NERA
ECONOMIC CONSULTING

Update of the Equity Beta and Asset Beta for BT Group and Comparators

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1. Introduction

In the context of the ongoing Business Connectivity Market Review for 2016-19 (2016 BCMR), the Office of Communications (Ofcom) commissioned NERA Economic Consulting to produce updates of the equity and asset beta of BT and comparators.

In our First Report for Ofcom[1], published alongside Ofcom's Public Consultation on *Leased lines charge controls and dark fibre pricing (LLCC Consultation)*[2], we reviewed the approach to calculating equity and asset betas for BT and comparator companies undertaken by its previous consultants, the Brattle Group[3] and updated the equity and asset beta calculations for recent data. Our First Report updated the equity and asset betas of BT and comparators using data up to 30 January 2015 (hence we refer to it below as our "January update").

In this Second Report for Ofcom, we were asked:

- To produce updates of the equity beta, asset beta and gearing for each of the companies included in the First Report, with 30 October 2015 as the cut-off date (we refer to this as our "October update"); and

- To extend the sample of comparators from our First Report, to include beta estimates for a set of (1) Information and Communications Technology (ICT) Comparators, selected as possible proxies for the beta risk of BT Global Services, and (2) pay TV Comparators, selected as possible proxies for the beta risk of BT's pay TV business.

We understand the equity and asset beta update set out in this report will be used as an input into Ofcom's broader assessment of BT's Weighted Average Cost of Capital (WACC), and more specifically as part of the *2016 Leased lines charge controls and dark fibre pricing statement.*

The analysis in this report is set out as follows:

- Section 2 briefly summarizes our methodology for calculating the equity and asset beta for BT and the comparators;

- Section 3 reports up-to-date equity and asset betas for BT and the comparators discussed in our First Report (namely UK telecoms and utilities, EU telecoms and US telecoms);

- Sections 4 and 5 set out our estimates of the betas of ICT and pay TV comparators; and

- Section 6 concludes the analysis, setting out asset beta ranges for BT and the comparators reviewed for this report.

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[1] NERA Economic Consulting (19 May 2015), *Estimation of BT's Equity and Asset Beta,* accessed here: http://stakeholders.ofcom.org.uk/binaries/consultations/llcc-dark-fibre/annexes/NERA_final_report.pdf

[2] Documents published on Ofcom's website: http://stakeholders.ofcom.org.uk/consultations/llcc-dark-fibre/

[3] The Brattle Group (3 March 2014): "Estimate of BT's Equity Beta". http://stakeholders.ofcom.org.uk/binaries/telecoms/ga/fixed-access-market-reviews-2014/draftstatement/15_annex15.pdf

The appendices to this report set out in greater detail the statistical analysis carried out to assess the robustness of the equity beta results.

2. Methodology

In this section we briefly summarize our methodology for calculating equity and asset betas, including the required sensitivity and robustness checks (which are further detailed in statistical Appendix A). This section draws heavily on our First Report.

2.1. Comparator Selection

In this report we report betas for five comparator groups:

1) UK Utilities and Telecoms;

2) European Telecoms;

3) US Telecoms;

4) ICT (Information Communications Technology) companies; and

5) Pay TV companies.

The first three samples are largely based on our January update, with the following modifications:

- Although Centrica has been traditionally included in the UK utilities sample used by Ofcom, we have removed it from the sample for this report; Centrica does not own network assets that are subject to price control regulation, and its main business activity includes electricity and gas retail (and generation), which exposes Centrica to market risk. In light of this, we do not consider Centrica as a good comparator for BT's regulated network business.

- We have taken out Colt from the UK telecoms sample as it was delisted in August 2015;[4]

- We have added Vodafone to the UK telecoms sample as it is a leading telecoms services provider domiciled in the UK, and can therefore provide useful additional evidence on trends in this market; however, we recognise that Vodafone's risk might be different from BT or other UK telecoms (see section 3 for further discussion); and

- We have relocated Comcast and Time Warner Cable from the US telecoms to the pay TV sample, to reflect that their pay TV business accounts for a higher percentage of revenues.

To estimate the beta for ICT and pay TV comparators, we have investigated BT's major products and services in these areas, and then have selected a sample of comparators taking the Bloomberg industry classification system as a starting point and then applying relevant filters and checks to this classification. We provide details of the selection processes in sections 4 (ICT) and 5 (pay TV) respectively.

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[4] Colt was acquired by Fidelity, and was therefore delisted from London Stock Exchange on 11 Aug 2015.

2.2. Data and Computation of Equity Betas

Data Sourcing and Frequency

For each of the five comparator groups listed above, we source data on stock returns, index returns and gearing from Bloomberg, using 30 October 2015 as the cut-off date.

We 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, increasing the robustness of the regression results through lowering of 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 (as set out in Appendix A.4), in this report we use beta estimates based on daily data. [5]

Relevant 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".

Consequently, a key consideration in the estimation of betas is whether to use a local index (or regional if same currency is used in the region in question) or worldwide index to proxy the market portfolio.

The appropriate reference market index depends on the level of integration of individual capital markets. Greater market integration implies that investors face low transaction costs and barriers to international trade, allowing them to tap foreign capital markets. In this case, the relevant investment opportunity set is wider than the home market, and the equity and asset beta estimates should be based on a broad market index that captures the potential for diversification.

Despite wider global integration, however, the academic literature finds a general consensus that equity markets are less integrated than bond or money markets[6], and that there is still a significant "equity home bias"[7], i.e. the observation that equity investors have a preference for domestic assets, despite the wider benefits of diversification. Such bias would suggest

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[5] 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.

[6] See for e.g. Ogier, Tim et al (2004), The real cost of capital : a business field guide to better financial decisions.

[7] See the seminal work of French, Kenneth; Poterba, James (1991). "Investor Diversification and International Equity Markets". American Economic Review 81 (2): 222–226 and Tesar, Linda; Werner, Ingrid (1995). "Home Bias and High Turnover". Journal of International Money and Finance 14 (4): 467–492.

that systematic risk, as quantified by the asset beta parameter, is more appropriately captured by the stock correlations with a domestic 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 Europe reflecting stocks traded in Europe, used to estimate betas for European comparators; and

- the S&P 500, a US stock index used to estimate betas for US comparators.

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, generally use domestic indices when setting price controls.[8] However, in comparing betas for companies from different jurisdictions, a like-for-like comparison can only be done if using a consistent index across companies, i.e. the world index. Using the world index reflects the systematic risk contribution of the given stock to a globally diversified portfolio, available to international investors with free access to stocks from all jurisdictions.[9]

2.3.   Statistical Analysis of Equity Betas

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[10] and/or inefficient[11] (i.e. not minimum variance) beta estimates. We visually inspect/ formally test the following key assumptions:[12]

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[8]   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.

[9]   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.

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

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

[12]   See standard textbook on 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.

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

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

3) *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.

We carry out standard statistical tests (see Appendix A for more detail) 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 Generalized Least Squares (GLS) method, an alternative estimation method to the standard OLS which can address both of these issues.[13]

Outliers

We also test for "outliers", i.e. influential observations in the data, the removal of which can significantly affect the beta estimates. Excluding abnormal periods of the data is equivalent to assuming they will not occur in the future. In this instance, to assess the potential impact from outliers we: (1) conduct regressions excluding the outliers, as well as (2) robust regressions which apply alternative weighting to the observations in the sample giving less weight to observations that have strong influence on the regression output (as measured by the residual), and are therefore less sensitive to outliers.

Thin trading bias

Beta estimates based on daily data can be subject to estimation bias. A common problem cited in the academic literature is that when stocks are traded more thinly or thickly than the market average, price signals are not assimilated simultaneously. Consequently, the firm's share price may react more slowly or quickly than the market price, and as a result a lead or a lag term of the market price can have a significant correlation with the stock price.

When markets are efficient and the stock in question is liquid, then all public information is assimilated in the stock and the market price contemporaneously. If a stock is not liquidly traded, however, formal diagnostic test for asynchronous trading are needed, e.g. as implemented by Dimson[14], to capture any non- contemporaneous correlation between the stock and the market returns.

We test the liquidity of each comparator in Appendix A.4.

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

[14] See NERA (May 2015), Estimation of BT's Equity and Asset beta, p.48

2.4. Computation of Asset Beta

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.

$$\beta a = \frac{E}{D+E}\beta e + \frac{D}{D+E}\beta d,$$

where βa is the asset beta of the company, βe is the equity beta and βd is the debt beta of the company, and E and D are the values of equity and debt respectively. In applying this formula, our data on the gearing and debt beta values are explained below.

Gearing

We calculate gearing, defined as the total (gross) value of debt to assets, based on data provided by Bloomberg.[15] An alternative way to calculate gearing is to use the net debt, i.e. liabilities net of cash and cash equivalents, which implicitly assumes that cash can be used to cover short-term liabilities. However, the use of net debt is not justified if companies need their cash holdings to finance their ongoing activities instead of paying off debt. Since we have no evidence that short term cash held by all the different comparators would be used to cover short term liabilities, we use total value of debt (i.e. gross debt) as a gearing assumption in the asset beta calculations in this report.

Debt beta

In this report we also conduct a sensitivity check on asset beta by assuming a debt beta of both 0 and 0.1. While other regulators have often assumed a debt beta of 0 (on grounds that the debt of regulated utilities is relatively low-risk) Ofcom has previously used a debt beta in the range from 0.1 to 0.15, with the most recent 2014 FAMR decision using a debt beta of 0.1.[16] In this report asset betas values quoted are calculated using a debt beta of 0.1 unless stated otherwise.

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[15] 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.

[16] Ofcom (2014): Fixed access market reviews: wholesale local access, wholesale fixed analogue exchange lines, ISDN2 and ISDN30 – Annexes, Annex 14: Cost of Capital, p.185, para A14.124

3. October Update of Equity and Asset Beta for BT Group and Comparators Groups from our First Report

In this section we report up-to-date beta estimates for BT and the three comparator groups set out in our First Report, i.e. (1) UK utilities and telecoms, (2) European telecoms, and (3) US telecoms. In the following sub-sections, we set out equity betas, gearing ratios and asset betas for each of these three comparator groups.

3.1. BT, UK Utilities and Telecoms

3.1.1. Equity beta

Table 3.1 reports equity beta estimates for BT Group, UK utilities and UK telecoms against both the FTSE All Share and FTSE All World indices using historical data over both 1-year and 2-year periods up to 30 October 2015.

We estimate BT's up-to-date 2-year equity beta at 0.90 against the FTSE All Share and 0.81 against FTSE All World. BT's 2-year equity beta against both indices has decreased since our January update (previously estimated at 0.97 against the FTSE All Share and 0.82 against the FTSE All World), although BT's 1-year beta has slightly increased during the period.

The equity betas in the UK utilities sample have uniformly increased against the January update, across both the 1-year and 2-year estimation windows, and against both indices. The average 2-year equity beta for the UK utilities currently stands at 0.76 against the FTSE All Share and 0.67 against FTSE All World, c.0.1 higher than our January update.

In this October update, we use a somewhat modified sample of UK comparators compared to our January update, as follows:

- Centrica was taken out from the UK utilities sample as it does not own network assets that are subject to price control regulations, and therefore it is not a suitable comparator for BT's regulated Openreach business.

