71) lies below the previous 2-year asset beta (0.78), with the 2-year estimate (0.51) being considerably lower.
- The evidence is more mixed for other UK telecoms. We observe a reduction in the 2-year asset beta for other UK-focussed telecoms operators (e.g. TalkTalk's 2-year beta of 0.51

lies below the previous estimate of 0.59 and Sky's 2-year beta of 0.32 lies below the previous estimate of 0.62[59]), although unlike for BT, the 5-year beta (0.63) remains above the previous 2-year beta estimate for TalkTalk. In contrast, Vodafone's asset beta is higher for both the 2-year and 5-year estimation window, likely explained by Vodafone's international exposure.

- Evidence from European telecoms comparators (using the FTSE All Europe as the reference index) shows a wider range of estimates compared to the previous 2-year asset beta range, with an increase in the upper end and a reduction in the lower end. However, we note that several European telecoms comparators that used to be close to the lower end of Ofcom's previous range for OUKT (0.55) now have empirical asset betas closer to 0.40 (Orange, Telecom Italia, Telenor), as shown in Table 3.9.
- We also observe somewhat lower beta ranges for ICT comparators relative to our previous update.
- The confidence intervals of the 2-year asset betas have become considerably wider for BT, UK comparators, and EU Telecoms, reflecting large increases in standard errors following the Brexit referendum.[60] By contrast, the 5-year confidence intervals are relatively narrow, reflecting the lower degree of uncertainty around these estimates.

Given this evidence, we conclude that in determining the beta for the 2019 BCMR, a case could be made for slightly widening the OUKT range to reflect both the observed downward trend in the most recent empirical estimates of other telecoms/ICT betas, and the increased uncertainty around the 2-year estimates, which seems to reflect the ongoing uncertainty around Brexit. Either way, a case could be made for some reduction in the point estimate for OUKT compared to Ofcom's 2018 WLA review. Given the uncertainty around the most recent 2-year estimates, we encourage only a cautious downward revision to the previous point estimates.

We also recommend that Ofcom closely monitors the market developments, and adjusts its outlook as more information becomes available.

[59] We note that the substantial drop in the asset beta of Sky is also related to the M&A activity described in section 3.1.

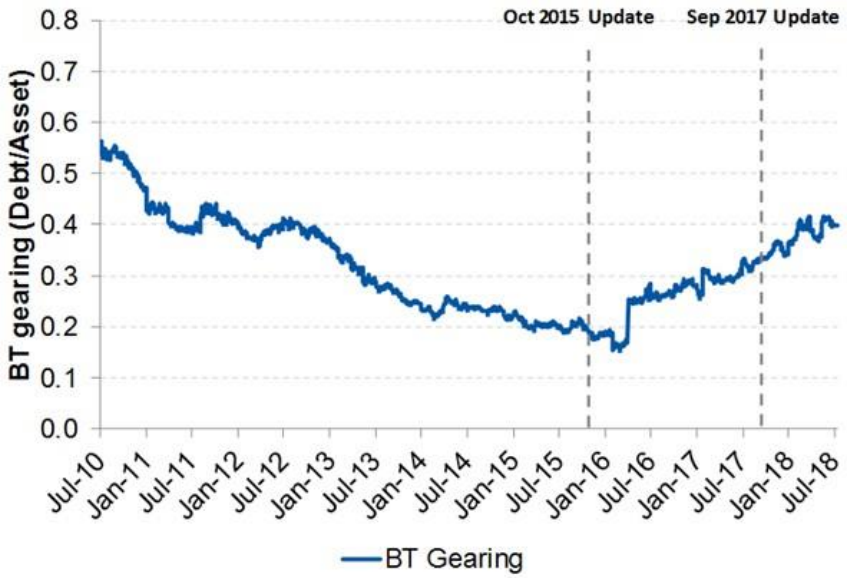
[60] See Appendix B for details.

6. Gearing

In its 2018 WLA market review, Ofcom estimated a range of 25%-50%, where the lower end reflected the average gearing for BT for the past two years and the upper end of the range was based on the gearing levels more typically observed for UK utilities and the maximum suggested in the 2016 Brattle report to the European Commission. BT's gearing at the time (33%) and the average gearing of most UK and European Telecoms (35%) fell within this range. Ofcom concluded that a gearing assumption of 30% was reasonable given its similarity to BT's current and longer-term gearing averages and the fact it fell within a credible range based on comparators.[61]

As shown in Figure 6.1, the gearing level of BT has increased from 33% to 40% since the last update in September 2017, and the most recent two-year average of BT's gearing has increased from 25% to 33%, which is higher than the most recent 5-year average of 27%.

Figure 6.1: BT's gearing over time



Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018

Taking into account the updated empirical gearing of UK comparators and European Telecoms comparators (see Table 6.1 below), we find that:

- The 1-year average gearing ranges have generally increased slightly relative to September 2017, mainly with regard to the lower end of these ranges; and
- The latest gearing values also show slight increases, with regard to both the lower and the upper ends of the ranges (except when including Sky in UK Telecoms, in which case the lower end decreased considerably).[62]

[61] WLA 2018 Review annex 20, p.112 para A20.141-A.20-144, Link: https://www.ofcom.org.uk/__data/assets/pdf_file/0020/112493/wla-statement-annexes-17-27.pdf.

[62] We present both 1-year averages and the latest point estimates. Whereas the latest estimates reflect the most recent information, they may be driven my extreme events in the stock market on a particular day. We therefore also present a 1-year average, which is less sensitive to outliers.

Table 6.1: Gearing levels of BT and comparators

Comparators	1Y Avg (Sep 17)	1Y Avg (Jul 18)	Latest (Jul 18)
BT	30%	37%	40%
UK Utilities (excl. SSE)	46%-54%	48%-59%	48%-62%
UK Telecoms (excl. Sky)[63]	34%-43%	37%-40%	38%-43%
UK Telecoms (incl. Sky)	34%-43%	32%-40%	24%-43%
European Telecoms (All)	13%-67%	18%-67%	18%-72%
European Telecoms (excl. Telecom Italia)	13%-57%	18%-57%	18%-59%

Source: NERA analysis based on Bloomberg data. Cut-off date: 20 July 2018.

Given that the increases are relatively moderate, we consider that Ofcom's previous range of 25% to 50% remains appropriate for the following reasons:

- The updated gearing levels for BT and UK telecoms still fall comfortably within this range (though including Sky puts the lower end of the obtained range closer to the 25% end).
- When removing Telecom Italia from the European Telecoms range (Telecom Italia is the only comparator in this sample that does not have an investment grade rating and its gearing level is by far the highest in the sample)[64], we see that the increase in this range is very small, especially with regard to the upper end.
- We also note that as shown in Figure 3.14 above, the gearing levels of the European telecom comparators are currently clustered around 25% and 45%, which supports the range of 25% to 50%.
- Whereas the updated utilities range is higher than previously, the increase is small, so we do not consider this to be a reason for Ofcom to change its range for BT.

Within this range, however, Ofcom may want to consider increasing its point estimate for BT slightly, to reflect the recent increase in BT's and comparators' empirical gearing levels. We note, however, that the final WACC estimate is generally not very sensitive to the gearing assumption.[65]

[63] As stated in section 2, "UK telecoms" refers to the UK telecoms comparator sample which does not include BT.

[64] Telecom Italia is the only European telecoms comparator that does not currently have an investment grade rating. We expect this to be at least partially driven by its high gearing, compared to the rest of the sample. See Telecom Italia Group Website (2018), Investors – Rating, link: http://www.telecomitalia.com/tit/en/investors/financial-profile/rating.html (accessed 5 September 2018).

[65] This insight was originally provided by Modigliani and Miller (1958). Any increase in gearing has two effects on a firm's cost of capital, which combine to offset each other: a higher cost of equity resulting in a higher WACC, and a greater weight placed on the cost of debt resulting in a lower WACC.

7. Summary and Conclusion

This section summarises the changes in the empirical evidence since our September 2017 update, as well as our recommendations on the asset beta assumption for BT's leased lines business, the debt beta assumption, and the gearing assumption.

Table 7.1 and Table 7.2 present the previous and updated ranges for the asset betas estimated against the local/regional index and the world index, respectively. As stated in section 2, we generally prefer to use local/regional indices, given the evidence on the "equity home bias". However, for the ICT comparators (the full sample, i.e. Tier 2), we put more weight on the estimates against the world index, as we are comparing companies that operate in different jurisdictions.

Table 7.1: BT and comparators Asset Beta ranges against Local/Regional index

Comparators	2Y (Sep 2017)	2Y (Jul 18)	5Y (Jul 18)
BT	0.78	0.51	0.71
UK Utilities (excl. SSE)	0.33-0.38	0.36-0.45	0.38-0.41
UK Telecoms - TalkTalk	0.59	0.51	0.63
UK Telecoms - Vodafone	0.60	0.65	0.68
UK Telecoms - Sky	0.62	0.32	0.56
European Telecoms	0.44-0.64	0.40-0.74	0.39-0.66
ICT Tier 2 (full sample)	0.27-1.24	0.26-0.86	0.57-1.15

Source: NERA analysis based on Bloomberg data. Cut-off date: 20 July 2018. Note: daily data, previous results have been updated to reflect the currency adjustment for the FTSE All Europe.

Table 7.2: BT and comparators Asset Beta ranges against FTSE All World

Comparators	2Y (Sep 2017)	2Y (Jul 18)	5Y (Jul 18)
BT	0.86	0.38	0.68
UK Utilities (excl. SSE)	0.28-0.37	0.19-0.28	0.32-0.35
UK Telecoms - TalkTalk	0.61	0.42	0.64
UK Telecoms - Vodafone	0.52	0.46	0.59
UK Telecoms - Sky	0.70	0.20	0.55
European Telecoms	0.51-0.86	0.38-0.63	0.43-0.74
ICT Tier 2 (full sample)	0.69-1.21	0.56-1.19	0.61-1.25

Source: NERA analysis based on Bloomberg data. Cut-off date: 20 July 2018.

With regard to the **2-year asset betas**, the following are our main conclusions from the updated empirical evidence:

- In July 2018, **BT's** 2-year asset beta dropped substantially against both the FTSE All Share index and the FTSE All World index, as a result of the Brexit referendum falling out of the 2-year estimation window. Our analysis shows that when removing the exceptional returns following the Brexit referendum, BT's 2-year asset beta still shows a clear downward trend and reaches a similarly low level at the cut-off date (20 July 2018) as when we include all observations (i.e. 0.51, against the FTSE All Share);
- With regard to the **UK telecoms comparators**, TalkTalk's 2-year beta exhibits a similar referendum effect as BT's asset beta against both indices, and has fallen sharply; Sky

shows an even larger decline, which seems to reflects both the recent speculation about Sky's takeover, and the referendum effect; Vodafone's asset beta, on the other hand, does not exhibit a referendum effect, reflecting the fact that it is more internationally diversified and hence less sensitive to the developments in the UK;

- The asset betas of the **UK utilities** have risen slightly on a 2-year calculation, and their average is c.0.04 higher than in our September 2017 update (excluding SSE, which is also affected by the referendum effect);
- For **European Telecoms**, we obtain mixed results and a wider range against the FTSE All Europe of 0.4-0.74 (compared to 0.44-0.64 in September 2017); however, the increase in this range is largely due to an outlier on the upper end, and not indicative of a general increase in asset betas – the majority of European telecoms comparators have seen a decrease in their asset betas; and
- We obtain mixed results for the **ICT comparators**, but the overall range has decreased slightly from 0.69-1.21 to 0.56-1.19 against the FTSE All World, which is our preferred reference index for the ICT sample.

With regard to the **5-year asset betas**, the following are our main conclusions from the updated empirical evidence:

- The 5-year ranges are generally narrower than the updated 2-year ranges, which is related to both the larger number of observations in the 5-year estimation window, and the uncertainty following the Brexit referendum, which has led to significant changes in the 2-year betas of UK-focused companies and some European Telecoms comparators;
- **BT's** asset beta (estimated against the FTSE All Share) is considerably higher using a 5-year estimation window than when using a 2-year window (0.71 vs 0.51), as the 5-year window places less weight on the observations after the Brexit referendum;
- **BT's** 5-year asset beta lies above the ranges for **UK Utilities**, **UK Telecoms** and **European Telecoms** (all estimated against local/regional indices), although it is relatively close to the upper end of the latter two (0.71 compared to 0.68 for UK Telecoms and 0.66 for European Telecoms). Results are broadly similar for the world index, except that BT's beta (0.68) lies inside the range for European Telecoms (0.43-0.74); and
- The current 5-year range for **ICT comparators** (against the world index) is 0.61-1.25, which is relatively similar to the current 2-year range for this sample; BT's 5-year asset beta (0.71 against the local index and 0.68 against the world index) lies close to the lower end of the range.

Based on the updated empirical estimates and our findings on the relative riskiness of leased lines, we consider it appropriate for Ofcom to maintain its previous approach of setting assets betas based on a three-way decomposition of BT Group into Openreach copper access, OUKT, and Rest of BT, and setting the asset beta for leased lines based on its determination for OUKT**.**

Given the heightened uncertainty with regard to the 2-year estimates following the Brexit referendum (as reflected in wider 2-year confidence intervals), and the decline in BT's asset beta relative to the time before the Brexit referendum, as well as the recent downward trends in the asset betas of many telecoms and ICT comparators, Ofcom may consider adopting a wider range and a lower point estimate for OUKT, and hence for leased lines. However, given the ongoing uncertainty around Brexit, we encourage only a cautious downward revision to the previous point estimates.

We also recommend that Ofcom closely monitors the market developments, and adjusts its outlook as more information becomes available.

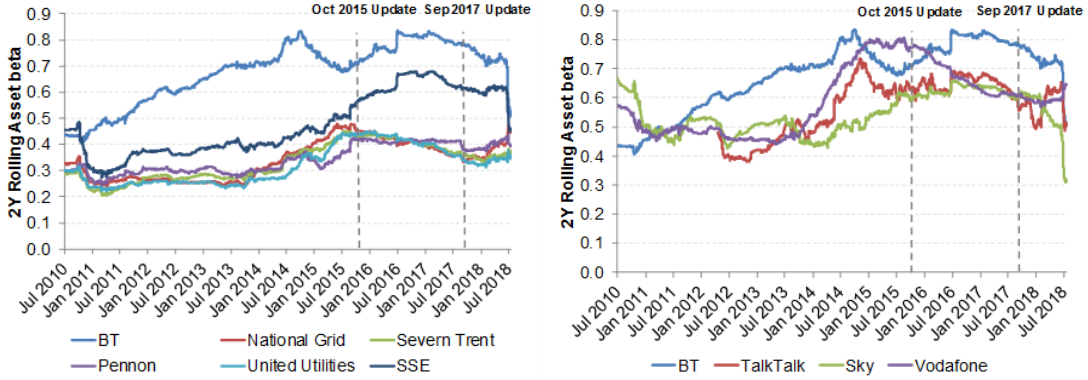
With regard to the debt beta assumption, we find that Ofcom's previous assumption (0.1) remains appropriate in light of recent regulatory precedent, academic evidence, and guidelines put forward by practitioners.

Given the recent evidence on the empirical gearing levels of BT and its UK/European comparators, we conclude that Ofcom's previous range of 25% to 50% remains appropriate. However, Ofcom may want to consider adopting a slightly higher point estimate for BT within this range.

Appendix A. Referendum Effect

As discussed in section 3 (and replicated in Figure A.1), we observe a substantial reduction in BT's 2-year asset beta estimate from 0.78 (Sep 2017) to 0.51 (Jul 2018), seemingly because the return observations around the Brexit Referendum no longer fall within 2-year estimation window (which we refer to as the "referendum effect"). The "referendum effect" also appears to affect SSE, and two of the UK Telecoms comparators, TalkTalk and Sky. By contrast, the asset betas for traditional utilities comparators and one of BT's UK Telecoms comparator (Vodafone) do not appear to be affected. This suggests that the systematic risk profiles of UK comparators may have evolved in different ways following the Brexit referendum: BT, SSE, TalkTalk and Sky appear to be significantly affected, but traditional utilities and Vodafone are not. In this section, we analyse the potential drives of this referendum effect.

Figure A.1: Referendum dates falling out of sample has different impact on UK comparators

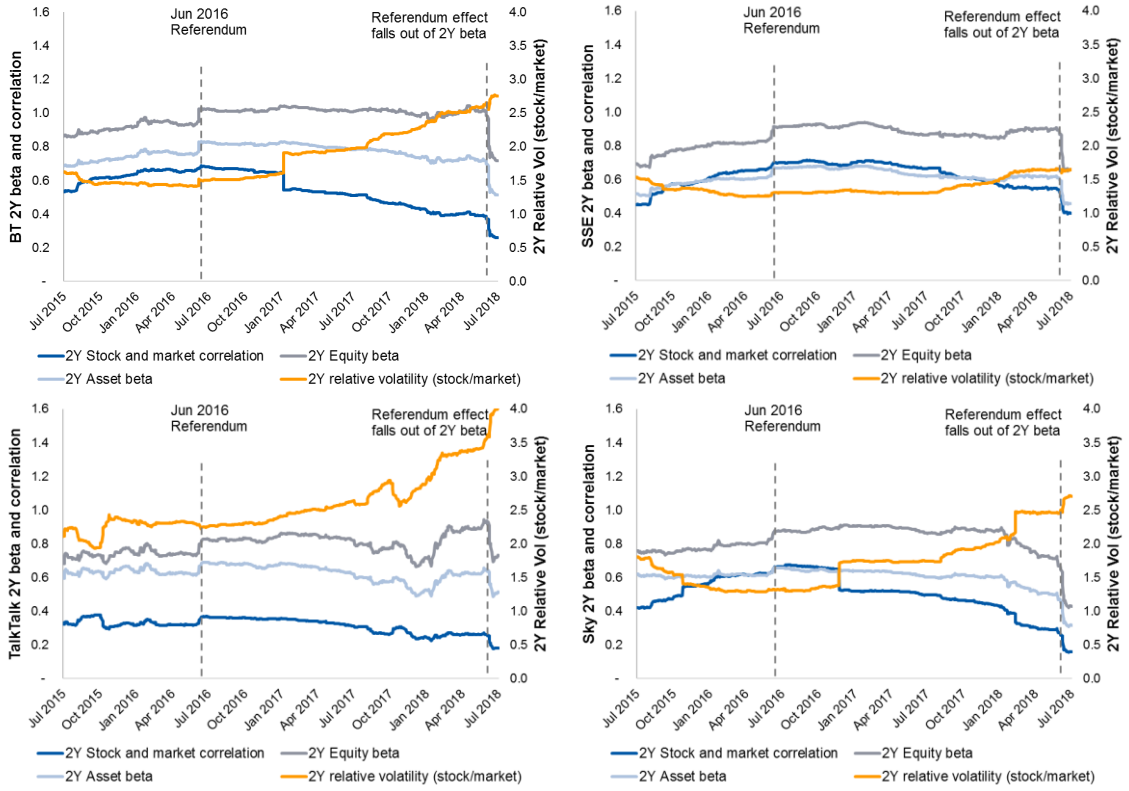


Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.

As a first step, we decompose the individual stocks' betas into the two key components: i) relative stock volatility (stock/market volatility) and ii) correlation. This allows us to attribute the change in the equity beta to a change in either or both components of the beta.

Figure A.2 shows the beta decomposition for BT, SSE, TalkTalk and Sky, i.e. the UK companies which were most affected by what we call the referendum effect. As shown in the figure, once the data from around the Brexit referendum falls out from the estimation window (i.e. in July 2018), we observe two opposing effects on betas: i) the stock-to-market correlation decreases (reducing the beta all else equal) and ii) the relative volatility increases (increasing the beta all else equal). However, the reduction in the correlation dominates, causing the equity and asset beta to fall. We note that this reduction in correlations observed once the data from around the Brexit referendum falls out of the sample (i.e. in July 2018) appears to "offset" the earlier (smaller) increase in correlations observed following the Brexit referendum (i.e. in June 2016).

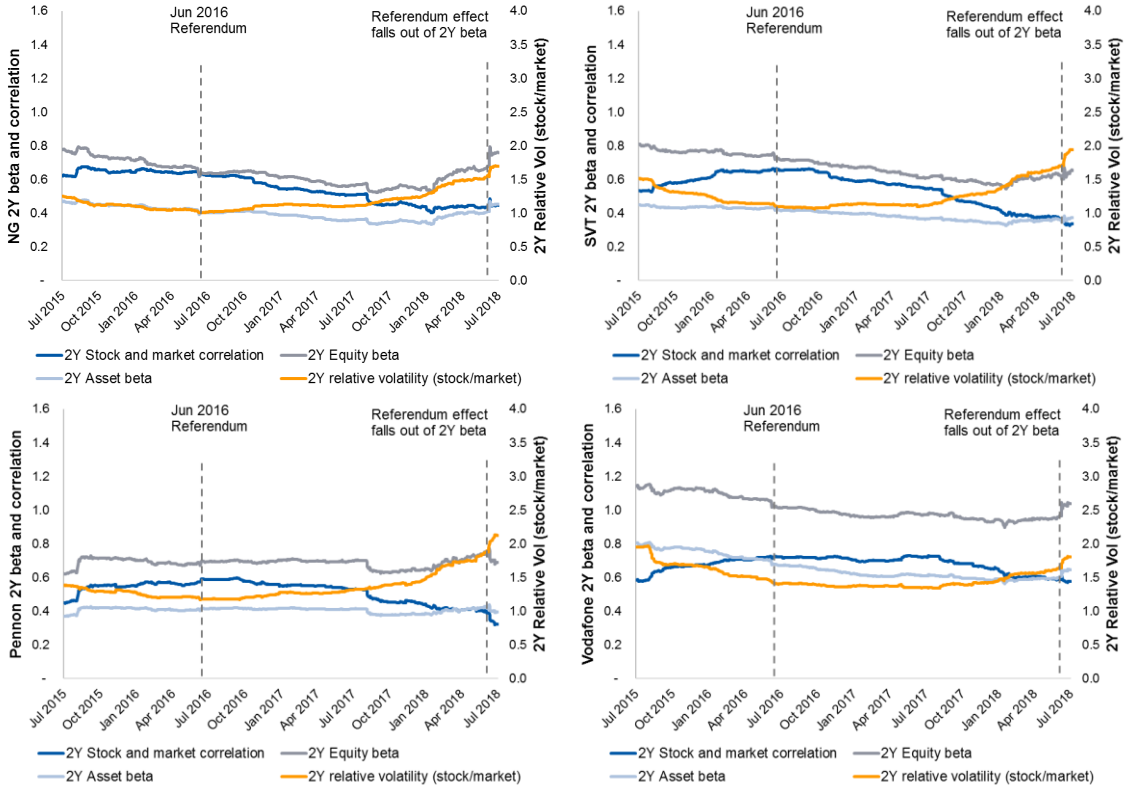
Figure A.2: BT, SSE, Sky and TalkTalk's betas and correlation increased following the referendum, and decreased when the referendum dates fall out of the sample



Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.

Figure A.3 shows the evolution of the two equity beta components for traditional utilities and Vodafone, which appear comparatively more stable. Compared to BT, these comparators' correlations and their relative volatilities do not show significant changes following the referendum (June 2016) or when the referendum dates fall out of the 2-year sample (July 2018).

Figure A.3: Beta components for traditional utilities and Vodafone have been relatively stable following the referendum



Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018

We identify two potential factors which may drive the changes in companies' beta and correlation following the Brexit referendum: i) relative riskiness, and ii) the "foreign earnings" effect.

Relative risk

The relative riskiness between the comparators could explain why the asset beta of BT, SSE, Sky and TalkTalk experienced step change following Brexit, but traditional utilities did not.

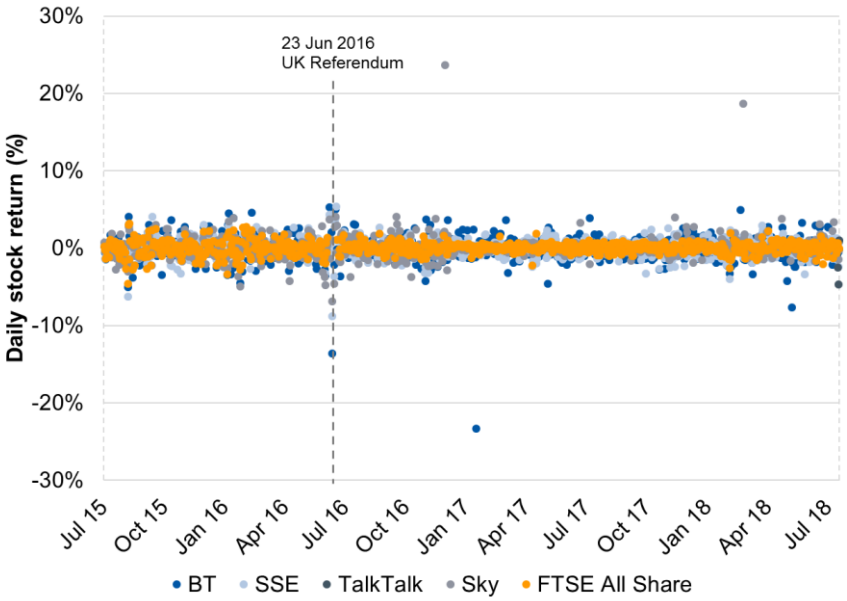
Traditional regulated utilities are regarded as "defensive" stocks that offer stable returns in times of heightened market volatility, and their beta tends to fall in times of high market uncertainty. In contrast, companies with higher risks tend to have higher correlations with the market during times of heightened market volatility, thus increasing their beta.

The fact that SSE has a relatively large proportion of generation and non-regulated activities is likely to explain SSE's higher systematic risk during the period of increased market uncertainty immediately following the Brexit referendum.[66] Similarly, UK telecoms have higher relative risks compared to traditional UK utilities. This is consistent with the increased beta and correlation for BT, TalkTalk and Sky immediately following the Referendum in June 2016.