- Colt was delisted in August 2015 and therefore it is no longer included in our UK telecoms sample;

- Vodafone was added to the telecoms sample following discussions with Ofcom. Vodafone is a leading telecoms service provider domiciled in the UK, and hence general movements in its stock price could be informative of current trends in the telecoms sector; however, we caution that Vodafone's risk profile might be different from BT Group, as discussed in more detail in the following paragraph.

In general we recognise that none of the companies in the UK telecoms sample are perfect comparators for BT Group. Specifically:

- TalkTalk, despite being a fixed telecoms operator, is much smaller in size compared to BT. It also has fewer infrastructure assets and focuses on retail customers.

- Sky predominantly sources revenues from its pay TV operations. We have also included Sky in the pay TV comparator sample in Section 5.

- Vodafone is different from BT given that 1) it is globally diversified (only c. 15% revenue generated from the UK market); [17] and 2) its biggest business area is mobile (accounting for c. 76% revenue).[18] We also note that Vodafone's equity beta is significantly higher than that of the other two UK telecoms comparators.

Comparing the adjusted UK telecoms sample average calculated with the current sample, the 2-year equity beta has on average increased against both indices, although individual companies show different trends (see Table 3.1).

We also note that in most cases, the UK comparators' betas are higher when regressed against the home index (i.e. the FTSE All Share) relative to the world index (i.e. the FTSE All World). This can be explained by the higher correlation between the individual stock return and the return of the local market, an issue we discuss further in section 3.4.

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[17] Vodafone 2015 Annual Report, p. 9

[18] Vodafone 2015 Annual Report, p. 8
Although we note that our First Report did not detect significant relationship between asset betas and the share of revenue coming mobile services. See NERA (2015) , accessed here:
http://stakeholders.ofcom.org.uk/binaries/consultations/llcc-dark-fibre/annexes/NERA_final_report.pdf

Table 3.1
BT and UK Telecoms/Utilities Equity Beta against the FTSE All Share and All World indices

		FTSE All Share				FTSE All World		
		OLS/GLS*				OLS/GLS*		
		Beta (Oct)	SE (Oct)	Beta (Jan)		Beta (Oct)	SE (Oct)	Beta (Jan)
BT								
	1Y	0.93	0.06	0.85	1Y	0.88	0.09	0.73
	2Y	0.90	0.05	0.97	2Y	0.81	0.07	0.82
National Grid								
	1Y	0.78	0.05	0.71	1Y*	0.67	0.07	0.69
	2Y*	0.74	0.04	0.69	2Y*	0.63	0.05	0.60
Severn Trent								
	1Y	0.77	0.05	0.76	1Y	0.69	0.08	0.69
	2Y	0.76	0.05	0.67	2Y	0.67	0.06	0.61
Pennon								
	1Y	0.74	0.06	0.55	1Y*	0.65	0.09	0.45
	2Y*	0.71	0.05	0.53	2Y*	0.62	0.06	0.49
United Utilities								
	1Y*	0.84	0.06	0.73	1Y	0.74	0.09	0.68
	2Y*	0.81	0.05	0.63	2Y*	0.71	0.07	0.57
SSE								
	1Y	0.86	0.06	0.59	1Y*	0.80	0.08	0.54
	2Y	0.78	0.05	0.60	2Y*	0.70	0.06	0.51
TalkTalk								
	1Y	0.66	0.13	0.67	1Y	0.75	0.17	0.72
	2Y	0.70	0.09	0.75	2Y	0.73	0.12	0.78
Sky								
	1Y	0.80	0.06	0.72	1Y*	0.82	0.08	0.69
	2Y*	0.76	0.06	0.64	2Y*	0.72	0.07	0.65
Vodafone								
	1Y	1.07	0.07	1.30[1]	1Y*	1.01	0.09	1.27[1]
	2Y	1.12	0.06	1.10[1]	2Y*	1.06	0.08	0.97[1]
Utilities average								
	1Y	**0.80**		**0.67**	1Y	**0.71**		**0.61**
	2Y	**0.76**		**0.62**	2Y	**0.67**		**0.56**
Telecoms average (excluding BT)								
	1Y	**0.84**		**0.90**	1Y	**0.86**		**0.89**
	2Y	**0.86**		**0.83**	2Y	**0.84**		**0.80**

Source: NERA analysis
Notes:
(1) Beta for Vodafone calculated as of January cut-off date;
* GLS reported where regression diagnostics show heteroscedasticity or autocorrelation.
Beta averages in January Update are adjusted to reflect the modified sample.

Figure 3.1 to Figure 3.3 illustrate the time series of the 2-year equity betas of BT and the UK comparator set against the FTSE All Share index, over the period December 2009 to October 2015.

As shown below, BT's 2-year equity beta has been largely falling since our January update, but has been on the rise most recently. In contrast, equity betas of UK utilities have been rising over the whole period since our January update. UK telecoms' equity betas have also increased slightly. This has led to some convergence in the beta between BT and its comparators.
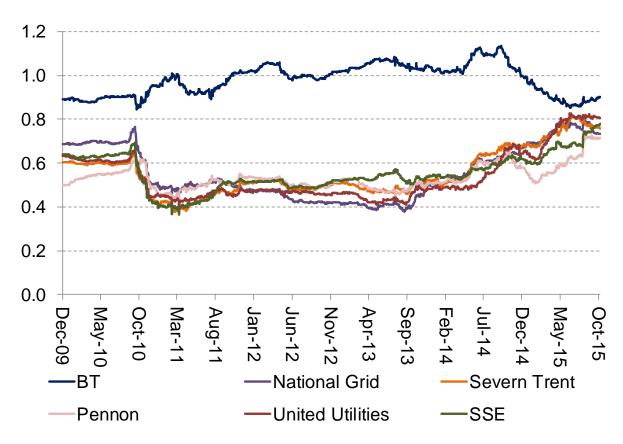
Figure 3.1
BT and UK Utilities 2Y Rolling Equity Beta against FTSE All Share

Source: NERA analysis
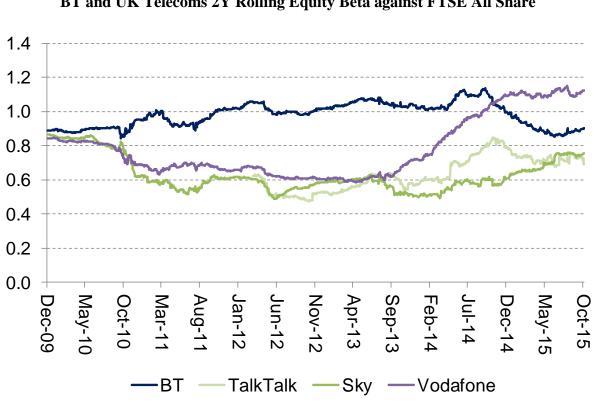
Figure 3.2
BT and UK Telecoms 2Y Rolling Equity Beta against FTSE All Share

Source: NERA analysis
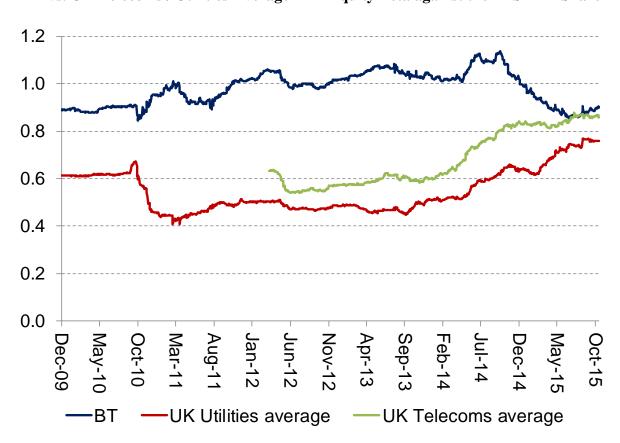
Figure 3.3
BT vs. UK Telecoms / Utilities Average – 2Y Equity Beta against the FTSE All Share

Source: NERA analysis

3.1.2. Gearing and asset beta

In this section, we derive asset betas for the UK comparators, which control for the financial risk element in the equity betas and are therefore comparable across companies with different capital structures. For BT and each of the comparator companies we calculate asset betas based on the Miller formula as described above in section 2.4.

We calculate gearing, defined as the total (gross) value of debt to assets, based on data provided by Bloomberg.[19] Figure 3.4 shows the evolution of gearing for the UK comparators from December 2009 to October 2015. BT's gearing has been declining over much of the period since 2010, but appears to have levelled off at around 20% in the last year or so. The gearing ratios of most of the remaining UK comparators have being slightly falling as well;

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[19]   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.

notable exceptions to this are Sky and Vodafone both of which experienced sharp increase in 2014.[20]
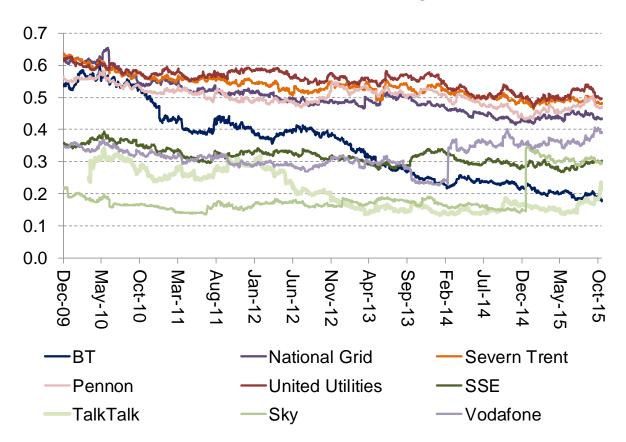
Figure 3.4
BT and UK Telecoms/Utilities Gearing Ratio

Source: NERA analysis

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

Table 3.2 below reports asset betas for BT and the UK comparators against both the FTSE All Share and the FTSE All World indices. Our asset beta estimates, based on a debt beta of 0.1 are as follows:

▪ BT's 2-year asset beta stands at 0.72 against the FTSE All Share and 0.65 against the FTSE All World;

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[20] Sky's gearing increased in late 2014 due to the £5.2b debt issuance to cover the acquisition of Sky Deutschland and Sky Italia. Vodafone's gearing increased in February 2014 because its stock price/ market cap fell after it sold off its stake in Verizon Wireless and distributed proceeds to shareholders.

- UK utilities have an average 2-year asset beta of 0.46 against FTSE All Share and 0.41 against FTSE All World; and

- UK telecoms have an average 2-year asset beta of 0.66 against FTSE All Share and 0.65 against FTSE All World.

As shown in Table 3.2, and Figure 3.5 - Figure 3.7, the average 2-year asset beta of UK utilities has increased by c.0.08 since our January update, whilst the asset betas of UK telecoms have remained broadly stable. The asset beta (2-year) of BT Group has been decreasing, however, for most of the period since our January update. We further discuss these trends in section 3.4.

Table 3.2

BT and UK Telecoms/Utilities Asset Beta against the FTSE All Share and All World indices

	Gearing	FTSE All Share			FTSE All World			Market Cap (£ billion)
		Asset beta (Oct)		Asset beta (Jan)	Asset beta (Oct)		Asset beta (Jan)	
		Debt beta=0	Debt beta=0.1	Debt beta=0.1	Debt beta=0	Debt beta=0.1	Debt beta=0.1	
BT								
1Y	20%	0.74	0.76	0.67	0.70	0.72	0.58	38.9
2Y	22%	0.70	0.72	0.74	0.63	0.65	0.64	
National Grid								
1Y	44%	0.44	0.48	0.44	0.38	0.42	0.42	34.6
2Y	45%	0.41	0.45	0.41	0.35	0.39	0.37	
Severn Trent								
1Y	49%	0.39	0.44	0.43	0.35	0.40	0.40	5.3
2Y	50%	0.38	0.43	0.38	0.34	0.39	0.35	
Pennon								
1Y	46%	0.40	0.44	0.33	0.35	0.40	0.28	3.3
2Y	48%	0.37	0.42	0.31	0.32	0.37	0.30	
United Utilities								
1Y	51%	0.41	0.46	0.40	0.37	0.42	0.38	6.7
2Y	52%	0.39	0.44	0.34	0.34	0.40	0.32	
SSE								
1Y	29%	0.61	0.64	0.44	0.57	0.60	0.41	15.2
2Y	30%	0.55	0.58	0.45	0.49	0.52	0.38	
TalkTalk								
1Y	16%	0.55	0.57	0.58	0.63	0.64	0.63	2.4
2Y	15%	0.59	0.60	0.65	0.62	0.63	0.67	
Sky								
1Y	29%	0.57	0.60	0.61	0.58	0.61	0.58	18.8
2Y	23%	0.58	0.61	0.55	0.56	0.58	0.56	
Vodafone								
1Y	36%	0.68	0.72	0.88[1]	0.64	0.68	0.86[1]	56.9
2Y	34%	0.74	0.77	0.78[1]	0.69	0.73	0.70[1]	
Utilities average								
1Y	44%	0.45	**0.49**	**0.41**	0.40	**0.45**	**0.38**	
2Y	45%	0.42	**0.46**	**0.38**	0.37	**0.41**	**0.34**	
Telecoms average (excluding BT)								
1Y	27%	0.60	**0.63**	**0.69**	0.62	**0.64**	**0.69**	
2Y	24%	0.64	**0.66**	**0.66**	0.62	**0.65**	**0.64**	

Source: NERA analysis
Notes:
(1) Beta for Vodafone calculated as of January cut-off date;
* GLS reported where regression diagnostics show heteroscedasticity or autocorrelation.
*Beta averages in January Update are adjusted to reflect the modified sample.*

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


Source: NERA analysis

Figure 3.6
**BT and UK Telecoms 2Y Rolling Asset Beta against FTSE All Share**

Source: NERA analysis

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

Source: NERA analysis

3.2.   EU Telecoms

3.2.1.   Equity beta

We report our equity beta estimates of the European telecoms sample, against both the FTSE All Europe and FTSE All World indices in Table 3.3 below. The average 2-year equity beta for the European comparator sample is 0.84 against the FTSE All Europe and 1.02 against the FTSE All World, both of which have increased since our January update.
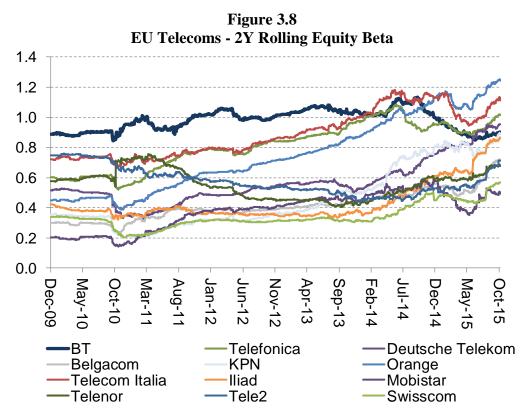
We note that in contrast to the UK sample, we observe that the equity betas of the EU comparators are always *lower* when regressed against home index (i.e. FTSE All Europe) relative to world index (i.e. FTSE All World). We discuss the reasons for this observation in section 3.4 below.

Table 3.3
EU Telecoms Equity Beta against the FTSE All Europe and FTSE All World

		FTSE All Europe				FTSE All World		
		OLS/GLS*				OLS/GLS*		
		Beta (Oct)	SE (Oct)	Beta (Jan)		Beta (Oct)	SE (Oct)	Beta (Jan)
BT								
	1Y	N/A	N/A	N/A	1Y	0.88	0.09	0.73
	2Y	N/A	N/A	N/A	2Y	0.81	0.07	0.82
Telefonica								
	1Y	1.07	0.06	1.00	1Y*	1.26	0.09	1.30
	2Y	1.02	0.04	0.96	2Y*	1.27	0.07	1.27
Deutsche Telekom								
	1Y	0.96	0.08	0.98	1Y	1.39	0.11	1.51
	2Y	0.95	0.06	0.78	2Y*	1.44	0.08	1.25
Belgacom								
	1Y*	0.77	0.07	0.64	1Y	0.86	0.10	0.86
	2Y*	0.72	0.05	0.54	2Y	0.88	0.08	0.73
KPN								
	1Y	0.89	0.08	1.02	1Y	1.03	0.12	1.39
	2Y*	0.89	0.07	0.84	2Y	1.10	0.10	1.21
Orange								
	1Y	1.27	0.09	1.37	1Y*	1.42	0.13	1.75
	2Y	1.25	0.07	1.15	2Y	1.48	0.10	1.51
Telecom Italia								
	1Y	0.97	0.11	1.28	1Y	1.06	0.15	1.57
	2Y	1.11	0.09	1.16	2Y	1.25	0.13	1.49
Iliad								
	1Y*	0.98	0.09	0.90	1Y*	1.14	0.12	0.89
	2Y	0.86	0.09	0.62	2Y*	0.95	0.13	0.68
Mobistar								
	1Y	0.46	0.12	0.43	1Y	0.38	0.16	0.41
	2Y*	0.48	0.09	0.50	2Y*	0.48	0.13	0.58
Telenor								
	1Y	0.63	0.07	0.75	1Y	0.84	0.10	0.97
	2Y	0.68	0.06	0.59	2Y	0.88	0.08	0.78
Tele2								
	1Y	0.76	0.08	0.63	1Y	0.90	0.11	0.78
	2Y	0.71	0.06	0.50	2Y	0.85	0.08	0.70
Swisscom								
	1Y*	0.60	0.06	0.54	1Y*	0.63	0.09	0.57
	2Y*	0.57	0.04	0.48	2Y*	0.64	0.06	0.58
EU Comparators Avg.								
	1Y	**0.85**		**0.87**		**0.99**		**1.09**
	2Y	**0.84**		**0.74**		**1.02**		**0.98**

Source: NERA analysis
Note: GLS reported where regression diagnostics show heteroscedasticity or autocorrelation.*

Figure 3.8
EU Telecoms - 2Y Rolling Equity Beta

Source: NERA analysis
Note: BT's beta is estimated against BT's home index, i.e. FTSE All Share

Figure 3.9
BT vs.EU Telecoms Average – 2Y Equity Beta

Source: NERA analysis
Note: BT's beta is estimated against BT's home index, i.e. FTSE All Share

3.2.2. Gearing and asset beta

Figure 3.10 shows the rolling gearing ratios for the European comparators set over the period December 2009 to October 2015. As shown in Figure 3.10, there is a somewhat uniform decline in the EU telecoms comparators' gearing since late 2013 with few exceptions (e.g. Tele2 and Telefonica).

Figure 3.10
EU Telecoms Gearing Ratio

Source: NERA analysis

Table 3.4 below reports asset betas for the set of European telecoms comparators. The average 2-year asset beta for the eleven comparators is 0.54 against the FTSE All Europe, and 0.65 against the FTSE All World, both of which increased by c. 0.1 since our January update. A comparison between BT's asset beta with that of the European telecoms shows that:
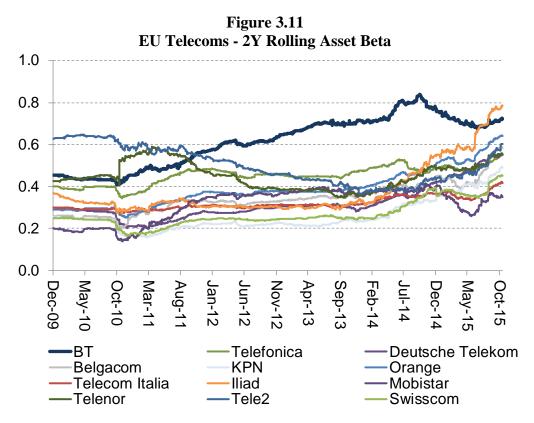
- Against the respective local/regional indices, BT's asset beta is towards the upper end of the asset beta range of the European telecoms;

- However, against the world index, BT's asset beta is at the same level as the European telecoms average, i.e. 0.65.

Table 3.4
EU Telecoms Asset Beta against the FTSE All Europe and FTSE All World

| | | | FTSE All Europe | | | FTSE All World | | |
| | | | Asset beta (Oct) | | Asset beta (Jan) | Asset beta (Oct) | | Asset beta (Jan) |
		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	20%	N/A	N/A	N/A	0.70	0.72	0.58
	2Y	22%	N/A	N/A	N/A	0.63	0.65	0.64
Telefonica								
	1Y	50%	0.53	0.58	0.53	0.63	0.68	0.68
	2Y	51%	0.50	0.55	0.50	0.62	0.67	0.64
Deutsche Telekom								
	1Y	45%	0.53	0.58	0.55	0.77	0.81	0.83
	2Y	47%	0.51	0.55	0.44	0.77	0.81	0.67
Belgacom								
	1Y	19%	0.62	0.64	0.52	0.69	0.71	0.69
	2Y	21%	0.57	0.59	0.43	0.69	0.71	0.58
KPN								
	1Y	45%	0.49	0.54	0.52	0.57	0.61	0.68
	2Y	50%	0.44	0.49	0.37	0.55	0.60	0.50
Orange								
	1Y	47%	0.67	0.72	0.69	0.74	0.79	0.86
	2Y	53%	0.59	0.64	0.53	0.70	0.75	0.68
Telecom Italia								
	1Y	66%	0.33	0.39	0.46	0.36	0.42	0.55
	2Y	69%	0.35	0.42	0.37	0.39	0.46	0.46
Iliad								
	1Y	9%	0.88	0.89	0.82	1.03	1.04	0.81
	2Y	10%	0.78	0.79	0.56	0.85	0.86	0.61
Mobistar								
	1Y	33%	0.31	0.34	0.31	0.26	0.29	0.29
	2Y	36%	0.30	0.34	0.35	0.30	0.34	0.40
Telenor								
	1Y	21%	0.49	0.51	0.61	0.66	0.68	0.78
	2Y	22%	0.53	0.55	0.48	0.69	0.71	0.64
Tele2								
	1Y	17%	0.63	0.65	0.52	0.75	0.77	0.64
	2Y	18%	0.58	0.60	0.42	0.70	0.72	0.57
Swisscom								
	1Y	24%	0.46	0.48	0.42	0.48	0.51	0.44
	2Y	24%	0.43	0.45	0.38	0.48	0.50	0.45
EU Comparators Avg.								
	1Y	34%	0.54	**0.57**	**0.54**	0.63	**0.67**	**0.66**
	2Y	37%	0.51	**0.54**	**0.44**	0.61	**0.65**	**0.56**

Source: NERA analysis

*Note: * GLS reported where regression diagnostics show heteroscedasticity or autocorrelation.*

Figure 3.11
EU Telecoms - 2Y Rolling Asset Beta

Figure 3.12
BT vs. EU Telecoms Average – 2Y Asset Beta

3.3. US Telecoms

3.3.1. Equity beta

Table 3.5 reports equity betas for the US comparator group. The US sample has changed since our January update, as we have relocated Comcast and Time Warner Cable to the pay TV sample, since they source a greater share of revenues from TV distribution rather than standard telecoms services. (We calculate betas for a sample of pay TV players in section 5 below.)