[66] In FY2016/2017, SSE derived only about 4% of its total revenues from regulated network activities (electricity transmission and distribution). The largest share of SSE's revenues came from generation activities (60%), followed by

Figure A.4 and Figure A.5 show the daily stock and market return data, which is consistent with this hypothesis. As shown in the figures, the traditional utilities comparators were not affected by the heightened market uncertainty on the Referendum date, whereas the stocks with higher relative risks had large negative stock returns on the Referendum date.

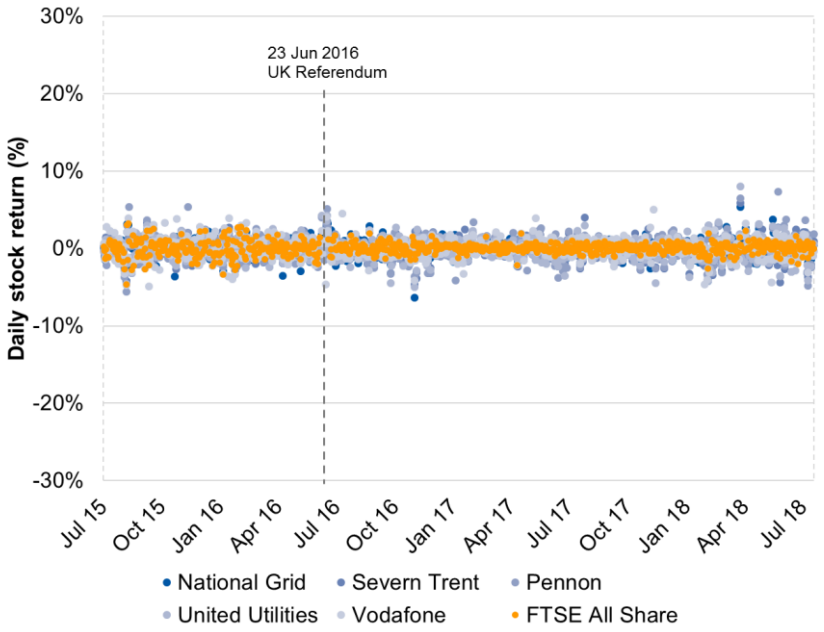
Figure A.4: BT, SSE, Sky and TalkTalk faced large negative stock return on the Referendum date, leading to increased correlation with market



Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018; Note: In addition to the Referendum date, there are other significant daily gains and losses - these reflect individual events that do not have a significant effect on the beta estimates. These events are: 24 Jan 2017, BT Italy scandal probe; 9 Dec 2016, Sky offered takeover bid from 21st Century Fox; 27 Feb 2018, Sky offered takeover bid from Comcast.

energy supply (22%). 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% of SSE's revenues in FY2016/2017. See SSE Annual report for FY2016/2017 (p.117-118).

Figure A.5: Traditional utilities and Vodafone's stock return were stable on the Referendum date



Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.

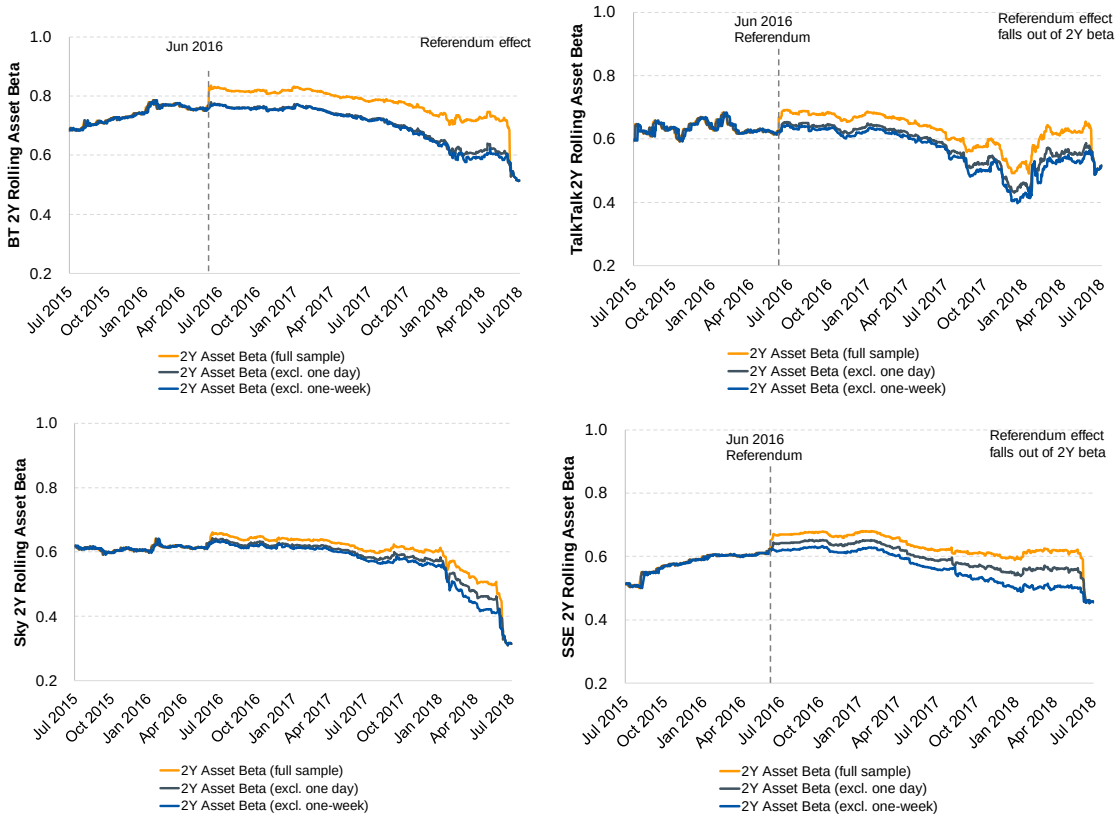
The "foreign earnings" effect

We have further considered whether the updated asset beta estimates for BT and other UK-focused comparators (Sky, TalkTalk, and SSE) are sensitive to the extreme daily stock return movements following the Referendum. To isolate the effect of the Referendum, we calculate the asset beta for BT and its comparators excluding the return observation that could be affected.[67]

Figure A.6 shows the evolution of the asset betas of BT, SSE, Sky, and TalkTalk in comparison to the asset beta estimates we would obtain if we excluded one day and one week of return data following the Referendum, respectively. Excluding these returns removes the step change increase in BT's asset beta observed immediately following the Referendum in June 2016, but does not affect the declining trend in asset betas observed since June 2016. This suggests that the observed reduction in asset betas following the referendum for these companies may reflect a non-temporary change in the systematic risk.

[67] We consider two approaches: i) excluding the one-day stock return after the Referendum, and ii) excluding one-week after the UK Referendum date. The first approach assumes that the equity market is efficient and reflects new information immediately, whereas the second approach allows for the possibility that the market might be less efficient and takes time to price in the relevant information.

Figure A.6: Declining trend in asset betas of BT, SSE, TalkTalk, and Sky after the Referendum is not sensitive to extreme daily return movement



Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.

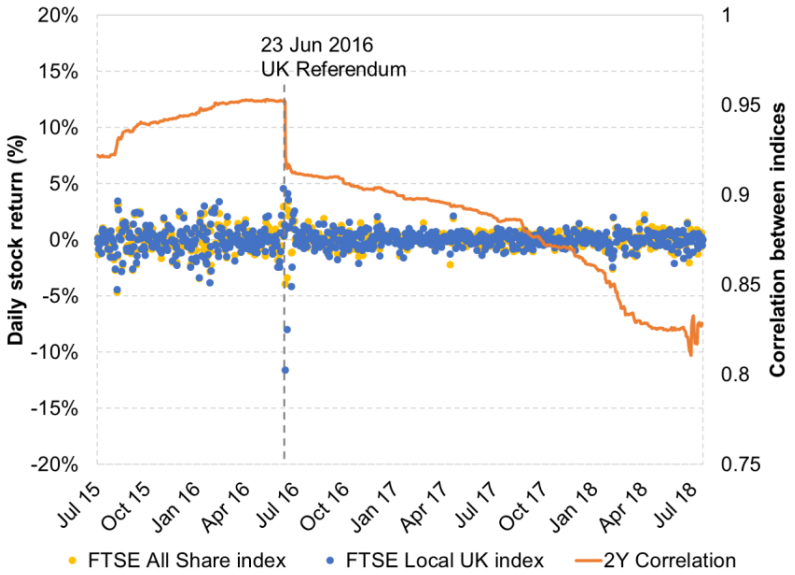
The "foreign earnings" effect could potentially explain the changes in BT's and other UK-focused comparators' asset betas observed since the Referendum. In its inflation report following the Referendum,[68] the Bank of England pointed out that the FTSE All Share index outperformed the UK-focused companies in the months after the Referendum, reflecting the increased profits of international companies in the FTSE All-Share index as a result of the pound depreciation. This "foreign earnings" effect may have reduced the correlations between UK-focused companies and the FTSE All Share index, putting downward pressure on UK-focused companies' beta. Indeed, this is confirmed by our estimates of the correlation between the FTSE All Share index and local UK index[69] which have been trending downward since the Referendum, as shown in Figure A.7.[70]

68 The Bank of England has explained this effect in its November 2016 inflation report, p.6. Link: https://www.bankofengland.co.uk/inflation-report/2016/november-2016.

69 FTSE Local UK index only includes UK companies that generate at least 70% of their revenues in the UK.

70 Bank of England has shown that the stock prices performance of internationally-focused companies relative to UK local companies have been closely correlated with changes in the sterling exchange rate. November 2016 inflation report, p.6.

Figure A.7: Correlation between return of UK-focused stocks and internationally-focused stocks have declined following the Referendum



Note: UK-focused FTSE Local UK index had large negative returns following the Referendum in June 2016, in contrast to the FTSE All Share index
Source: NERA analysis based on Bloomberg and FactSet data. Cut-off date is 20 July 2018.

Similarly, the "foreign earnings" effect suggests that the downward pressure on beta for internationally-focused companies should be considerably smaller. Indeed, among the UK Telecoms comparators, the internationally focused Vodafone (only c. 15% revenue generated from the UK) [71] appears to be unaffected by the referendum effect, in contrast to the UK-focused BT, TalkTalk and Sky.[72] Therefore, the "foreign earnings" effect could potentially explain the divergence in the asset beta for UK Telecoms, and the declining trend of UK-focused comparators' asset beta against FTSE All Share index. A further breakdown of revenues by region can be found in Appendix E.

[71] Vodafone 2017 Annual Report, p.8.

[72] BT, Sky and TalkTalk derive most of their revenues from the UK (respectively, 80%, 70% and 100%), while Vodafone derives revenues from a broader range of countries (Germany with around 22%, UK with 15% and Italy with 13% are the most represented). See Appendix E for a geographical breakdown of revenues for other comparators.

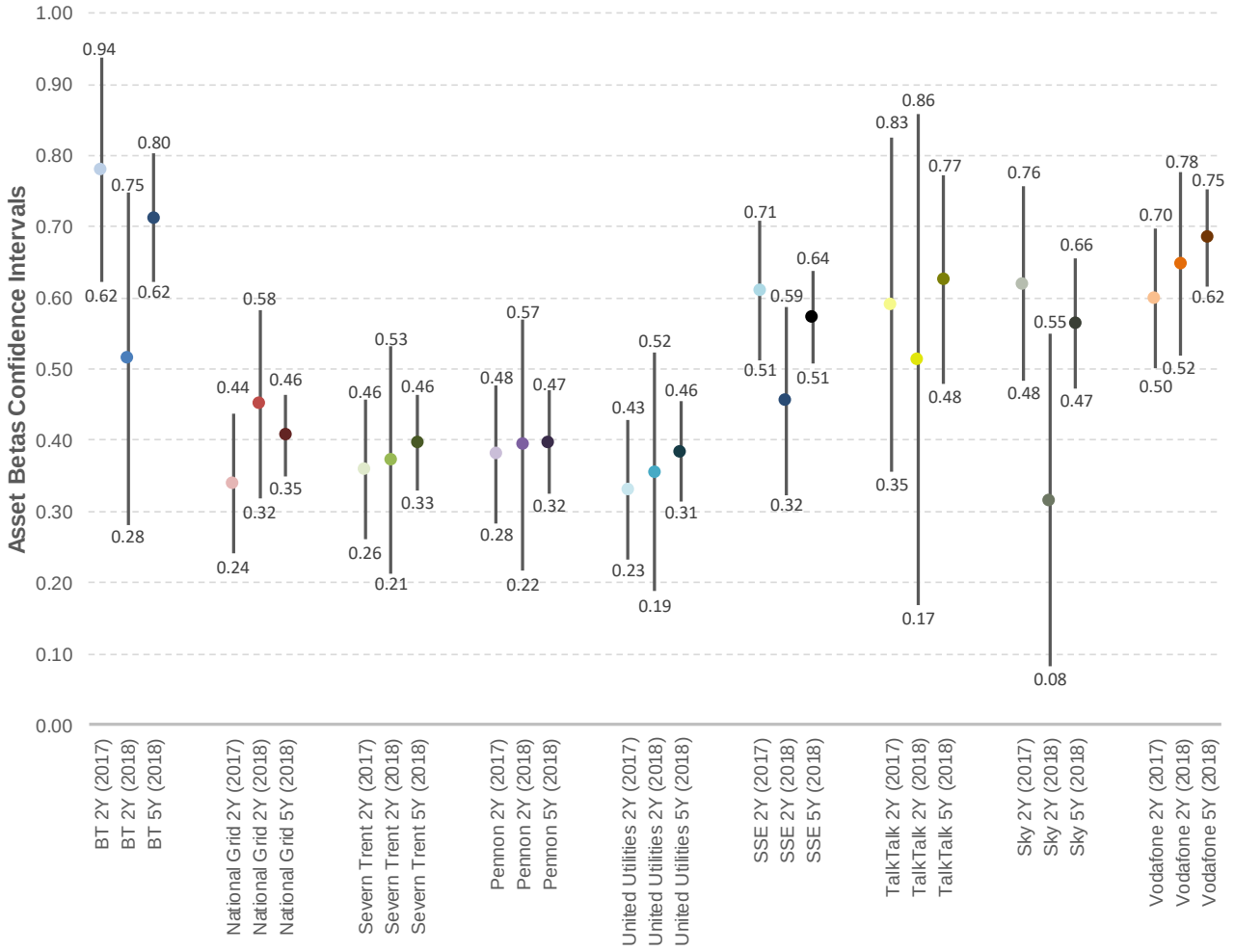
Appendix B. Confidence Intervals for Beta Estimates

In order to assess the uncertainty around the beta estimates presented in this report, we provide confidence intervals for each of our comparator sets in Figure B.1 to Figure B.3 below. These figures show the 95% confidence intervals for the previous 2-year asset betas (cut-off: September 2017), the current 2-year asset betas, and the current 5-year asset betas. We show these intervals only 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).