Our revised US comparator group includes three companies – AT&T, Verizon and Century Link – which have an average 2-year equity beta of 0.73 against the home index (i.e. S&P 500) and 0.83 against the world index (i.e. FTSE All World). The average equity beta for the US telecoms sample has increased slightly from our January update, driven primarily by Century Link (shown in Figure 3.13).

Table 3.5
US Telecoms Equity Beta

		S&P 500 OLS/GLS*				FTSE All World OLS/GLS*		
		Beta (Oct)	SE (Oct)	Beta (Jan)		Beta (Oct)	SE (Oct)	Beta (Jan)
BT								
	1Y	N/A	N/A	N/A	1Y	0.88	0.09	0.73
	2Y	N/A	N/A	N/A	2Y	0.81	0.07	0.82
AT&T								
	1Y	0.70	0.05	0.57	1Y	0.77	0.06	N/A
	2Y	0.66	0.04	0.63	2Y	0.74	0.05	N/A
Verizon								
	1Y	0.72	0.05	0.61	1Y	0.76	0.06	N/A
	2Y	0.68	0.04	0.62	2Y	0.75	0.05	N/A
Century Link								
	1Y	0.94	0.09	0.67	1Y	1.03	0.11	N/A
	2Y	0.85	0.06	0.72	2Y	1.01	0.08	N/A
US Comparator Avg.								
	1Y	**0.78**		**0.62**	1Y	**0.85**		
	2Y	**0.73**		**0.66**	2Y	**0.83**		

Source: NERA analysis
Note:
Beta averages in January Update are adjusted to reflect the modified sample.
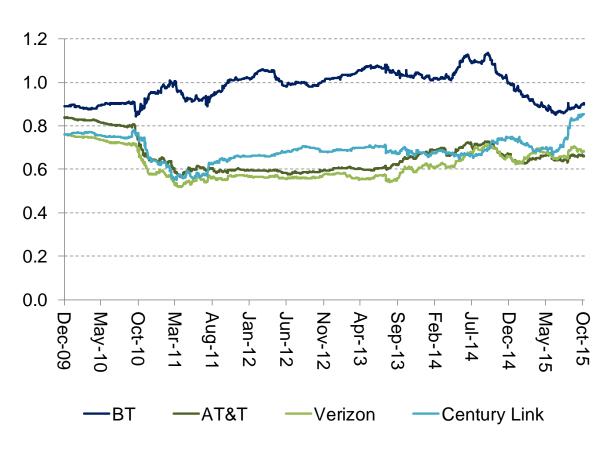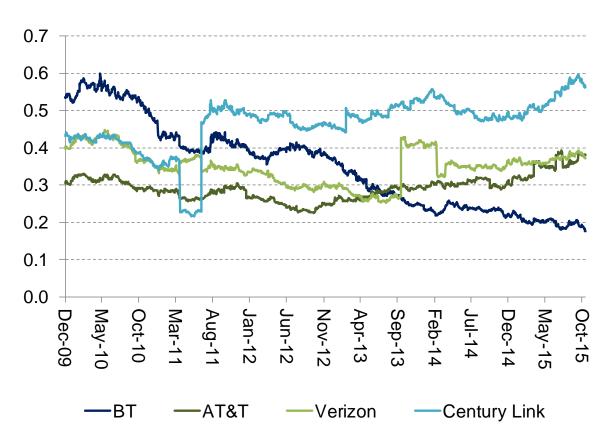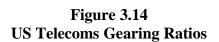
Figure 3.13
US Telecoms 2Y Rolling Equity Beta

Source: NERA analysis
Note: BT's beta is estimated against BT's home index, i.e. FTSE All Share

3.3.2. Gearing and asset beta

In this section we report the gearing ratios and asset betas for the US comparator sample. As shown in Table 3.5, the 2-year asset beta average of the US telecoms sample is 0.47 against the home index and 0.53 against the world index, slightly higher than our January update. The asset beta range of the revised sample is also relatively narrower, compared to our last update.

Figure 3.14
US Telecoms Gearing Ratios

Source: NERA analysis

Table 3.6
US Telecoms Asset Beta
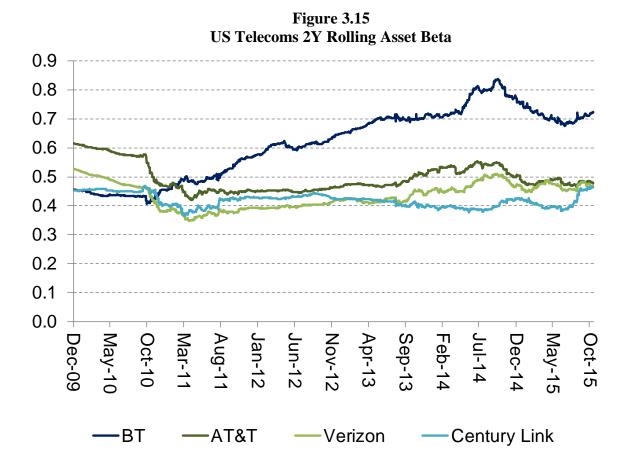
			S&P 500			FTSE All World		
			Asset beta (Oct)		Asset beta (Jan)	Asset beta (Oct)		Asset beta (Jan)
		Gearing	Debt beta=0	Debt beta=0.1	Debt beta=0.1	Debt beta=0	Debt beta=0.1	Debt beta=0.1
BT								
	1Y	20%	N/A	N/A	N/A	0.70	0.72	0.58
	2Y	22%	N/A	N/A	N/A	0.63	0.65	0.64
AT&T								
	1Y	34%	0.46	0.49	0.42	0.51	0.54	N/A
	2Y	32%	0.45	0.48	0.47	0.50	0.53	N/A
Verizon								
	1Y	37%	0.45	0.49	0.43	0.48	0.52	N/A
	2Y	37%	0.43	0.47	0.45	0.47	0.51	N/A
Century Link								
	1Y	52%	0.45	0.50	0.39	0.49	0.54	N/A
	2Y	52%	0.41	0.46	0.41	0.49	0.54	N/A
US Comparator Avg.								
	1Y		0.45	**0.49**	**0.41**	0.49	**0.53**	
	2Y		0.43	**0.47**	**0.44**	0.49	**0.53**	

Source: NERA analysis
Note:
Beta averages in January Update are adjusted to reflect the modified sample.

Figure 3.15
US Telecoms 2Y Rolling Asset Beta

Source: NERA analysis
Note: BT's beta is estimated against BT's home index, i.e. FTSE All Share

3.4. Discussion

We summarize the trends in the betas of BT and comparators below.

Asset beta trends

BT's asset beta has been largely decreasing since its peak in late 2014, but has been on the rise since June 2015, and overall is slightly lower than our January update against the FTSE All Share and slightly higher than our January update against the FTSE All World. By contrast,

- the asset betas of the UK telecoms sample (excluding BT) have been relatively stable since our January update;

- the asset betas of UK utilities have uniformly increased since our January update, although by different magnitudes. In summary, the average 2-year asset beta of the utilities sample has increased by c.0.08, which, together with the change in BT's beta, has reduced the gap between BT and the average utility asset beta by c.0.1 from 0.36 to 0.26 against the FTSE All Share and by 0.06 from 0.3 to 0.24 against the FTSE All World;

- the EU telecoms asset beta has on average increased by c.0.1 since our January update; and

- the US telecoms asset betas remain relatively stable.

Local/ Regional vs. Global Index Results

We also note that with only one exception[21] all European and US comparators have a higher beta when regressed against the world index relative to the local/ regional index, while the opposite observation holds in general for the UK comparators and BT. To investigate the issue, we have decomposed the beta estimate into three components based on the equity beta formula under OLS, where:[22]

$$Equity\ \beta = \rho_{stock,\ market} \times \frac{\sigma_{stock}}{\sigma_{market}} \qquad \text{Equation (1)}$$

where

$\rho_{stock,\ market}$ is the correlation coefficient of the stock and the market return; and

σ_{stock} and σ_{market} are the respective standard deviations of the stock and the market return respectively.

It can be seen from Equation (1) that the beta estimate is *directly proportional* to the correlation between the company and the market, and to the volatility of the stock return, but *inversely proportional* to the volatility of the market.

Based on the decomposition above, carried out for all comparators, we find that:

---

[21]   The only exception is Mobistar, which has a higher 1-year equity beta against the local/regional index relative to the world index and a 2-year equity beta that is same against both indices.

[22]   In financial theory, beta measures the riskiness of a stock relative to a market portfolio, in other words, how sensitive it is to market movement. In statistics, beta is estimated based on the following equation

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

where σ_{im} is the covariance between the stock returns and the market returns, and σ^2_{market} is the variance of the returns on the market. See more detail in any standard finance textbook, for example, *Principle of Corporate Finance* by Brealey, Myers and Allen.

σ_{im} is defined in statistics as the product of 1) $\rho_{stock,\ market}$, the correlation coefficient of the stock and the market return; 2) σ_{stock}, the standard deviation of the stock return; and 3) σ_{market}, the standard deviation of the market return. Based on the definition for σ_{im}, we can carry out the following transformation to the beta formula:

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

$$= \frac{\rho_{stock,\ market} \times \sigma_{stock} \times \sigma_{market}}{\sigma^2_{marekt}}$$

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

- Generally for all comparators, the correlation coefficient ($\rho_{stock, market}$) between the stock and the home index is *higher* than that between the stock and the world index, which indicates that a company's stock return co-moves to a larger extent with the more narrow, local/ regional market compared to the global market. This is likely driven by the region-specific or local risk factors that affect both the company and the home market, but not the global market portfolio (to the same extent), because the latter is comprised of a more diversified portfolio of stocks across different regions.

- However, we also find that the volatility of the local/ regional index (σ_{market}) is always *higher* than that of the world index. The reason for this is that a local / regional portfolio is exposed to region-specific risks. Hence, a local/ regional portfolio reacts more strongly to fluctuations caused by local/ regional factors.

Thus, the equity beta against the local index will be driven upwards due to the higher correlation coefficient with the local index (since beta varies directly with the correlation coefficient), but this will be at least to some extent offset by the fact that the local index also has a higher volatility, which drives beta downwards.

In our EU/US comparator samples, we notice that the reduction in equity beta due to the higher volatility of the local/ regional index outweighs higher correlation with the local/regional stock return. Therefore, in the EU/ US comparator samples, we observe lower equity betas relative to the local/regional index, driven by the comparatively high volatility of the local/regional index.