Overall, we find that:

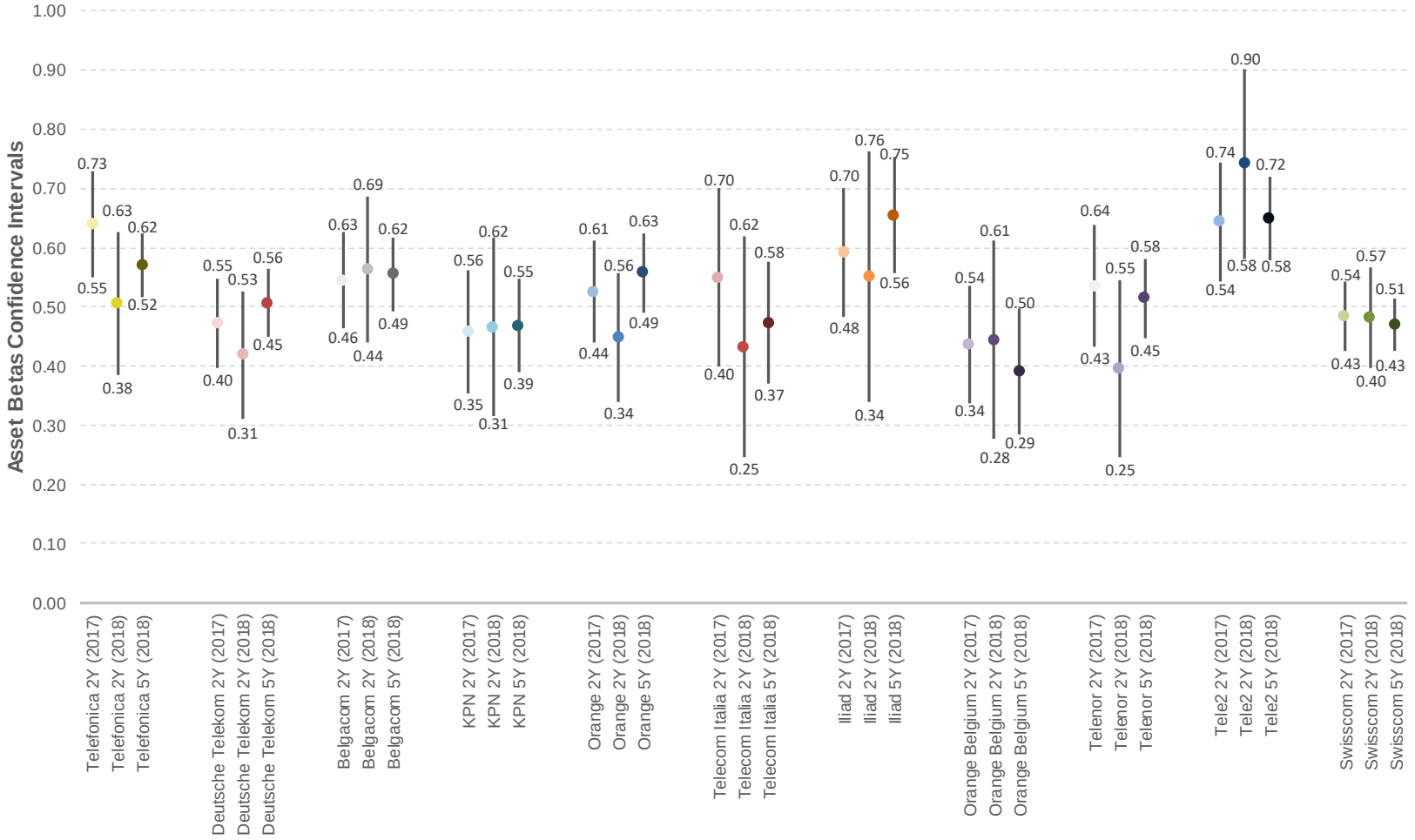
- the evidence on the changes in point estimates is mixed; however, as explained in the main part of this report, we observe a large decline in the asset betas of UK-focused companies (BT, TalkTalk, Sky, and SSE);
- the 2-year confidence intervals for both UK comparators and European Telecoms comparators have increased since our September 2017 update. This is due to a significant increase in standard errors for the UK and European Telecoms comparators since the time of the Brexit referendum;
- the confidence intervals for ICT comparators have increased as well, but to a lesser extent than for other comparators;
- the 5-year confidence intervals are considerably less wide 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 have been increasing since the Brexit referendum, which affects the 2-year estimates more than the 5-year estimates; and
- in most cases, we find that the current 5-year point estimate lies within the current 2-year confidence interval; this is even true for BT and other UK-focused comparators (except Sky) whose 2-year asset betas have fallen sharply due to the referendum effect, because their confidence intervals are considerably wider than previously.

Figure B.1: Confidence intervals of asset beta estimates for BT and UK comparators



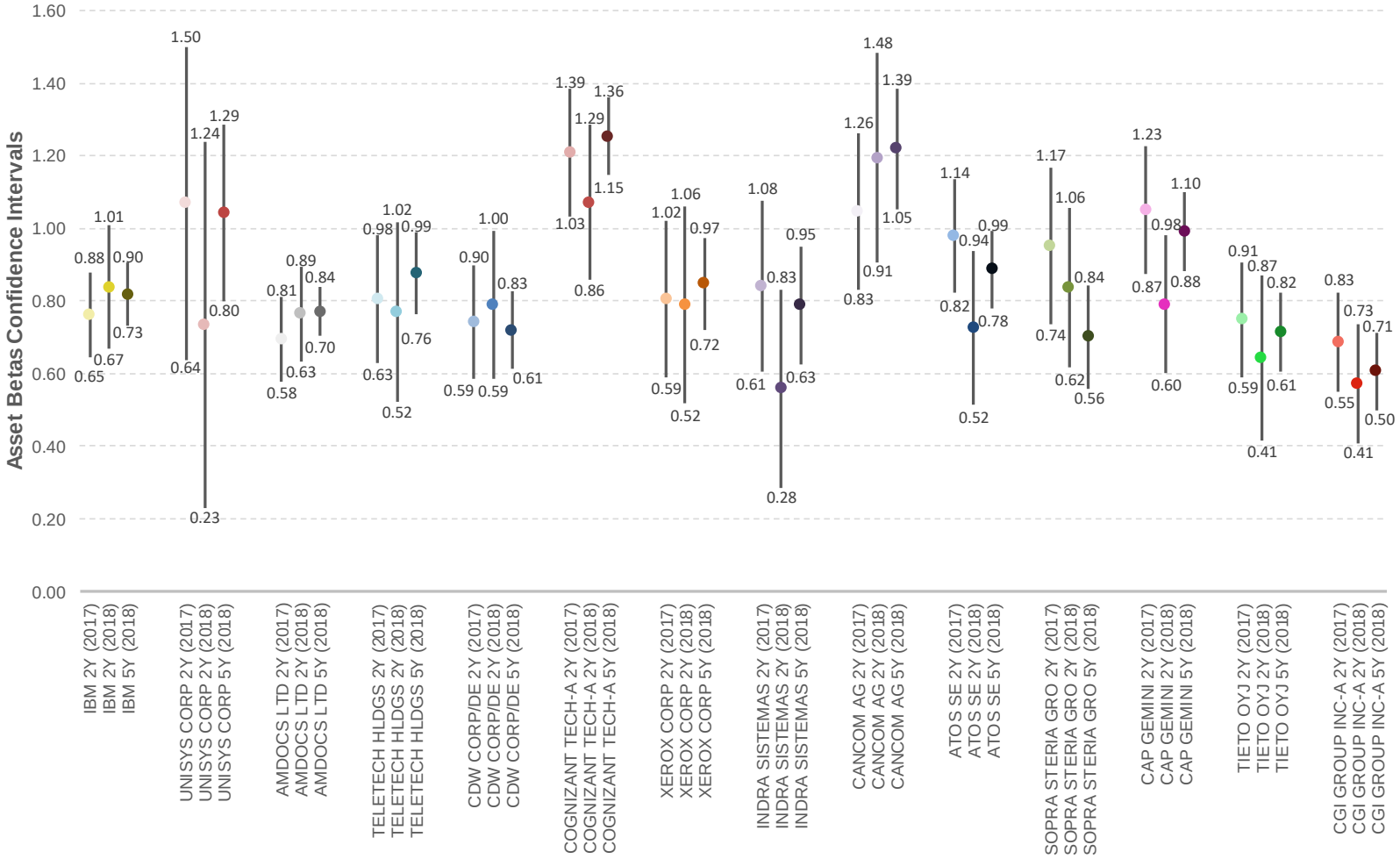
Source: NERA analysis based on Bloomberg data. Notes: 95% confidence intervals; local/regional reference index (FTSE All Share).

Figure B.2: Confidence intervals of asset beta estimates for European Telecoms comparators



Source: NERA analysis based on Bloomberg data. Notes: 95% confidence intervals; local/regional reference index (FTSE All Europe).

Figure B.3: Confidence intervals of asset beta estimates for ICT comparators



Source: NERA analysis based on Bloomberg data. Notes: 95% confidence intervals; global reference index (FTSE All World).

Appendix C. Relative Risk Analysis

In this appendix, we provide further details on our analysis of the systematic riskiness of leased lines (Business Connectivity Markets) relative to BT's copper access business and BT Group as a whole. As explained in section 5, there are substantial limitations regarding data availability / consistency and we therefore consider that this analysis should be only considered as indicative.

C.1. Operational leverage

First, we consider operational leverage, i.e. the measure of the degree of cost fixity. As explained in section 5.3, we assess the degree of operational leverage based on two ratios, which described in Table C.1.[73]

Table C.1: Ratios used to assess degree of operational leverage

Measure of Operational Leverage	Direction	Precedent
FCF/Total Revenues	Higher value, lower operating leverage	CMA and CRE (variant)
CAPEX/MCE	Higher value, higher operating leverage	Ofgem

Source: Ofgem (2012) RIIO-GD1: Final Proposals - Finance and uncertainty supporting document; Ofgem (2012) RIIO-T1: Final Proposals for SP Transmission Ltd and Scottish Hydro Electric Transmission Ltd; Ofgem (2012) RIIO-T1: Final Proposals for National Grid Electricity Transmission and National Grid Gas; CMA (2015) Bristol Water plc A reference under section 12(3)(a) of the Water Industry Act 1991; Frontier Economics: Audit des demandes de RTE sur le cadre de rémunération - Un rapport mandaté par la Commission de Régulation de l'Energie (2016).

We focus our analysis on these ratios because unlike other ratios that regulators have considered in this context (e.g. OPEX/MCE), these ratios take into account capex which we consider highly relevant for cost fixity: FCF/Total Revenues is a cash-flow measure that incorporates capex-related outflows, and Capex/MCE is a straightforward measure of the impact of capex.[74]

Leased lines versus copper access

Table C.2 shows the two ratios for leased lines (BCM), for the years 2016 and 2017.

Table C.2: Operational Leverage ratios for Leased Lines vs Copper Access

	Direction	BCM (2017)	Copper access* (2017)	BCM (2016)	Copper access* (2016)
FCF/Total Revenues	Higher value, lower operating leverage	✂	✂	✂	✂
CAPEX/MCE	Higher value, higher operating leverage	✂	✂	✂	✂

Source: NERA analysis based on BT's Regulatory Financial Statements and data provided by Ofcom

[73] For this analysis, we rely on BT's Regulatory Financial Statements from 2017 (using the restated versions for 2016).

[74] MCE stands for Mean Capital Employed.

Both ratios indicate that leased lines have a higher degree of operational leverage compared to copper access in 2017. Using 2016 data, the Capex/MCE ratio also shows higher operational leverage for leased lines, while the FCF/Total Revenues indicate a lower degree of operational leverage for leased lines.

Overall, this analysis points towards leased lines being somewhat more risky than copper access, which is consistent Ofcom's previous approach of setting the asset beta for OUKT/leased lines above the asset beta for "Openreach Copper access". However, we note that these results are indicative only, given the limitations of this analysis as described below.

Leased lines versus BT Group

We perform the same calculations of operational leverage ratios for leased lines and BT Group as a whole for 2016 and 2017, as shown in Table C.3.

Table C.3: Operational Leverage ratios for Leased Lines vs BT Group

OL Ratios	Direction	BCM (2017)	BT (2017)	BCM (2016)	BT (2016)
FCF/Total Revenues	Higher value, lower operating leverage	✂	✂	✂	✂
CAPEX/MCE	Higher value, higher operating leverage	✂	✂	✂	✂

Source: NERA analysis based on BT's Regulatory Financial Statements and data provided by Ofcom; BT annual reports.

The evidence on operational gearing for leased lines vs. BT Group is mixed: the Capex/MCE ratio indicates that leased lines have higher operational leverage compared to BT Group as a whole, while FCF/Total Revenues indicates that BT Group has a higher operational leverage, in both years. Based on our indicative results, we have no reason to conclude that leased lines have a lower or higher operational leverage than BT as a whole or OUKT.

Limitations of the analysis of operational leverage

As explained in section 5, we only use the above analysis as a cross-check, given the substantive data-related limitations:

- We do not have data for BT's copper lines segment per se, and therefore calculate a proxy based on the data for fixed access markets provided in BT's regulatory financial statements (RFS), from which we remove ISDN and fibre services. Whereas this proxy mainly comprises copper access services, it also includes some other activities which we cannot remove based on the data in the RFS;
- The RFS do not provide a basis for comparing ratios over time. First, there are several instances where activities and services have been recategorised in recent years (e.g. fibre). Second, charge controls have affected the ratios (e.g. the 2016 BCMR significantly reduced revenues for leased lines);
- We avoid inconsistent comparisons by only relying on the 2017 RFS, which provides restated information for 2016 that is consistent with 2017 data in terms of categories. However, using the restated statements does not remove the impact of charge controls, and relying only on the 2017 RFS leaves us with a very short time series;

- Ideally we would have also wanted 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 Group.

C.2. Volume risk

We have also assessed the volume risk of leased lines relative to copper access. In principle, given that BT's regulated business operations are subject to price caps, volume variability should be an indicator of systematic risk exposure for leased lines. Looking at volumes across different types of products should therefore allow us to get an additional measure of the relative riskiness of leased lines in relation to other markets/products.

We analyse volume risk by looking at the monthly variability of rental and call volume data and BT's volume forecast accuracy. For the former, we look at the ratio of maximum and minimum monthly variance for BT's actual rental and call volumes, while for the latter, we look at the forecast volume variability against actual rental and call volumes.

Table C.4 presents the results for the Max/Min monthly variance. Theoretically, we would expect a lower demand risk to be reflected in a lower volume variability. By computing the Max/Min monthly variance, we can observe that Copper Lines show almost no variability throughout the period under consideration (2011-2018), while leased lines show more variability.

Table C.4: Max/min monthly variance (2011-2018)

Max/min monthly variance	2011	2012	2013	2014	2015	2016	2017	2018	Average
Copper lines (PSTN, WLR, LLU)	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Other copper lines (incl ISDN2)	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
ISDN30	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Leased lines	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
WBA	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Fibre BB	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Call minutes	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
EE mobile minutes	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
EE mobile subscribers	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
BT TV subscribers	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]

Source: Ofcom analysis.

Secondly, we evaluate how accurately BT can forecast demand. If BT can do so accurately for certain products, then this indicates that these products would face a lower systematic risk given the lower volume risk. We assess forecasting accuracy by computing the ratio of actual volumes to forecasted volumes (i.e. values above 100% indicate that actual volume was above forecasted volume). The results are presented in Table C.5. The main insight from this table is that leased lines volumes appear relatively more difficult to forecast compared to copper lines.

Table C.5: Ratios of actual volumes to forecast volume (2011-2018)

Ratio of actual volumes to forecast volumes	2011	2012	2013	2014	2015	2016	2017	2018
Copper lines (PSTN, WLR, LLU)	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Other copper lines (incl ISDN2)	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
ISDN30	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Leased lines	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
WBA	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Fibre BB	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Call minutes	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Mobile minutes	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Mobile subscribers	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
TV Customers	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]

Source: Ofcom analysis.

Overall, both measures point towards the same conclusion. Leased lines experience greater volume variability, which would be consistent with their higher exposure to systematic risk compared with copper lines.

Limitations of the analysis of volume risk

As in the case of operational leverage, these results are merely indicative as the analysis has a number of limitations:

- The volumes presented include total volumes for each type of product, e.g. the leased lines category includes both wholesale volumes and retail volumes. We do not have a robust basis to disentangle the "regulated wholesale" from "unregulated retail" elements; and
- Rather than being a measure of systematic risks, this analysis measures total risk, i.e. systematic and company-specific risks. By contrast, the beta in the CAPM is a measure of systematic risk only, as investors are assumed to hold diversified portfolios and are hence only compensated for systematic risk.

Appendix D. Equity and Asset betas against FTSE All World

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

As shown in Table D.1 to Table D.4, we obtain the following results for BT and UK Utilities/Telecoms comparators against the FTSE All World index:

- BT's 2-year asset beta declined from 0.86 in September 2017 to 0.38 in July 2018. Its current 5-year asset beta is 0.68;
- The 2-year asset beta range for UK Utilities (excl. SSE) has decreased from 0.28-0.37 to 0.19-0.28. The current 5-year asset beta range is 0.32-0.35; and
- The 2-year asset beta range for UK Telecoms' (excl. Sky) decreased from 0.52-0.61 to 0.42-0.46. Its current 5-year asset beta range is 0.59-0.64.

The results for European Telecoms comparators are presented in Table D.5 and Table D.6. They show that the 2-year asset beta range for European Telecoms has decreased from 0.51-0.86 in our last update to 0.38-0.63. The current 5-year asset beta range for this comparator sample is 0.43-0.74.

Table D.1: BT and UK Utilities Equity Beta against the FTSE All World

	FTSE All World		
	OLS/GLS*		
	Beta (Jul 18)	SE (Jul 18)	Beta (Sep 17)
BT			
1Y	0.52	0.14	0.44
2Y	0.52	0.15	1.13
5Y*	0.89	0.06	n.a.
National Grid			
1Y	0.40	0.11	0.27
2Y	0.38	0.09	0.43
5Y*	0.51	0.04	n.a.
Severn Trent			
1Y	0.35	0.14	0.30
2Y	0.35	0.10	0.57
5Y*	0.59	0.05	n.a.
Pennon			
1Y	0.45	0.15	0.38
2Y	0.46	0.11	0.62
5Y*	0.59	0.05	n.a.
United Utilities			
1Y	0.26	0.15	0.21
2Y	0.30	0.11	0.55
5Y*	0.58	0.05	n.a.
SSE			
1Y	0.37	0.12	0.18
2Y	0.35	0.09	0.96
5Y*	0.75	0.04	n.a.
Utilities average			
1Y	**0.37**		**0.27**
2Y	**0.37**		**0.63**
5Y	**0.60**		**n.a.**
Utilities average (excl. SSE)			
1Y	**0.36**		**0.29**
2Y	**0.37**		**0.54**
5Y	**0.57**		**n.a.**

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018. Note: daily data.

Table D.2: BT and UK Telecoms Equity Beta against the FTSE All World

	FTSE All World		
	OLS/GLS*		
	Beta (Jul 18)	**SE (Jul 18)**	**Beta (Sep 17)**
BT			
1Y	0.52	0.14	0.44
2Y	0.52	0.15	1.13
5Y*	0.89	0.06	n.a.
TalkTalk			
1Y*	0.85	0.29	-0.12
2Y*	0.60	0.21	0.82
5Y*	0.82	0.09	n.a.
Sky			
1Y	0.01	0.16	0.49
2Y	0.25	0.14	1.01
5Y	0.74	0.06	n.a.
Vodafone			
1Y*	0.74	0.12	0.75
2Y*	0.72	0.09	0.82
5Y*	0.89	0.05	n.a.
Telecoms average (excluding BT)			
1Y	**0.53**		**0.37**
2Y	**0.52**		**0.88**
5Y	**0.82**		**n.a.**
Telecoms average (excluding Sky and BT)			
1Y	**0.79**		**0.31**
2Y	**0.66**		**0.82**
5Y	**0.86**		**n.a.**

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018; Note: daily data.

Table D.3: BT and UK Utilities Asset Betas against the FTSE All World

		FTSE All World	
		Asset beta (Jul 18)	Asset beta (Sep 17)
	Gearing	Debt beta=0.1	Debt beta=0.1
BT			
1Y	37%	0.37	0.34
2Y	33%	0.38	0.86
5Y	27%	0.68	n.a.
National Grid			
1Y	48%	0.26	0.19
2Y	47%	0.25	0.28
5Y	46%	0.32	n.a.
Severn Trent			
1Y	53%	0.22	0.20
2Y	51%	0.22	0.35
5Y	50%	0.34	n.a.
Pennon			
1Y	52%	0.27	0.24
2Y	50%	0.28	0.37
5Y	49%	0.35	n.a.
United Utilities			
1Y	59%	0.16	0.15
2Y	56%	0.19	0.31
5Y	54%	0.32	n.a.
SSE			
1Y	38%	0.27	0.15
2Y	36%	0.26	0.68
5Y	33%	0.54	n.a.
Utilities average			
1Y	50%	**0.23**	**0.19**
2Y	48%	**0.24**	**0.40**
5Y	46%	**0.37**	**n.a**
Utilities average (excl. SSE)			
1Y	53%	**0.23**	**0.20**
2Y	51%	**0.24**	**0.33**
5Y	50%	**0.33**	**n.a.**

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018; Note: daily data.

Table D.4: BT and UK Telecoms Asset Betas against the FTSE All World

			FTSE All World	
			Asset beta (Jul 18)	Asset beta (Sep 17)
		Gearing	Debt beta=0.1	Debt beta=0.1
BT				
	1Y	37%	0.37	0.34
	2Y	33%	0.38	0.86
	5Y	27%	0.68	n.a.
TalkTalk				
	1Y	37%	0.57	-0.05
	2Y	35%	0.42	0.61
	5Y	26%	0.64	n.a.
Sky				
	1Y	32%	0.04	0.35
	2Y	34%	0.20	0.70
	5Y	29%	0.55	n.a.
Vodafone				
	1Y	40%	0.48	0.47
	2Y	42%	0.46	0.52
	5Y	38%	0.59	n.a.
Telecoms average (excluding BT)				
	1Y	36%	**0.37**	**0.26**
	2Y	37%	**0.36**	**0.61**
	5Y	31%	**0.59**	**n.a.**
Telecoms average (excluding Sky and BT)				
	1Y	39%	**0.53**	**0.21**
	2Y	38%	**0.44**	**0.57**
	5Y	32%	**0.62**	**n.a.**

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018. Note: daily data.

Table D.5: BT and European Telecoms Equity Beta against the FTSE All World

	FTSE All World		
	OLS/GLS*		
	Beta (Jul 18)	SE (Jul 18)	Beta (Sep 17)
BT			
1Y	0.52	0.14	0.44
2Y	0.52	0.15	1.13
5Y*	0.89	0.06	n.a.
Telefonica			
1Y	0.81	0.11	1.50
2Y	1.04	0.09	1.85
5Y*	1.40	0.05	n.a.
Deutsche Telekom			
1Y	0.86	0.10	1.18
2Y	0.96	0.07	1.19
5Y*	1.23	0.05	n.a.
Belgacom			
1Y	0.58	0.12	0.76
2Y	0.63	0.09	0.85
5Y	0.79	0.05	n.a.
KPN			
1Y	0.51	0.12	0.8
2Y*	0.71	0.11	0.97
5Y	0.94	0.06	n.a.
Orange			
1Y	0.66	0.09	1.06
2Y	0.78	0.08	1.14
5Y	1.20	0.06	n.a.
Telecom Italia			
1Y*	0.61	0.18	1.46
2Y*	0.97	0.14	1.96
5Y*	1.43	0.09	n.a.
Iliad			
1Y	0.74	0.23	0.91
2Y*	0.71	0.15	0.84
5Y	0.84	0.08	n.a.
Orange Belgium			
1Y	0.62	0.16	0.68
2Y	0.62	0.12	0.65
5Y*	0.58	0.08	n.a.
Telenor			
1Y*	0.35	0.12	0.9
2Y*	0.48	0.10	0.96
5Y*	0.81	0.05	n.a.
Tele2			
1Y	0.62	0.17	1.17
2Y	0.79	0.12	1.04
5Y*	0.87	0.06	n.a.
Swisscom			
1Y	0.59	0.09	0.65
2Y	0.60	0.06	0.84
5Y*	0.71	0.04	n.a.
EU Comparators Avg.			
	0.63		**1.01**
	0.75		**1.12**
	0.98		**n.a.**

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018. Note: daily data.