In contrast, for our UK comparators, we notice that the higher correlation with the domestic market is high enough to offset the impact from the greater market volatility of the local index - hence betas estimated against the local index are typically higher than the betas estimated against the world index for the UK comparators.

We illustrate the above analysis in Table 3.7 below, which shows 1) the correlation coefficient, 2) stock volatility and 3) market volatility of one example company for each comparator group, and calculates the beta for both the local and the world indices.

To undertake this illustration we focus on three specific companies: BT, Telefonica and AT&T which are representative of the UK, EU and US comparator groups respectively. Table 3.7 shows that:

1) the correlation coefficient between the stock and the local/regional index is always *higher* than that between the stock and the world index, in all three comparator examples;

2) the volatility of the local/regional index is always *higher* than the volatility of the world index, in all three comparator examples.

These two effects are offsetting, since a higher correlation with the market index increases the beta coefficient, while higher market volatility decreases the beta coefficient, as we discussed above. However, equity beta is higher against the local index for BT while it is lower for Telefonica and AT&T. This is because the effect from the higher correlation dominates in the UK sample, while the ratio of company volatility to market volatility effect dominates in the EU and US samples. Specifically, BT has a much higher relative correlation coefficient against the local index vs the world index (i.e. correlation of 0.62 as against 0.45)

than Telefonica (i.e. correlation of 0.72 as against 0.65) or AT&T (i.e. correlation of 0.58 as against 0.54).

As a result, the higher correlation outweighs the impact from the higher volatility of the local market in the case of BT but not for Telefonica and AT&T.

Table 3.7
Decomposition of Equity Beta against Local/Regional vs. World Indices

		UK sample		EU sample		US sample	
		BT		**Telefonica**		**AT&T**	
		Local/Regional index	World index	Local/Regional index	World index	Local/Regional index	World index
$\rho_{stock,\ market}$	1)	0.62	0.45	0.72	0.65	0.58	0.54
σ_{stock}	2)	1.21%	1.21%	1.31%	1.31%	0.92%	0.92%
σ_{market}	3)	0.82%	0.67%	0.92%	0.67%	0.81%	0.67%
β	4) =1) × 2) ÷ 3)	**0.90**	**0.81**	**1.02**	**1.26**	**0.66**	**0.74**

Source: NERA analysis
Note: We show OLS estimates for all three comparators in this table.

4.   Asset Beta for ICT Companies

Ofcom asked NERA to identify a set of possible comparators for BT Global Services, and estimate the equity beta, asset beta and gearing for these companies.

In this section, we set out our assessment of:

- The business areas within Global Services, in section 4.1;
- The filtering process for comparator selection, in section 4.2; and
- The beta results for the selected set of comparators, in section 4.3.

4.1.   BT's Global Services Division

BT's Global Services (GS) division is BT's largest segment by revenue, currently contributing 38% of BT's revenues.[23] Under this segment, BT combines its connectivity, network, and IT capabilities to deliver global information and communications technology (ICT) services to around 6,500 corporate and public clients in more than 170 countries.[24]

GS offers a diversified portfolio of products and solutions, which we group as follows:

1) **Managed Networked IT Services and Security** is the largest segment under the GS umbrella, and covers:

    - Managed networked services (MGS), offered under the *BT Connect* brand; BT Connect comprises the largest source of revenue within GS[25], 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 Assure* brand; BT Assure covers a range of products and services to protect clients from cyber threats, including firewalls, web security, intrusion prevention etc.

2) **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

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[23]   BT 2015 annual report, p. 7

[24]   BT 2015 Annual Report, p. 55.

[25]   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.

- 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.

3) **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 of the type of activity within each segment in Table 4.1 below.

Table 4.1
BT's Global Services Division is Comprised of the Following Segments

(1) Managed Networked IT Services	(2) Unified Comms / IT Infrastructure		(3) Professional Services/ IT Consulting (CRM / BPM)	
BT Connect (& Assure)	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 of BT Annual Reports

4.2. Comparator Selection

We would expect the demand for (new) ICT service contracts to be cyclical, to the extent that businesses are likely to have some control over spending on ICT, although elasticity of demand could differ across the different lines of business within GS.

As discussed above, the primary line of business of BT's GS division is the provision of managed networked services, an area where BT competes with other global integrated telecoms companies, including AT&T, Deutsche Telecom, Orange, Telefonica, KPN, Verizon etc. Thus, direct evidence on the beta risk of the provision of managed networked services is not readily available.

Thus, we select comparators from the broader IT Services space, which engages in a wider set of ICT services.

We follow a three-step filtering procedure through which we have identified 17 possible comparators that focus on at least two of the three main lines of business covered by GS (set out in Table 4.1):

1) *Initial Bloomberg screening:* In this first step, we screen the Bloomberg companies listed under the IT Services classification, to identify:

   - Companies domiciled within the US/ EU, thus drawing on evidence from entities in developed markets with similar country risk;

   - Companies that have revenues larger than 1bn US dollars, to avoid small company bias[26]; and

   - Companies that receive more than 50% of their revenue from IT Services, to ensure we are measuring predominantly the business risk of IT Services provision.

2) *Screening based on company profiles :* In a second step, we screen companies based on their Bloomberg and website descriptions, eliminating instances 1) where the revenue was sourced from one major client (e.g. government) and 2) where the business was focused on consulting only (e.g. engaged in strategy/ management/ engineering consulting etc.)

3) *Filtering based on qualitative assessment of Annual Reports and Liquidity constraints:* In a third and final step, we've reviewed the annual accounts of the remaining set of comparators, to identify those that provide at least two of the three main lines of business covered under GS.

In this final step, we also remove comparators that do not pass our liquidity test.[27]

4.3. Beta Estimates

Table 4.2 reports the asset betas of our sample of ICT comparators, indicating whether each comparator is active in each of the business lines within GS discussed in section 4.1 above.[28]

Based on the business areas coverage in Table 4.2, we categorize the sample of comparators into two tiers, namely:

1) *Tier 1* – includes companies that are active across all three main business areas within GS. The average 2-year asset beta of this group of comparators is 0.84 against the local/regional index and 0.96 against the world index; and

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[26] We exclude smaller companies because, as evidenced by Ibbotson, Kaplan and Peterson (1997) they tend to suffer from asynchronous trading, often resulting in their betas being too low. See Ibbotson, R.G., Kaplan, P.D. and Peterson, J.D. (1997). Estimates of Small Stock Betas are Much Too Low, page 3.

[27] We use a bid- ask spread metric to assess liquidity, where we consider that companies with a bid-ask spread < 1% are liquid. See Appendix A.4 for details. We do not exclude any ICT comparators on the basis of liquidity.

[28] 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.

2) *Tier 2* – includes companies that are active across two of the three main business areas within GS. The average 2-year asset beta of this wider group of companies is 0.81 against the local/regional index and 0.90 against the world index.

We note that the variability of the asset betas for ICT comparators is greater than the variability of the telecoms sample. The asset beta range for the Tier 1 comparators is 0.61-1.26 against the local/regional index and 0.64-1.39 against the world index.

Table 4.2
Betas of ICT Companies

Company	Country of listing	(1) Managed networked IT services	(2) Unified Comms/ IT Infrastructure	(3) Professional Services/ IT consulting	Local/Regional index	2Y Asset beta (Local/ Regional index)	2Y Asset beta (World index)	Tier 1?
IBM	US	Y	Y	Y	S&P 500	0.77 *	0.84	✓
Unisys Corp	US	Y	Y	Y	S&P 500	1.26 *	1.39 *	✓
Amdocs Ltd	US	Y	Y	Y	S&P 500	0.73	0.83 *	✓
Computer Science	US	Y	Y	Y	S&P 500	0.78 *	0.85 *	✓
Teletech Hldgs	US	Y	Y	Y	S&P 500	0.91 *	0.98 *	✓
Cdw Corp	US	N	Y	Y	S&P 500	0.61	0.70	
Cognizant Tech	US	N	Y	Y	S&P 500	1.21 *	1.35 *	
Xerox Corp	US	N	Y	Y	S&P 500	0.87	0.94 *	
Indra Sistemas	SP	Y	Y	Y	FTSE All Europe	0.73	0.82	✓
Engineering Spa	IT	Y	Y	Y	FTSE All Europe	0.61	0.64	✓
Cancom	GE	Y	Y	Y	FTSE All Europe	1.02 *	1.35 *	✓
Atos SE	FR	Y	Y	Y	FTSE All Europe	0.76	0.90 *	✓
Sopra Steria Group	FR	N	Y	Y	FTSE All Europe	0.40	0.44	
Cap Gemini	FR	N	Y	Y	FTSE All Europe	0.84 *	0.96 *	
Tieto	FI	N	Y	Y	FTSE All Europe	0.74 *	0.79 *	
Cgi Group Inc	CA	N	Y	Y	S&P/TSX Composite	0.67 *	0.62 *	
Average Asset Beta								
Tier 1						**0.84**	**0.96**	
Tier 2 (all comparators)						**0.81**	**0.90**	

Source: NERA Analysis
*Note: * GLS reported where regression diagnostics show heteroscedasticity or autocorrelation.*

5.   Asset Beta for Pay TV Companies

Ofcom also asked NERA to identify a set of suitable comparators for BT's pay TV business, and estimate the equity beta, asset beta and gearing for these companies.

In this section, we set out our assessment of:

- the pay TV industrial value chain and where BT sits within that chain, in section 5.1;
- the criteria for selecting comparators for BT's pay TV business, in section 5.2; and
- the beta results for the selected set of comparators, in section 5.3.

5.1.   Definition of the Pay TV Value Chain

The pay TV industrial value chain is comprised of the following four levels, as recently discussed by Ofcom:[29]

- **Content production**, i.e. the generation and recording of content which can then be used for broadcasting;
- **Wholesale channel provision,** i.e. the acquisition of rights to broadcast content, and the bundling of content into channels;
- **Platform service provision,** i.e. the hardware or software platform which enables retailers to control the supply of content to consumers; and
- **Retail service provision**, i.e. the bundling of channels into packages to retail to consumers.

BT is a vertically integrated player in the pay TV market, providing both TV content (e.g. BT records sports events and bundles them into live sports channels, via the BT Sport division) and TV broadcasting services (e.g. BT bundles channels into packages for distribution to end-viewers, via the BT TV division).

However, not all operators are active across all levels of the pay TV value chain, but rather engage in either TV content production or TV broadcasting services but not both. For example, Discovery (US) is a pure content provider whose channels are broadcast on the platform of other cable and satellite companies, while TalkTalk provides the platform for TV broadcasting but does not produce TV programs.

We discuss our selection process for pay TV comparator for BT in the next section.

5.2.   Comparator Selection

We discussed above that BT is a vertically integrated player in the pay TV market. Thus, since BT is active across the pay TV value chain, we have considered companies engaging in either level of the pay TV value chain, as they are indicative of the range within which we would expect the beta for BT's pay TV services offering to lie. Nevertheless, the most

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[29]   Ofcom (2014), Review of the pay TV wholesale must-offer obligation, p.19

relevant comparators for BT are those companies which engage in both content production as well as distribution.

However, most of the companies active in the pay TV market are not pure-play pay TV companies. For example, many TV content production companies also produce music, film and other forms of entertainment that are not distributed via TV channels, and would therefore have different risk characteristics from the integrated pay TV beta risk we are interested in measuring. Therefore, we set out further below the selection process we have used to identify the most relevant ("Tier 1") comparators for BT pay TV.

In a first step, we used the Bloomberg BICS industrial classification to identify pay TV comparators. Specifically, we use:[30]

- The "Cable & Satellite" category to identify TV distribution providers; and

- The "Entertainment Content" category to identify TV content providers.

We use the following general selection criteria to identify relevant pay TV comparators:

- We select comparators based in Europe or North America;

- Revenue greater than 1 billion USD;

- Over 50% revenue from either "Cable & Satellite" or "Entertainment Content" business

Based on the filters above, we have identified 14 Cable & Satellite comparators and 12 Entertainment Content comparators.

In a second step, to identify the most suitable comparators for BT among the companies above, we further select those companies that are vertically integrated pay TV operators, i.e. engage in both TV content production and distribution, labelled below as "Tier 1" comparators. The six Tier 1 companies are Comcast, Modern Times, Nos SGPS, Sky, Liberty Global and Vivendi.

5.3.   Beta Estimates

Table 5.1 reports asset betas for the different pay TV comparator groups, including:

1) *Tier 1 comparators* – vertically integrated pay TV companies, active in both TV content production / bundling as well as distribution;

2) *Cable & Satellite comparators (excluding Tier 1)* – companies engaged in TV distribution only; and

3) *Entertainment Content comparators (excluding Tier 1)* – companies engaged in TV content production only.

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[30]   Sky, a vertically integrated pure-play pay TV operator, is classified under "Cable & Satellite" and "Entertainment Content" industries by Bloomberg. We therefore consider these two industries represent TV distribution and TV contention production respectively.

For the Cable & Satellite comparators, the 2-year asset beta against the local/ regional index (assuming 0.1 debt beta) ranges from 0.27 to 0.70 and has an average of 0.49; the 2-year asset beta against the world index (assuming 0.1 debt beta) ranges from 0.36 to 0.78 and has an average of 0.62. In contrast, for the Entertainment Content comparators, the 2-year asset beta against the local/ regional index ranges from 0.66 to 0.93, and has an average of 0.79; the 2-year asset beta against the world index ranges from 0.70 to 1.01, and has an average of 0.86. Thus, TV distribution companies generally have a lower beta relative to the TV Content production companies, potentially due to the comparatively lower income elasticity of demand for TV distribution, to the extent that television subscription is a standard form of entertainment in households in the developed world, and is likely to be less cyclical than the demand for entertainment content. The latter includes the production of music, film and other forms of entertainment which are likely to be more cyclical.[31]

The asset betas for the Tier 1 sample have an average of 0.67 against the local/regional index and 0.75 against the world index. This average lies above the average beta for TV distribution, but below the average for TV Content production, which is consistent with our conclusion that TV distribution is generally less risky relative to entertainment content production.

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[31]   See See for example S&P (Dec 2013), Key Credit Factors For The Media And Entertainment Industry, p.5
https://www.standardandpoors.com/ja_JP/delegate/getPDF;jsessionid=BjlsWyHFnn7dn19hvzVFcDp2d4TC7yktXTL0k
8WKQT21rJX8YM5l!1045841175?articleId=1494308&type=COMMENTS&subType=CRITERIA

Table 5.1
2-year Asset Beta for Pay TV Operators

Company	Country of listing	Local/Regional index	2Y Asset beta (Local/ Regional index)	2Y Asset beta (World index)	Tier 1?
Cable & Satellite					
Comcast Corp	US	S&P 500	0.78	0.84	✓
Time Warner Cable	US	S&P 500	0.59	0.61	
Dish Network	US	S&P 500	0.70	0.78	
Charter Com	US	S&P 500	0.53 *	0.57 *	
Cablevision	US	S&P 500	0.41	0.45	
Echostar Corp	US	S&P 500	0.60	0.69	
Modern Times	SW	FTSE All Europe	0.94	1.13 *	✓
Nos Sgps	PO	FTSE All Europe	0.57	0.65 *	✓
Ses	LX	FTSE All Europe	0.47	0.55	
Kabel Deutschlan	GE	FTSE All Europe	0.27 *	0.42 *	
Liberty Global	US	S&P 500	0.49 *	0.58	✓
Sky Plc	UK	FTSE All Share	0.61 *	0.58 *	✓
Shaw Comm	CA	S&P/TSX Composite	0.41	0.36	
Telenet Grp Hldg	BE	FTSE All Europe	0.39	0.46	
Entertainment Content					
Walt Disney Co	US	S&P 500	0.93	1.01	
Twenty-First	US	S&P 500	0.81	0.90	
Time Warner Inc	US	S&P 500	0.77	0.86	
Cbs Corp	US	S&P 500	0.92	0.98 *	
Viacom Inc	US	S&P 500	0.77	0.89	
Discovery Comm	US	S&P 500	0.77	0.89	
Scripps Net-Cl A	US	S&P 500	0.73	0.83	
Lions Gate	US	S&P 500	0.88 *	0.90 *	
Amc Networks	US	S&P 500	0.72 *	0.86 *	
Starz	US	S&P 500	0.72 *	0.78 *	
Vivendi	FR	FTSE All Europe	0.62	0.72 *	✓
Entertainment One	UK	FTSE All Share	0.66 *	0.70 *	
Average Asset Beta					
Cable & Satellite excl. Tier 1			**0.49**	**0.62**	
Entertainment Content excl. Tier 1			**0.79**	**0.86**	
Tier 1 - vertically integrated Pay-TV			**0.67**	**0.75**	

Source: NERA analysis
Note:
* GLS reported where regression diagnostics show heteroscedasticity or autocorrelation.

A comparison of these beta estimates with the betas of standard telecoms indicates that:

- The average asset beta for the Cable & Satellite comparators is within the range formed by the standard telecoms comparators:

    - Against the local/regional index, the average asset beta for Cable & Satellite is 0.49, within the range of the UK telecoms average of 0.66, EU telecoms of 0.54 and US telecoms of 0.47;

    - Against the world index, the average asset beta of Cable & Satellite is 0.62, within the range of the UK telecoms average of 0.65, EU telecoms of 0.65 and US telecoms of 0.53.

    This observation indicates that TV distribution is likely to share similar risk characteristics with telecoms services to the extent that: 1) both require network infrastructure, which is likely to be used for both TV distribution and telephony/broadband; and 2) both are likely to have relatively low income elasticity.
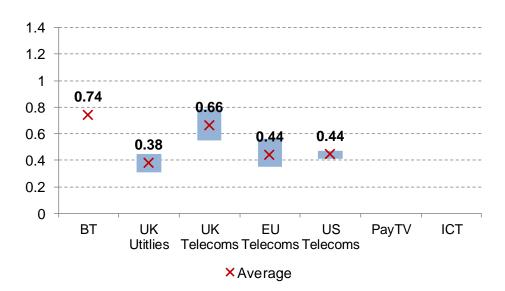
- The average asset beta for TV entertainment content production is 0.79 against the local/regional index, i.e. c.0.1 higher than the upper end of the standard telecoms comparator set) and 0.86 against the world index, i.e. c.0.2 higher than the upper end of the standard telecoms comparator set.

- Finally, the average asset beta for the vertically integrated pay TV sample (Tier 1), at 0.67 against the local/regional index and 0.75 against the world index sits between the beta estimates for TV distribution and TV content production. Based on the Tier 1 sample, our average asset beta for pay TV operators is somewhat higher than that of standard telecoms. However, the ranges between the pay TV operators and telecoms operators overlap significantly (we show these diagrammatically in Figure 6.2 and Figure 6.4 below). Furthermore, we find that the pay TV operators' beta range is relatively wide, to the extent that TV distribution companies tend to exhibit lower asset betas, and TV content providers tend to exhibit higher betas. Thus, the wide beta range reflects the different risk profiles of the sub-sectors along the pay TV value chain, and BT's pay TV risk will crucially depend on the proportion of revenues it sources from each activity along the value chain.

6. Summary and Conclusions

Figure 6.1 and Figure 6.2 compare our current estimates of the 2-year asset betas of BT and comparators against the local/regional indices with our January update. In summary, we find that:
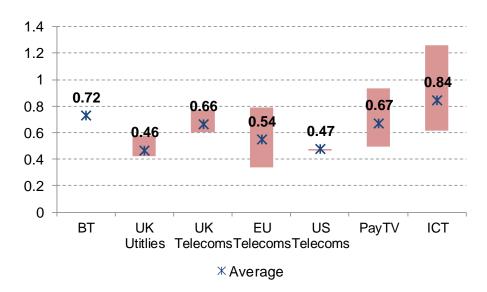
- BT's asset beta has been largely decreasing over the period but on the rise recently, and is overall slightly lower than our January update.

- By contrast, the betas of **UK telecoms** (excluding BT) have been relatively stable over the period, while the betas of **UK utilities** have continued to rise, and their average is c.0.08 higher than our January update. As a result, there is a convergence between BT's beta and that of the UK comparators.

- The asset betas of **EU telecoms** have also increased by c. 0.1 since our January update, and currently display a wider range; BT currently lies towards the top of that range.

- The **US telecoms** asset betas have been broadly stable over the period. As Comcast and Time Warner Cable have been reallocated to the pay TV sample, the US telecoms sample now includes three companies whose asset betas lie very close to one another but are lower than the beta averages for the UK and EU telecoms samples.

Figure 6.1
Summary of 2-year Asset Beta against the Local/ Regional Index - January Update

Source: NERA analysis
Note: we have shown beta averages and ranges for ICT and pay TV based on Tier 1 comparators.
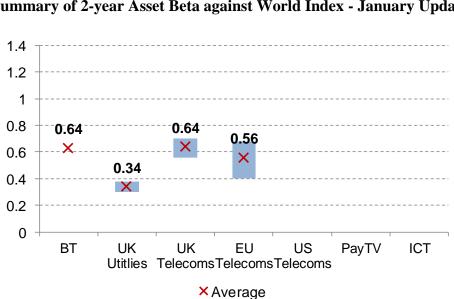
Figure 6.2
Summary of 2-year Asset Beta against the Local/ Regional Index – Current (October Update)
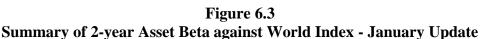
Source: NERA analysis
Note: we have shown beta averages and ranges for ICT and pay TV based on Tier 1 comparators.

Figure 6.3 and Figure 6.4 compare our current estimates of the 2-year asset betas of BT and comparators, estimated against the world index, with our January update. For all European and US comparators, betas are higher against the world index relative to the local / regional

index, whilst for the UK comparators sample the opposite is true. As we showed in Section 3.4, this is crucially driven by the differences in correlations of the stocks with each market as well as the differences in volatility of the company stocks relative to market indices.