Table D.6: BT and European Telecoms Asset Beta against the FTSE All World

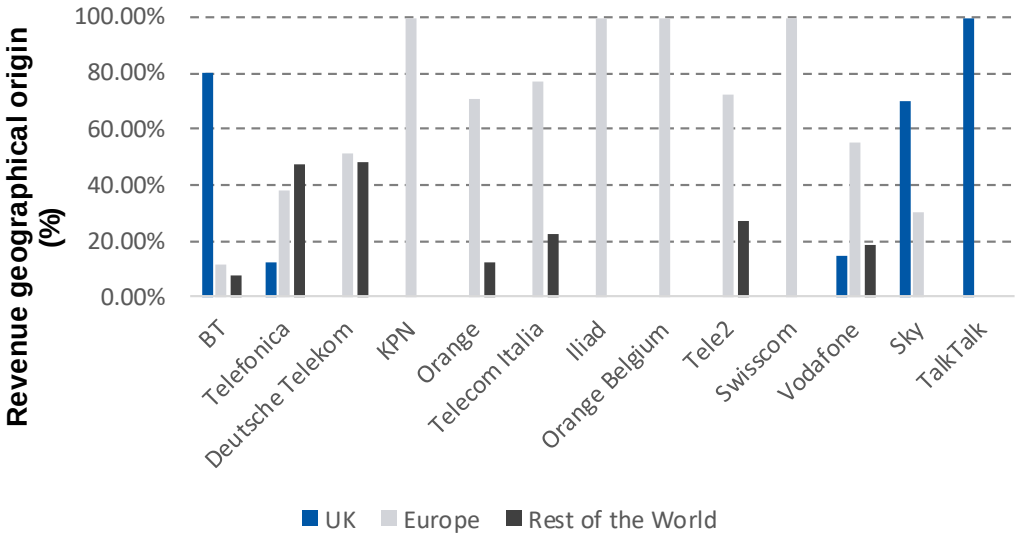
		FTSE All World	
		Asset beta (Jul 18)	Asset beta (Sep 17)
	Gearing	Debt beta=0.1	Debt beta=0.1
BT			
1Y	37%	0.37	0.34
2Y	33%	0.38	0.86
5Y	27%	0.68	n.a.
Telefonica			
1Y	57%	0.40	0.71
2Y	57%	0.50	0.86
5Y	54%	0.69	n.a.
Deutsche Telekom			
1Y	46%	0.51	0.69
2Y	46%	0.57	0.69
5Y	46%	0.71	n.a.
Belgacom			
1Y	21%	0.48	0.63
2Y	21%	0.52	0.70
5Y	21%	0.65	n.a.
KPN			
1Y	40%	0.34	0.51
2Y	40%	0.46	0.62
5Y	47%	0.54	n.a.
Orange			
1Y	46%	0.40	0.61
2Y	47%	0.46	0.66
5Y	50%	0.65	n.a.
Telecom Italia			
1Y	67%	0.27	0.54
2Y	68%	0.38	0.71
5Y	68%	0.52	n.a.
Iliad			
1Y	18%	0.63	0.80
2Y	16%	0.61	0.74
5Y	13%	0.74	n.a.
Orange Belgium			
1Y	24%	0.50	0.54
2Y	24%	0.49	0.51
5Y	31%	0.43	n.a.
Telenor			
1Y	22%	0.29	0.67
2Y	26%	0.38	0.72
5Y	24%	0.64	n.a.
Tele2			
1Y	20%	0.52	0.92
2Y	23%	0.63	0.82
5Y	21%	0.71	n.a.
Swisscom			
1Y	25%	0.46	0.50
2Y	26%	0.47	0.64
5Y	26%	0.55	n.a.
EU Comparators Avg.			
1Y	35%	**0.44**	**0.65**
2Y	36%	**0.50**	**0.70**
5Y	36%	**0.62**	**n.a.**

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018. Note: daily data.

Appendix E. Revenue Breakdown for BT and Telecoms Comparators

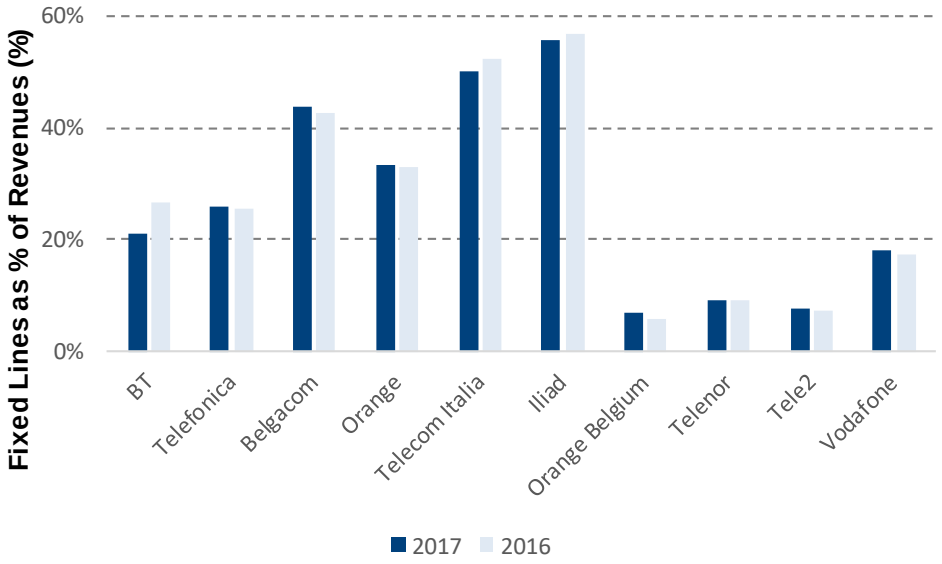
This appendix presents a revenue breakdown for BT and several telecoms comparators. Figure E.1 shows a breakdown by geography, and Figure E.2 shows the approximate percentage of revenues that each company generated from fixed line activities in 2017 (as opposed to mobile and other services).

Figure E.1: Revenue by geographical origin for BT and telecoms comparators



Source: NERA analysis based on Bloomberg data and 2017 Annual reports.

Figure E.2: Revenue from fixed line activities for BT and telecoms comparators



Source: NERA analysis based on Bloomberg data and 2017 Annual reports.

Figure E.1 shows that BT, Sky, and TalkTalk are UK-focused businesses, whereas Vodafone is internationally diversified. As described above, the UK-focused businesses have generally seen declines in their 2-year asset betas. We do not see such a decline for Vodafone, which may be driven by its international diversification.

Most European telecoms comparators focus on European markets, with the exception of Deutsche Telekom and Telefonica.

Figure E.2 suggests that the percentage of revenues generated from fixed line activities varies considerably across UK and European telecoms companies. Based on this measure only, the closest comparators for BT are Telefonica, Orange, and Vodafone. However, we do not see a consistent relationship between the share of fixed line activities and the empirical asset betas.

We note that this data is not available for all telecoms comparators. Moreover, the shares of fixed line activities are only approximate shares, based on high level breakdowns presented in annual reports. Given these limitations, we consider these results to be indicative only.

Appendix F. Debt Beta Sensitivity

This appendix presents the results on the sensitivity of our asset beta estimates to the debt beta assumption. Table F.1 and Table F.2 show average asset beta estimates for different assumptions on the debt beta (0, 0.05, 0.1, 0.2), for the local/regional index and the world index, respectively.

Generally, given the current gearing levels, increasing the debt beta from 0.1 to 0.2 would lead to an increase in asset betas of c.0.04 while decreasing the debt beta from 0.1 to 0.05 would reduce asset betas by around 0.02, against the local/regional indices. The results are similar when using the FTSE All World index.

Table F.1: Sensitivity of asset beta estimates to debt beta assumption – Local/regional indices

	Domestic and Regional Index				
		Equity Beta	Asset Beta		
			βd = 0	βd = 0.05	βd = 0.1	βd = 0.2
BT						
	1Y	0.83	0.52	0.54	0.56	0.59
	2Y	0.72	0.48	0.50	0.51	0.55
	5Y	0.94	0.69	0.70	0.71	0.74
UK Utilities Comparators average						
	1Y	0.80	0.40	0.42	0.45	0.50
	2Y	0.69	0.36	0.38	0.41	0.45
	5Y	0.71	0.39	0.41	0.43	0.48
UK Telecoms Comparators average						
	1Y	0.78	0.48	0.50	0.52	0.56
	2Y	0.73	0.46	0.47	0.49	0.53
	5Y	0.87	0.59	0.61	0.62	0.65
European Telecoms Comparators average						
	1Y	0.76	0.48	0.50	0.51	0.55
	2Y	0.75	0.46	0.48	0.50	0.53
	5Y	0.82	0.49	0.51	0.53	0.56

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.

Table F.2: Sensitivity of asset beta estimates to debt beta assumption – FTSE All World Index

	FTSE All World Index				
	Equity Beta	Asset Beta			
		βd = 0	βd = 0.05	βd = 0.1	βd = 0.2
BT					
1Y	0.52	0.33	0.35	0.37	0.40
2Y	0.52	0.35	0.36	0.38	0.41
5Y	0.89	0.65	0.66	0.68	0.70
UK Utilities Comparators average					
1Y	0.37	0.18	0.21	0.23	0.28
2Y	0.37	0.19	0.22	0.24	0.29
5Y	0.60	0.33	0.35	0.37	0.42
UK Telecoms Comparators average					
1Y	0.53	0.33	0.35	0.37	0.40
2Y	0.52	0.32	0.34	0.36	0.40
5Y	0.82	0.56	0.58	0.59	0.63
European Telecoms Comparators average					
1Y	0.63	0.40	0.42	0.44	0.47
2Y	0.75	0.46	0.48	0.50	0.53
5Y	0.98	0.59	0.60	0.62	0.66

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.

Appendix G. Cross-check: Weekly Data

In this appendix, we present our equity and asset beta estimates for BT Group and comparators, using weekly instead of daily data. As explained in section 2, we prefer using daily data as this leads to more statistically robust estimates. We include the results for the weekly data frequency as a cross-check only. In general, we obtain consistent results using weekly data, although the ranges tend to be somewhat higher for the comparator samples. The estimates for BT are lower compared to the estimates based on daily data.

Based on the evidence presented in section G.1, we summarise the weekly ranges for BT and UK Utilities/Telecoms comparators as follows:

- BT's 2-year asset beta is currently 0.42, while its 5-year asset beta is 0.59 against the FTSE All Share. Against the FTSE All World, these values are slightly lower (0.4 for the 2-year asset beta and 0.56 for the 5-year asset beta);
- UK Utilities (excluding SSE) have ranges of 0.37-0.49 and 0.41-0.43 for the 2-year and 5-year asset betas, respectively, against the FTSE All Share index. Against the FTSE All World, these ranges are lower: 0.22-0.33 for the 2-year asset betas and 0.31-34 for the 5-year asset betas; and
- UK Telecoms (excluding Sky) have ranges of 0.57-0.7 and 0.66-0.78 for the 2-year and 5-year asset betas, respectively, against the FTSE All Share index. Against the FTSE All World, these ranges are 0.53-0.61 for the 2-year asset betas and 0.51-0.84 for the 5-year asset betas.

Section G.2 shows that European Telecoms have ranges of 0.44-0.75 and 0.43-0.67 for the 2-year and 5-year asset betas, respectively, against the FTSE All Europe index. Against the FTSE All World, these ranges are 0.31-0.94 for the 2-year asset betas and 0.39-0.76 for the 5-year asset betas.

Section G.3 shows the results for the ICT comparators. Against the local/regional indices, these comparators have weekly asset betas in the ranges of 0.53-0.95 and 0.61-1.19 for the 2-year and 5-year windows, respectively. Against the FTSE All World, the ranges are 0.57-1.40 for the 2-year asset betas and 0.62-1.16 for the 5-year asset betas.