Figure 6.3
Summary of 2-year Asset Beta against World Index - January Update

Source: NERA analysis
*Note: we have shown beta averages and ranges for ICT and pay TV based on Tier 1 comparators.*
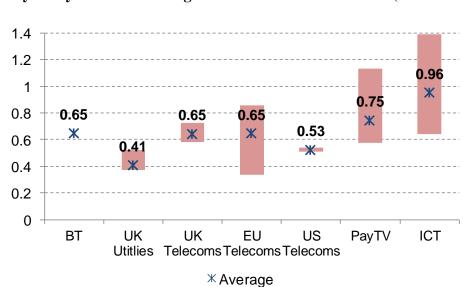
Figure 6.4
Summary of 2-year Asset Beta against World Index – Current (October Update)

Source: NERA analysis
Note: we have shown beta averages and ranges for ICT and pay TV based on Tier 1 comparators.

For this review, Ofcom also asked NERA to estimate the beta for **ICT** and **pay TV comparators.** We find that:

- Our average asset beta for the vertically integrated **pay TV operators (Tier 1)** is somewhat higher than that of standard telecoms. However, we find that the beta range is relatively wide, to the extent that TV distribution companies tend to exhibit lower asset betas, and TV content providers tend to exhibit higher betas. Thus, the wide beta range reflects the different risk profiles of the sub-sectors along the pay TV value chain, and BT's pay TV risk will crucially depend on the proportion of revenues it sources from each activity along the value chain;

- Our average asset beta for **ICT companies (Tier 1)** is higher than the other comparator groups. However, the range of asset beta estimates for ICT comparators is also much wider than for the telecoms operators and pay TV operators. As a result of this variability, there is a degree of overlap in the asset betas between ICT companies and the other comparator groups, with the exception of US telecoms.

Appendix A. Statistical Tests

In this appendix we set out statistical test carried out to test the assumptions underpinning our beta estimation (see section 2). Based on visual inspection of the data, and the set of formal statistical diagnostic tests carried out for this assignment, we conclude that:

- Visual inspection of the data does not indicate structural problems with the data; some evidence of autocorrelation and heteroscedasticity exists, but is likely to be caused by outliers;

- The GLS estimates, used to correct for autocorrelation and heteroskedasticity are generally similar to the OLS estimates across the samples;

- While there is some evidence of outliers, these observations do not appear to have a material impact on the beta estimates – the beta estimates corrected for outliers are almost always within one standard deviation of OLS estimates.

- All comparator stocks and market indices are liquid, indicating that there is no ex ante need to apply Dimson adjustments for asynchronous trading bias.

We structure the remainder of this appendix as follows:
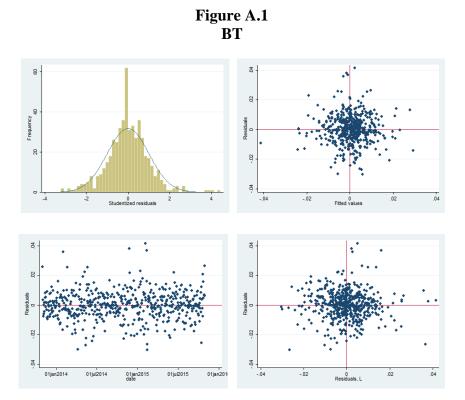
- A.1 reports our visual inspection of the data and results for the UK comparators set;

- A.2 reports test results on heteroscedasticity and autocorrelation;

- A.3 reports test results on outliers as well as beta estimates accounting for outliers;

- A.4 reports our liquidity checks for each comparator.

A.1. Visual Inspection of the Data
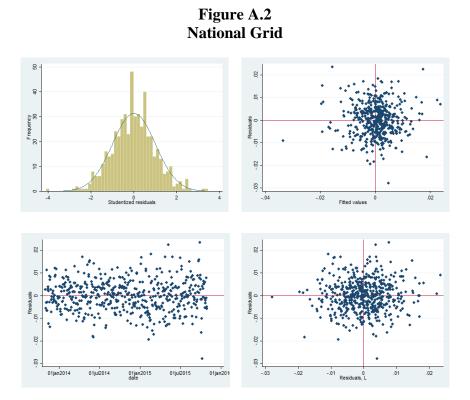
In this section we show for each UK comparator, the following results associated with the 2-year beta regression against the FTSE All Share:

1) a histogram of residuals, to assess evidence on the normality of the error terms;

2) a scatter plot with fitted value on the X-axis and residual on the Y-axis, to assess whether the variation of the error term is systematically different when the independent variable changes value;

3) a scatter plot of the residuals through time, to assess whether the variance of the error term appears constant through time; and

4) a scatter plot of residuals and their lagged values to assess any positive/negative dependence which would be indicative of autocorrelation of the error terms.

The charts below do not exhibit systematic relationships which would indicate a violation of the OLS assumptions. We carry out further statistical tests in the following sections to assess these findings more formally.

Figure A.1
BT

Source: NERA analysis

Figure A.2
National Grid
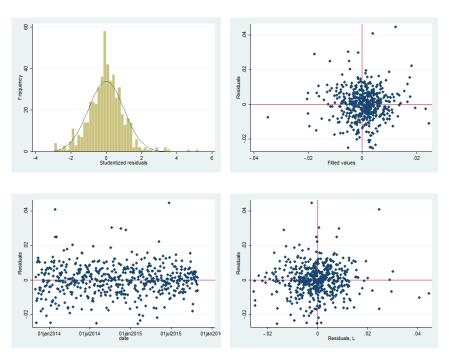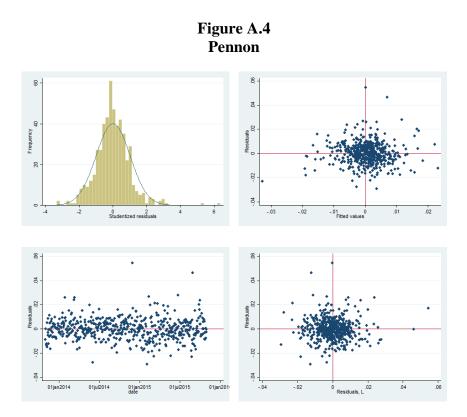
Source: NERA analysis

Figure A.3
Severn Trent

Source: NERA analysis

Figure A.4
Pennon
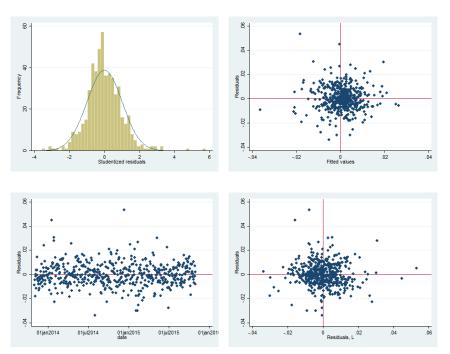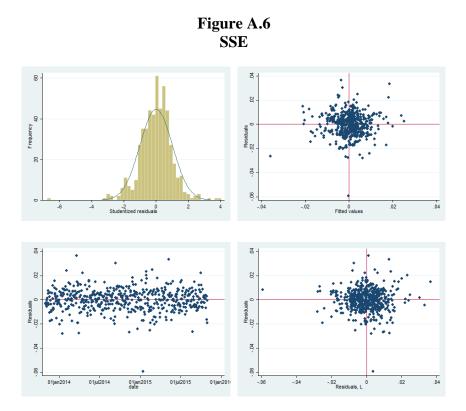
Source: NERA analysis

Figure A.5
United Utilities

Source: NERA analysis

Figure A.6
SSE
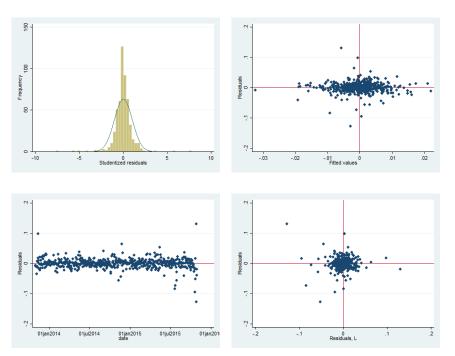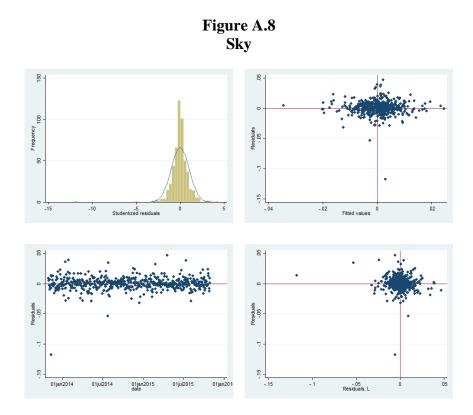
Source: NERA analysis

Figure A.7
Talk Talk

Source: NERA analysis

Figure A.8
Sky

Source: NERA analysis

Figure A.9
Vodafone

Source: NERA analysis

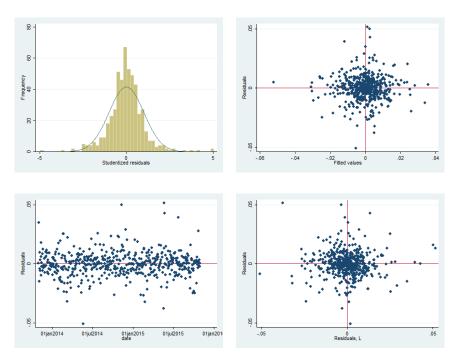## A.2. Heteroscedasticity and Auto-correlation Tests

We carry out a series of diagnostic tests on the error terms of the regressions to assess whether there is evidence of autocorrelation and/or heteroscedasticity in the error terms.

We have run White and Durbin Watson tests in STATA to detect heteroscedasticity and autocorrelation respectively. We define significance at 95% confidence level for both tests (as reported in Table A.1). When either heteroscedasticity or autocorrelation is detected, we report GLS (Generalized Least Squares) estimates instead of OLS estimates. However as shown in Table A.2 for the UK comparators, the GLS estimates are generally very similar to the OLS estimates across the comparators – an observation that also holds for all other comparator sets.

Table A.1
UK Comparator Heteroscedasticity/Autocorrelation Tests

		FTSE All Share						FTSE All World					
		White Stat	P-val	Durbin Watson	Hetero-skedast icity	Serial Correla tion	GLS?	White Stat	P-val	Durbin Watson	Hetero-skedast icity	Serial Correla tion	GLS?
BT													
	1Y	0.19	0.91	2.07	NO	NO	NO	1.28	0.53	2.18	NO	NO	NO
	2Y	0.03	0.98	2.05	NO	NO	NO	1.46	0.48	2.13	NO	NO	NO
National Grid													
	1Y	5.17	0.08	1.94	NO	NO	NO	7.43	0.02	2.11	YES	NO	YES
	2Y	11.06	0.00	1.94	YES	NO	YES	15.49	0.00	2.11	YES	NO	YES
Severn Trent													
	1Y	3.74	0.15	2.00	NO	NO	NO	4.82	0.09	2.14	NO	NO	NO
	2Y	2.39	0.30	1.95	NO	NO	NO	4.03	0.13	2.07	NO	NO	NO
Pennon													
	1Y	2.50	0.29	2.05	NO	NO	NO	6.43	0.04	2.14	YES	NO	YES
	2Y	6.02	0.05	2.02	YES	NO	YES	14.90	0.00	2.12	YES	NO	YES
United Utilities													
	1Y	6.99	0.03	2.03	YES	NO	YES	2.73	0.26	2.15	NO	NO	NO
	2Y	14.83	0.00	2.11	YES	NO	YES	4.99	0.08	2.18	NO	YES	YES
SSE													
	1Y	2.15	0.34	2.03	NO	NO	NO	7.31	0.03	2.25	YES	YES	YES
	2Y	5.32	0.07	2.05	NO	NO	NO	19.59	0.00	2.21	YES	YES	YES
TalkTalk													
	1Y	0.93	0.63	2.16	NO	NO	NO	1.35	0.51	2.16	NO	NO	NO
	2Y	0.72	0.70	2.08	NO	NO	NO	1.20	0.55	2.11	NO	NO	NO
Sky													
	1Y	0.63	0.73	2.09	NO	NO	NO	0.38	0.83	2.20	NO	Inconc	YES
	2Y	0.40	0.82	2.20	NO	YES	YES	0.22	0.90	2.23	NO	YES	YES
Vodafone													
	1Y	0.67	0.72	2.12	NO	NO	NO	0.05	0.97	2.33	NO	YES	YES
	2Y	0.49	0.78	2.06	NO	NO	NO	0.37	0.83	2.19	NO	YES	YES

Source: NERA analysis

Table A.2
OLS vs. GLS estimates for UK Comparators

		FTSE All Share				FTSE All World			
		OLS		GLS		OLS		GLS	
BT		Beta	SE	Beta	SE		Beta	SE	Beta	SE
	1Y	0.93	0.06	0.93	0.06	1Y	0.88	0.09	0.87	0.09
	2Y	0.90	0.05	0.90	0.05	2Y	0.81	0.07	0.81	0.07
National Grid										
	1Y	0.78	0.05	0.78	0.05	1Y*	0.68	0.07	0.67	0.07
	2Y*	0.73	0.04	0.74	0.04	2Y*	0.63	0.05	0.63	0.05
Severn Trent										
	1Y	0.77	0.05	0.77	0.05	1Y	0.69	0.08	0.68	0.08
	2Y	0.76	0.05	0.76	0.05	2Y	0.67	0.06	0.67	0.06
Pennon										
	1Y	0.74	0.06	0.74	0.06	1Y*	0.64	0.09	0.65	0.09
	2Y*	0.71	0.05	0.71	0.05	2Y*	0.62	0.06	0.62	0.06
United Utilities										
	1Y*	0.84	0.06	0.84	0.06	1Y	0.74	0.09	0.74	0.09
	2Y*	0.81	0.05	0.81	0.05	2Y*	0.71	0.07	0.71	0.07
SSE										
	1Y	0.86	0.06	0.86	0.06	1Y*	0.83	0.09	0.80	0.08
	2Y	0.78	0.05	0.77	0.05	2Y*	0.72	0.07	0.70	0.06
TalkTalk										
	1Y	0.66	0.13	0.67	0.13	1Y	0.75	0.17	0.74	0.16
	2Y	0.70	0.09	0.70	0.09	2Y	0.73	0.12	0.73	0.12
Sky										
	1Y	0.80	0.06	0.80	0.06	1Y*	0.82	0.08	0.82	0.08
	2Y*	0.76	0.06	0.76	0.06	2Y*	0.73	0.08	0.72	0.07
Vodafone										
	1Y	1.07	0.07	1.06	0.07	1Y*	1.02	0.10	1.01	0.09
	2Y	1.12	0.06	1.12	0.06	2Y*	1.06	0.08	1.06	0.08

Source: NERA analysis

A.3. Outliers & Robust Regressions

In this section we consider two approaches to assessing the impact of outliers on beta estimates for the UK comparators.

One approach is to re-run the OLS regression after excluding the outliers. We detect outliers in our dataset using Cook's Distance test – if Cook's D measure exceeds four divided by the number of observations in the regression, we consider this data point as an outlier.

The alternative is to run robust regressions in STATA, which effectively assign lower weights to data points that have strong influence on the regression line (i.e. outliers).

The table below reports different beta estimates under OLS, OLS with excluded outliers, and robust regressions, for the UK comparators. The beta estimates accounting for outliers are mostly within one standard deviation of the OLS estimates. In general, we do not consider there to be a strong, a priori reason to exclude observations from the data sample, as these may be features of the data that could be repeated over the next regulatory period.

Table A.3
Outliers Tests & Robust Regressions for UK Comparators

		FTSE All Share				FTSE All World		
	OLS	Robust	Excl. Outliers	No of Outliers	OLS	Robust	Excl. Outliers	No of Outliers
BT								
1Y	0.93	0.96	0.94	18	0.88	0.90	0.81	14
2Y	0.90	0.92	0.91	31	0.81	0.84	0.82	32
National Grid								
1Y	0.78	0.82	0.84	17	0.68	0.71	0.71	15
2Y	0.73	0.74	0.72	29	0.63	0.62	0.62	27
Severn Trent								
1Y	0.77	0.75	0.71	13	0.69	0.65	0.61	12
2Y	0.76	0.76	0.73	28	0.67	0.67	0.63	25
Pennon								
1Y	0.74	0.66	0.62	18	0.64	0.54	0.47	16
2Y	0.71	0.65	0.66	32	0.62	0.52	0.52	29
United Utilities								
1Y	0.84	0.86	0.82	16	0.74	0.77	0.74	16
2Y	0.81	0.82	0.75	34	0.71	0.72	0.68	34
SSE								
1Y	0.86	0.81	0.85	14	0.83	0.71	0.77	12
2Y	0.78	0.73	0.75	24	0.72	0.64	0.70	27
TalkTalk								
1Y	0.66	0.59	0.63	13	0.75	0.62	0.65	12
2Y	0.70	0.65	0.66	23	0.73	0.65	0.61	23
Sky								
1Y	0.80	0.77	0.85	16	0.82	0.81	0.79	12
2Y	0.76	0.75	0.79	21	0.73	0.70	0.72	19
Vodafone								
1Y	1.07	1.06	1.06	12	1.02	1.06	0.98	15
2Y	1.12	1.09	1.06	22	1.06	1.07	0.99	27

Source: NERA analysis

A.4. Liquidity test

In this section we test the liquidity of each comparator stock, by using the bid-ask spread measure. We define a stock as illiquid if its 2-year average daily bid-ask spread is larger than

1%.[32] The liquidity threshold of 1% bid-ask spread has been used by other regulators, e.g. the German Energy Regulator (BNetzA) for setting WACC allowance for gas/electricity transmission and distribution.[33]

As shown in Table A.4, all comparators across the three sample groups pass the liquidity test, which indicates that these stocks are unlikely to be subject an asynchronous trading bias.[34]

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[32] Daily bid-ask spread is calculated as ask price minus bid price, divided by the average of bid and ask price. Bid and ask prices are downloaded from Bloomberg.

[33] See Bundesnetzagentur (2008), Beschluss hinsichtlich der Festlegung von Eigenkapitalzinssaetzen fuer Alt- und Neuanlagen fuer Betreiber von Elektrizitaetsversorgungsnetzen und Betreiber Von Gasversorgungsnetzen fuer die erste Regulierungsperiode in der Anreizregulierung (Decision), BK4-08-068, p.18

[34] Also see Ian Cooper (June 2005), Comments on the document: Beta analysis of British Telecommunications: Update which advised that there is no need to include / apply E.g. Dimson adjustments for asynchronious trading to liquid stocks (in his case BT). Accessed at:
http://faculty.london.edu/icooper/assets/documents/commentsonBRATTLE2forpdf(3).pdf

Table A.4
Comparator Liquidity Test

	Bid - Ask Spread				Bid - Ask Spread		
	1Y Average	2Y Average	Liquidity		1Y Average	2Y Average	Liquidity
UK Utilities/Telecoms				**Pay TV comparators**			
BT	0.03%	0.03%	YES	Comcast Corp-A	0.02%	0.02%	YES
National Grid	0.03%	0.04%	YES	Time Warner Cabl	0.05%	0.05%	YES
Severn Trent	0.06%	0.06%	YES	Dish Network-A	0.03%	0.02%	YES
Pennon	0.07%	0.08%	YES	Charter Com-A	0.05%	0.04%	YES
United Utilities	0.07%	0.07%	YES	Cablevision Sy-A	0.05%	0.12%	YES
SSE	0.07%	0.07%	YES	Echostar Corp-A	0.09%	0.08%	YES
TalkTalk	0.09%	0.08%	YES	Modern Times-B	0.10%	0.11%	YES
Sky	0.09%	0.08%	YES	Nos Sgps	0.25%	0.25%	YES
Vodafone	0.03%	0.03%	YES	Ses	0.14%	0.14%	YES
				Kabel Deutschlan	0.44%	0.38%	YES
EU Telecoms				Liberty Global-A	0.03%	0.03%	YES
Telefonica	0.04%	0.21%	YES	Sky Plc	0.09%	0.08%	YES
Deutsche Telekom	0.13%	0.18%	YES	Shaw Comm-B	0.28%	0.31%	YES
Belgacom	0.14%	0.14%	YES	Telenet Grp Hldg	0.18%	0.18%	YES
KPN	0.09%	0.09%	YES	Walt Disney Co	0.01%	0.01%	YES
Orange	0.06%	0.06%	YES	Twenty-First C-A	0.03%	0.03%	YES
Telecom Italia	0.10%	0.09%	YES	Time Warner Inc	0.05%	0.04%	YES
Iliad	0.12%	0.15%	YES	Cbs Corp-B	0.03%	0.03%	YES
Mobistar	0.21%	0.24%	YES	Viacom Inc-B	0.03%	0.02%	YES
Telenor	0.11%	0.12%	YES	Discovery Comm-A	0.04%	0.03%	YES
Tele2	0.10%	0.10%	YES	Scripps Net-Cl A	0.02%	0.02%	YES
Swisscom	0.09%	0.09%	YES	Lions Gate	0.05%	0.04%	YES
				Amc Networks-A	0.03%	0.03%	YES
US Telecoms				Starz - A	0.06%	0.06%	YES
AT&T	0.02%	0.02%	YES	Vivendi	0.05%	0.05%	YES
Verizon	0.02%	0.02%	YES	Entertainment On	0.19%	0.22%	YES
Century Link	0.03%	0.04%	YES				
				ICT comparators			
				IBM	0.02%	0.02%	YES
				Unisys Corp	0.05%	0.05%	YES
				Amdocs Ltd	0.04%	0.03%	YES
				Computer Science	0.02%	0.02%	YES
				Teletech Hldgs	0.10%	0.09%	YES
				Cdw Corp/De	0.04%	0.07%	YES
				Cognizant Tech-A	0.02%	0.02%	YES
				Xerox Corp	0.10%	0.12%	YES
				Indra Sistemas	0.06%	0.66%	YES
				Engineering Spa	0.74%	0.76%	YES
				Cancom Ag	0.42%	0.46%	YES
				Atos Se	0.11%	0.12%	YES
				Sopra Steria Gro	0.21%	0.29%	YES
				Cap Gemini	0.08%	0.07%	YES
				Tieto Oyj	0.15%	0.19%	YES
				Cgi Group Inc-A	0.23%	0.27%	YES

Source: NERA analysis

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