G.1. UK Utilities and UK Telecoms comparators

Table G.1: BT and UK Utilities Equity Beta against the FTSE All Share and All World indices (weekly data)

	FTSE All Share			FTSE All World	
	Beta (Jul 18)	**SE (Jul 18)**		**Beta (Jul 18)**	**SE (Jul 18)**
BT					
1Y*	0.67	0.29	1Y*	0.64	0.25
2Y	0.58	0.27	2Y	0.55	0.28
5Y	0.77	0.11	5Y	0.73	0.12
National Grid					
1Y	0.83	0.18	1Y	0.48	0.18
2Y	0.80	0.14	2Y	0.45	0.16
5Y*	0.70	0.07	5Y*	0.47	0.08
Severn Trent					
1Y*	0.87	0.26	1Y	0.38	0.26
2Y*	0.85	0.17	2Y	0.43	0.20
5Y	0.76	0.08	5Y*	0.58	0.09
Pennon					
1Y*	1.00	0.27	1Y	0.60	0.28
2Y*	0.87	0.20	2Y	0.57	0.22
5Y	0.74	0.09	5Y*	0.56	0.10
United Utilities					
1Y	0.84	0.25	1Y	0.35	0.25
2Y	0.71	0.18	2Y	0.37	0.19
5Y	0.77	0.08	5Y	0.56	0.10
SSE					
1Y	0.70	0.16	1Y	0.50	0.16
2Y	0.57	0.13	2Y	0.34	0.15
5Y	0.70	0.07	5Y	0.61	0.08
UK Utilities Avg.					
1Y	**0.85**			**0.46**	
2Y	**0.76**			**0.43**	
5Y	**0.73**			**0.56**	

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.

Table G.2: BT and UK Telecoms Equity Beta against the FTSE All Share and All World indices (weekly data)

	FTSE All Share			FTSE All World	
	Beta (Jul 18)	**SE (Jul 18)**		**Beta (Jul 18)**	**SE (Jul 18)**
BT					
1Y*	0.67	0.29	1Y*	0.64	0.25
2Y	0.58	0.27	2Y	0.55	0.28
5Y	0.77	0.11	5Y	0.73	0.12
TalkTalk					
1Y*	1.06	0.48	1Y*	0.95	0.43
2Y*	0.81	0.35	2Y*	0.88	0.35
5Y	1.01	0.16	5Y	1.09	0.17
Sky					
1Y	-0.11	0.34	1Y	-0.30	0.31
2Y*	0.30	0.27	2Y	0.19	0.29
5Y	0.68	0.11	5Y	0.58	0.12
Vodafone					
1Y	1.05	0.21	1Y	0.83	0.20
2Y	1.13	0.15	2Y	0.83	0.18
5Y	1.00	0.08	5Y	0.76	0.10
UK Telecoms Avg.					
1Y	**0.67**			**0.49**	
2Y	**0.75**			**0.63**	
5Y	**0.90**			**0.81**	

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.

Table G.3: BT and UK Utilities Asset Beta against the FTSE All Share and All World indices (weekly data)

		FTSE All Share		FTSE All World	
	Gearing	Debt beta=0	Debt beta=0.1	Debt beta=0	Debt beta=0.1
BT					
1Y	37%	0.43	0.46	0.40	0.44
2Y	33%	0.39	0.42	0.37	0.40
5Y	27%	0.56	0.59	0.53	0.56
National Grid					
1Y	48%	0.43	0.48	0.25	0.30
2Y	46%	0.43	0.47	0.24	0.29
5Y	46%	0.38	0.42	0.26	0.30
Severn Trent					
1Y	53%	0.41	0.46	0.18	0.23
2Y	51%	0.42	0.47	0.21	0.26
5Y	50%	0.38	0.43	0.29	0.34
Pennon					
1Y	52%	0.48	0.53	0.29	0.34
2Y	50%	0.44	0.49	0.28	0.33
5Y	49%	0.38	0.43	0.28	0.33
United Utilities					
1Y	59%	0.35	0.41	0.14	0.20
2Y	56%	0.31	0.37	0.16	0.22
5Y	54%	0.35	0.41	0.26	0.31
SSE					
1Y	38%	0.43	0.47	0.31	0.34
2Y	36%	0.37	0.40	0.21	0.25
5Y	33%	0.47	0.50	0.41	0.44
UK Utilities Avg.					
1Y	0.50	0.42	**0.47**	0.23	**0.28**
2Y	0.48	0.39	**0.44**	0.22	**0.27**
5Y	0.46	0.39	**0.44**	0.30	**0.35**

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.

Table G.4: BT and UK Telecoms Asset Beta against the FTSE All Share and All World indices (weekly data)

		FTSE All Share		FTSE All World	
	Gearing	Debt beta=0	Debt beta=0.1	Debt beta=0	Debt beta=0.1
BT					
1Y	37%	0.43	0.46	0.40	0.44
2Y	33%	0.39	0.42	0.37	0.40
5Y	27%	0.56	0.59	0.53	0.56
TalkTalk					
1Y	37%	0.67	0.71	0.60	0.64
2Y	35%	0.53	0.57	0.57	0.61
5Y	25%	0.75	0.78	0.81	0.84
Sky					
1Y	32%	-0.08	-0.04	-0.21	-0.17
2Y	34%	0.20	0.23	0.12	0.16
5Y	29%	0.48	0.51	0.41	0.44
Vodafone					
1Y	40%	0.63	0.67	0.50	0.54
2Y	42%	0.66	0.70	0.48	0.53
5Y	38%	0.62	0.66	0.47	0.51
UK Telecoms Avg.					
1Y	36%	0.41	**0.44**	0.30	**0.33**
2Y	37%	0.46	**0.50**	0.39	**0.43**
5Y	31%	0.62	**0.65**	0.56	**0.60**

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.

G.2. European Telecoms comparators

Table G.5: BT and European Telecoms Equity Betas using FTSE All Share and FTSE All World (weekly data)

	FTSE All Europe			FTSE All World	
	OLS/GLS*			OLS/GLS*	
	Beta (Jul 18)	SE (Jul 18)		Beta (Jul 18)	SE (Jul 18)
BT					
1Y*	0.63	0.27	1Y*	0.64	0.25
2Y	0.40	0.25	2Y	0.55	0.28
5Y	0.64	0.09	5Y	0.73	0.12
Telefonica					
1Y	1.15	0.18	1Y	1.06	0.17
2Y	1.17	0.15	2Y	1.10	0.18
5Y	1.15	0.07	5Y	1.29	0.10
Deutsche Telekom					
1Y	0.99	0.15	1Y	0.74	0.16
2Y	1.01	0.11	2Y	0.90	0.14
5Y	1.08	0.06	5Y	1.02	0.10
Belgacom					
1Y	0.79	0.22	1Y*	0.90	0.19
2Y	0.78	0.15	2Y	0.91	0.17
5Y	0.75	0.08	5Y	0.82	0.10
KPN					
1Y	0.88	0.20	1Y	1.05	0.17
2Y	0.86	0.17	2Y	1.04	0.18
5Y	0.78	0.10	5Y	0.85	0.13
Orange					
1Y	0.88	0.16	1Y	0.83	0.15
2Y	0.84	0.12	2Y	0.81	0.14
5Y	1.01	0.08	5Y	1.02	0.11
Telecom Italia					
1Y*	1.04	0.35	1Y	0.59	0.36
2Y*	1.16	0.24	2Y	0.76	0.29
5Y	1.14	0.13	5Y	1.01	0.18
Iliad					
1Y*	0.69	0.41	1Y*	1.10	0.37
2Y*	0.88	0.26	2Y*	1.10	0.28
5Y	0.57	0.12	5Y	0.71	0.15
Orange Belgium					
1Y	1.01	0.30	1Y	1.05	0.28
2Y	0.94	0.20	2Y	1.13	0.21
5Y	0.69	0.14	5Y	0.81	0.17
Telenor					
1Y*	0.69	0.23	1Y	0.74	0.22
2Y	0.74	0.16	2Y	0.86	0.18
5Y	0.83	0.08	5Y*	0.94	0.11
Tele2					
1Y	0.90	0.32	1Y	0.80	0.31
2Y	0.94	0.19	2Y	0.94	0.22
5Y	0.81	0.08	5Y	0.94	0.11
Swisscom					
1Y	0.83	0.13	1Y*	0.88	0.12
2Y	0.77	0.09	2Y	0.85	0.10
5Y	0.62	0.05	5Y	0.72	0.07
EU Comparators Avg.					
1Y	**0.89**			**0.88**	
2Y	**0.92**			**0.95**	
5Y	**0.86**			**0.92**	

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.

Table G.6: BT and European Telecoms Asset Beta against the FTSE All Europe and FTSE All World (weekly data)

		FTSE All Europe		FTSE All World	
		Asset beta (Jul 18)		Asset beta (Jul 18)	
	Gearing	Debt beta=0	Debt beta=0.1	Debt beta=0	Debt beta=0.1
BT					
1Y	37%	0.40	0.43	0.40	0.44
2Y	33%	0.27	0.30	0.37	0.40
5Y	27%	0.47	0.49	0.53	0.56
Telefonica					
1Y	57%	0.50	0.55	0.46	0.51
2Y	57%	0.50	0.56	0.47	0.53
5Y	54%	0.52	0.58	0.59	0.64
Deutsche Telekom					
1Y	46%	0.54	0.58	0.40	0.45
2Y	46%	0.55	0.59	0.49	0.54
5Y	46%	0.58	0.63	0.55	0.59
Belgacom					
1Y	21%	0.62	0.64	0.71	0.73
2Y	21%	0.62	0.64	0.72	0.74
5Y	21%	0.59	0.61	0.65	0.67
KPN					
1Y	40%	0.53	0.57	0.64	0.67
2Y	40%	0.51	0.55	0.62	0.66
5Y	48%	0.41	0.46	0.44	0.49
Orange					
1Y	46%	0.47	0.51	0.44	0.49
2Y	47%	0.45	0.49	0.43	0.48
5Y	50%	0.50	0.55	0.51	0.56
Telecom Italia					
1Y	67%	0.34	0.41	0.19	0.26
2Y	68%	0.37	0.44	0.25	0.31
5Y	68%	0.36	0.43	0.32	0.39
Iliad					
1Y	18%	0.57	0.59	0.90	0.92
2Y	16%	0.74	0.75	0.93	0.94
5Y	13%	0.49	0.51	0.62	0.63
Orange Belgium					
1Y	24%	0.76	0.79	0.80	0.82
2Y	24%	0.72	0.74	0.86	0.88
5Y	31%	0.48	0.51	0.56	0.59
Telenor					
1Y	22%	0.53	0.56	0.57	0.59
2Y	26%	0.54	0.57	0.64	0.67
5Y	24%	0.63	0.65	0.71	0.74
Tele2					
1Y	20%	0.72	0.74	0.64	0.66
2Y	22%	0.73	0.75	0.72	0.75
5Y	21%	0.65	0.67	0.74	0.76
Swisscom					
1Y	25%	0.62	0.65	0.65	0.68
2Y	26%	0.57	0.59	0.63	0.65
5Y	26%	0.46	0.48	0.53	0.56
EU Comparators Avg.					
1Y	35%	**0.56**	**0.60**	**0.58**	**0.62**
2Y	36%	**0.57**	**0.61**	**0.61**	**0.65**
5Y	37%	**0.52**	**0.55**	**0.57**	**0.60**

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.

G.3. ICT comparators

Table G.7: 2Y Equity and Asset Beta of ICT comparators against local/regional and world index (weekly data)

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	20%	1.09	0.13	1.08	0.16	0.89		0.88		✓
UNISYS CORP	US	Y	Y	Y	S&P 500	49%	1.41	0.44	1.24	0.50	0.76		0.68		✓
AMDOCS LTD	US	Y	Y	Y	S&P 500	1%	0.69	0.09	0.78	0.10	0.68		0.77		✓
TELETECH HLDGS	US	Y	Y	Y	S&P 500	13%	1.05	0.20	1.12	0.23	0.93		0.99		✓
CDW CORP/DE	US	N	Y	Y	S&P 500	26%	1.25	0.16	1.19	0.19	0.95		0.91		
COGNIZANT TECH-A	US	N	Y	Y	S&P 500	2%	0.76	0.17	0.74	0.19	0.74	*	0.73	*	
XEROX CORP	US	N	Y	Y	S&P 500	43%	1.30	0.22	1.46	0.25	0.78		0.87		
INDRA SISTEMAS	SP	Y	Y	Y	FTSE All Europe	39%	0.92	0.20	1.02	0.22	0.56		0.66		✓
CANCOM AG	GE	Y	Y	Y	FTSE All Europe	5%	1.33	0.22	1.47	0.24	0.53		1.40		✓
ATOS SE	FR	Y	Y	Y	FTSE All Europe	13%	1.02	0.17	1.01	0.19	0.53		0.90		✓
SOPRA STERIA GRO	FR	N	Y	Y	FTSE All Europe	23%	1.47	0.17	1.35	0.21	0.81		1.06		
CAP GEMINI	FR	N	Y	Y	FTSE All Europe	18%	1.34	0.14	1.14	0.18	0.66	*	0.94	*	
TIETO OYJ	FI	N	Y	Y	FTSE All Europe	9%	0.98	0.16	0.90	0.19	0.67		0.83		
CGI GROUP INC-A	CA	N	Y	Y	S&P/TSX Composite	8%	0.64	0.13	0.61	0.14	0.59		0.57		
Average Asset Beta (Jul 2018)															
Tier 1						20%	1.07		1.10		0.70		0.90		
Tier 2 (all comparators)						19%	1.09		1.08		0.72		0.87		

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.

Table G.8: 5Y Equity and Asset Beta of ICT comparators against the local/regional and world index (weekly data)

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	18%	0.88	0.08	0.91	0.09	0.74	*	0.76	*	✓
UNISYS CORP	US	Y	Y	Y	S&P 500	38%	1.86	0.24	1.65	0.25	1.19		1.06		✓
AMDOCS LTD	US	Y	Y	Y	S&P 500	1%	0.80	0.06	0.78	0.06	0.79		0.77		✓
TELETECH HLDGS	US	Y	Y	Y	S&P 500	10%	1.01	0.10	0.99	0.11	0.92		0.90		✓
CDW CORP/DE	US	N	Y	Y	S&P 500	33%	1.13	0.10	1.12	0.11	0.79		0.78		
COGNIZANT TECH-A	US	N	Y	Y	S&P 500	2%	1.01	0.10	0.99	0.11	1.00		0.97		
XEROX CORP	US	N	Y	Y	S&P 500	41%	1.26	0.12	1.32	0.12	0.79		0.83		
INDRA SISTEMAS	SP	Y	Y	Y	FTSE All Europe	38%	0.93	0.12	1.04	0.15	0.61		0.68		✓
CANCOM AG	GE	Y	Y	Y	FTSE All Europe	7%	1.00	0.12	1.24	0.16	0.93		1.16		✓
ATOS SE	FR	Y	Y	Y	FTSE All Europe	12%	0.86	0.07	0.95	0.10	0.76		0.85		✓
SOPRA STERIA GRO	FR	N	Y	Y	FTSE All Europe	25%	0.90	0.11	1.04	0.14	0.70		0.81		
CAP GEMINI	FR	N	Y	Y	FTSE All Europe	17%	1.01	0.07	1.06	0.10	0.85	*	0.90		
TIETO OYJ	FI	N	Y	Y	FTSE All Europe	9%	0.79	0.07	0.89	0.10	0.73	*	0.82	*	
CGI GROUP INC-A	CA	N	Y	Y	S&P/TSX Composite	13%	0.70	0.11	0.70	0.10	0.63		0.62		
Average Asset Beta (Jul 2018)															
Tier 1						18%	1.05		1.08		0.85		0.88		
Tier 2 (all comparators)						19%	1.01		1.05		0.82		0.85		

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.

Appendix H. Results for European Comparators under Previous Methodology (FTSE All Europe in USD)

This appendix presents updated beta estimates for the European telecoms and ICT comparators under our previous approach of using the default currency (i.e. US dollars) for the FTSE All Europe. As stated in section 2, we have reconsidered this approach for this update and now convert the FTSE All Europe to Euros, in line with the fact that the European telecoms sample is dominated by Euro-denominated stocks. To ensure comparability with our previous updates, we provide the updated estimates under our previous approach in Table H.1 to Table H.3 below.

H.1. European Telecoms comparators

Table H.1: BT and European Telecoms Equity Betas using FTSE All Europe and FTSE All World

	FTSE All Europe				FTSE All World		
	OLS/GLS*				OLS/GLS*		
	Beta (Jul 18)	SE (Jul 18)	Beta (Sep 17)		Beta (Jul 18)	SE (Jul 18)	Beta (Sep 17)
BT							
1Y*	0.71	0.12	0.43	1Y	0.52	0.14	0.44
2Y	0.56	0.11	0.82	2Y	0.52	0.15	1.13
5Y	0.74	0.04	n.a.	5Y*	0.89	0.06	n.a.
Telefonica							
1Y	0.86	0.09	0.95	1Y	0.81	0.11	1.50
2Y	0.91	0.06	1.25	2Y	1.04	0.09	1.85
5Y*	1.10	0.03	n.a.	5Y*	1.40	0.05	n.a.
Deutsche Telekom							
1Y*	0.54	0.09	0.66	1Y	0.86	0.10	1.18
2Y*	0.61	0.06	0.69	2Y	0.96	0.07	1.19
5Y*	0.77	0.03	n.a.	5Y*	1.23	0.05	n.a.
Belgacom							
1Y*	0.57	0.10	0.50	1Y	0.58	0.12	0.76
2Y	0.53	0.06	0.58	2Y	0.63	0.09	0.85
5Y*	0.62	0.03	n.a.	5Y	0.79	0.05	n.a.
KPN							
1Y	0.67	0.10	0.72	1Y	0.51	0.12	0.8
2Y	0.72	0.08	0.68	2Y*	0.71	0.11	0.97
5Y*	0.76	0.04	n.a.	5Y	0.94	0.06	n.a.
Orange							
1Y*	0.65	0.07	0.81	1Y	0.66	0.09	1.06
2Y	0.69	0.06	0.80	2Y	0.78	0.08	1.14
5Y	0.94	0.04	n.a.	5Y	1.20	0.06	n.a.
Telecom Italia							
1Y*	1.00	0.14	1.02	1Y*	0.61	0.18	1.46
2Y*	1.03	0.10	1.40	2Y*	0.97	0.14	1.96
5Y*	1.21	0.06	n.a.	5Y*	1.43	0.09	n.a.
Iliad							
1Y	0.76	0.19	0.61	1Y	0.74	0.23	0.91
2Y	0.64	0.11	0.60	2Y*	0.71	0.15	0.84
5Y	0.71	0.05	n.a.	5Y	0.84	0.08	n.a.
Orange Belgium							
1Y	0.53	0.14	0.48	1Y	0.62	0.16	0.68
2Y	0.48	0.08	0.49	2Y	0.62	0.12	0.65
5Y*	0.48	0.06	n.a.	5Y*	0.58	0.08	n.a.
Telenor							
1Y*	0.46	0.10	0.53	1Y*	0.35	0.12	0.9
2Y*	0.45	0.07	0.67	2Y*	0.48	0.10	0.96
5Y*	0.65	0.04	n.a.	5Y*	0.81	0.05	n.a.
Tele2							
1Y	0.78	0.14	0.76	1Y	0.62	0.17	1.17
2Y	0.75	0.08	0.76	2Y	0.79	0.12	1.04
5Y*	0.71	0.04	n.a.	5Y*	0.87	0.06	n.a.
Swisscom							
1Y	0.69	0.07	0.45	1Y	0.59	0.09	0.65
2Y*	0.56	0.04	0.57	2Y	0.60	0.06	0.84
5Y*	0.58	0.02	n.a.	5Y*	0.71	0.04	n.a.
EU Comparators Avg.							
1Y	**0.68**		**0.68**		**0.63**		**1.01**
2Y	**0.67**		**0.77**		**0.75**		**1.12**
5Y	**0.78**		**n.a.**		**0.98**		**n.a.**

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.

Table H.2: BT and European Telecoms Asset Betas against FTSE All Europe and FTSE All World

		FTSE All Europe			FTSE All World		
		Asset beta (Jul 18)		Asset beta (Sep 17)	Asset beta (Jul 18)		Asset beta (Sep 17)
	Gearing	Debt beta=0	Debt beta=0.1	Debt beta=0.1	Debt beta=0	Debt beta=0.1	Debt beta=0.1
BT							
1Y	37%	0.44	0.48	0.33	0.33	0.37	0.34
2Y	33%	0.38	0.41	0.63	0.35	0.38	0.86
5Y	27%	0.54	0.57	n.a.	0.65	0.68	n.a.
Telefonica							
1Y	57%	0.37	0.43	0.47	0.35	0.40	0.71
2Y	57%	0.39	0.45	0.60	0.45	0.50	0.86
5Y	54%	0.50	0.56	n.a.	0.64	0.69	n.a.
Deutsche Telekom							
1Y	46%	0.30	0.34	0.41	0.47	0.51	0.69
2Y	46%	0.33	0.38	0.42	0.52	0.57	0.69
5Y	46%	0.42	0.46	n.a.	0.66	0.71	n.a.
Belgacom							
1Y	21%	0.44	0.47	0.43	0.46	0.48	0.63
2Y	21%	0.42	0.44	0.49	0.50	0.52	0.70
5Y	21%	0.49	0.51	n.a.	0.62	0.65	n.a.
KPN							
1Y	40%	0.41	0.45	0.47	0.31	0.34	0.51
2Y	40%	0.43	0.47	0.45	0.42	0.46	0.62
5Y	47%	0.40	0.45	n.a.	0.50	0.54	n.a.
Orange							
1Y	46%	0.35	0.39	0.48	0.35	0.40	0.61
2Y	47%	0.37	0.41	0.47	0.42	0.46	0.66
5Y	50%	0.47	0.52	n.a.	0.60	0.65	n.a.
Telecom Italia							
1Y	67%	0.33	0.39	0.40	0.20	0.27	0.54
2Y	68%	0.33	0.40	0.53	0.31	0.38	0.71
5Y	68%	0.39	0.45	n.a.	0.45	0.52	n.a.
Iliad							
1Y	18%	0.62	0.64	0.54	0.61	0.63	0.80
2Y	16%	0.53	0.55	0.53	0.60	0.61	0.74
5Y	13%	0.62	0.63	n.a.	0.73	0.74	n.a.
Orange Belgium							
1Y	24%	0.40	0.42	0.39	0.47	0.50	0.54
2Y	24%	0.36	0.39	0.39	0.47	0.49	0.51
5Y	31%	0.34	0.37	n.a.	0.40	0.43	n.a.
Telenor							
1Y	22%	0.35	0.38	0.41	0.27	0.29	0.67
2Y	26%	0.33	0.36	0.51	0.36	0.38	0.72
5Y	24%	0.49	0.52	n.a.	0.61	0.64	n.a.
Tele2							
1Y	20%	0.62	0.64	0.60	0.50	0.52	0.92
2Y	23%	0.58	0.60	0.60	0.61	0.63	0.82
5Y	21%	0.57	0.59	n.a.	0.69	0.71	n.a.
Swisscom							
1Y	25%	0.51	0.54	0.35	0.44	0.46	0.50
2Y	26%	0.41	0.44	0.44	0.44	0.47	0.64
5Y	26%	0.43	0.45	n.a.	0.53	0.55	n.a.
EU Comparators Avg.							
1Y	35%	0.43	**0.46**	**0.45**	0.40	**0.44**	**0.65**
2Y	36%	0.41	**0.44**	**0.49**	0.46	**0.50**	**0.70**
5Y	36%	0.46	**0.50**	**n.a.**	0.59	**0.62**	**n.a.**

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.

H.2. ICT comparators

Table H.3: 2Y Equity and Asset Beta of ICT comparators against local/regional and world index

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	20%	0.90	0.06	1.02	0.09	0.74		0.84		✓
UNISYS CORP	US	Y	Y	Y	S&P 500	49%	1.28	0.20	1.35	0.26	0.70		0.73		✓
AMDOCS LTD	US	Y	Y	Y	S&P 500	1%	0.67	0.05	0.77	0.07	0.66		0.76	*	✓
TELETECH HLDGS	US	Y	Y	Y	S&P 500	13%	0.71	0.10	0.87	0.13	0.63		0.77	*	✓
CDW CORP/DE	US	N	Y	Y	S&P 500	26%	0.91	0.08	1.03	0.10	0.70	*	0.79		
COGNIZANT TECH-A	US	N	Y	Y	S&P 500	2%	0.87	0.08	1.10	0.11	0.86		1.07		
XEROX CORP	US	N	Y	Y	S&P 500	43%	1.06	0.11	1.32	0.14	0.64		0.79		
INDRA SISTEMAS	SP	Y	Y	Y	FTSE All Europe	39%	0.67	0.11	0.85	0.14	0.28		0.56		✓
CANCOM AG	GE	Y	Y	Y	FTSE All Europe	5%	0.68	0.10	1.25	0.15	0.32	*	1.19	*	✓
ATOS SE	FR	Y	Y	Y	FTSE All Europe	13%	0.75	0.11	0.82	0.11	0.27	*	0.73		✓
SOPRA STERIA GRO	FR	N	Y	Y	FTSE All Europe	23%	0.74	0.08	1.06	0.11	-0.05		0.84		
CAP GEMINI	FR	N	Y	Y	FTSE All Europe	18%	0.90	0.08	0.95	0.10	0.30		0.79		
TIETO OYJ	FI	N	Y	Y	FTSE All Europe	9%	0.53	0.08	0.70	0.12	0.27	*	0.64		
CGI GROUP INC-A	CA	N	Y	Y	S&P/TSX Composite	8%	0.62	0.09	0.62	0.08	0.57		0.57		
Average (Jul 2018)															
Tier 1						**20%**	**0.81**		**0.99**		**0.51**		**0.80**		
Tier 2 (all comparators)						**19%**	**0.80**		**0.98**		**0.49**		**0.79**		
Average (Sep 17)															
Tier 1						**28%**	**0.98**		**1.13**		**0.72**		**0.80**		
Tier 2 (all comparators)						**21%**	**0.96**		**1.11**		**0.76**		**0.88**		

Source: NERA analysis based on Bloomberg data. Cut-off date is 20 July 2018.

NERA
ECONOMIC CONSULTING

NERA Economic Consulting
Marble Arch House
66 Seymour Street
London, UK W1H 5BT

NERA UK Limited, registered in England and Wales, No 3974527
Registered Office: Marble Arch House, 66 Seymour Street, London W1H 5BT