Cost of Capital: Beta and Gearing for WFTMR 2021

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TABLE OF CONTENTS

TABLE OF TABLES

TABLE OF FIGURES

I. Introduction

1. The weighted average cost of capital (WACC) is a key ingredient in Ofcom's price cap determination for the regulated telecoms services offered by the BT Group (BT) in its Wholesale Fixed Telecoms Market Review 2021-26 (WFTMR 2021) for the period from 1 April 2021 to 31 March 2026. Ofcom has engaged The Brattle Group to provide consulting support concerning two inputs for its WACC estimation: the calculation of the beta and the assumed level of debt and equity financing ('gearing').

2. In its most recent telecoms market review – the 2019 Business Connectivity Markets Review Statement (2019 BCMR) – Ofcom estimated the asset beta of BT and decomposed it as the weighted average of three components:

   a. The asset beta of Openreach, covering wholesale access to copper lines, ducts and poles, and measured by reference to the asset beta of UK network utilities and telecom operators.[1]

   b. The asset beta of "Other UK telecoms", covering BT's wholesale and retail leased lines, retail and wholesale voice, mobile, broadband and bundled services, and measured by reference to the asset betas of UK and European telecoms operators.[2]

   c. The asset beta for the "Rest of BT", primarily covering BT's information and communications technology (ICT) operations from its Global Services and Business and Public Sector divisions, and measured by reference to the betas of international ICT comparators.[3]

3. Ofcom set the asset betas for Openreach, Other UK Telecoms and the Rest of BT such that their weighted sum was equal to the BT's overall asset beta.[4]

4. Within this context, Ofcom has requested us to provide updated estimates of the equity betas, asset betas and gearing of BT and comparator groups relevant to estimate the benchmark asset betas for the various services. Ofcom has also asked us to:

   a. Explain the recent evolution of betas over time by reference to relevant events and how these events affect the interpretation of the beta estimates.

   b. Analyse the impact on gearing and asset betas of the updated provisions in IFRS 16 introduced in 2019 and affecting the treatment of operating leases.

5. Ofcom has also asked us to investigate the implications for systematic risk from next generation, full-fibre networks (a.k.a. fibre-to-the-premises or FTTP).

6. We detail our analyses in the remainder of this report. In particular:

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[1] See BCMR 2019 Statement, Annex 21, A21.158, A21.203.

[2] See BCMR 2019 Statement, Annex 21, A21.158, A21.203.

[3] See BCMR 2019 Statement, Annex 21, A21.158, A21.203.

[4] See BCMR 2019 Statement, Annex 21, A21.189-A21.196.

a. Section II provides a summary overview of our methodology and our findings.

b. Section III summarizes our approach and methodology to updating the comparator groups, estimating betas and gearing, and accounting for IFRS 16.

c. Section IV details our selection of the comparator groups.

d. Section V presents our estimates of equity beta, asset beta and gearing for BT and for the comparator groups. Section V also assesses the recent evolution of betas over time.

e. Section VI analyses the systematic risk of an FTTP access network relative to traditional fixed telecoms services.

7. This report also contains four technical appendices:

   a. Appendix A details the results of various screening tests used to select peers for inclusion in the comparator groups.

   b. IFRS 16 requires the capitalisation of operating leases from the end of 2019. Appendix B details our approach to calculating lease liabilities and gearing over time and in particular if IFRS 16 had been introduced in prior years. Appendix B provides corresponding estimates of gearing and 1-year, 2-year and 5-year asset betas.

   c. Appendix C provides a summary of regulatory precedents on fibre premiums.

   d. Appendix D provides the 5-year equity and asset beta estimates and their 95% confidence intervals for UK and European Telecoms comparator groups, also distinguishing between incumbent and alternative telecoms operators.

II. Summary

A. Methodology

8. We estimate the betas and gearing of BT and the comparator groups – namely UK Telecoms, UK Utilities, European Telecoms, and ICT – using 31 October 2020 as the cut-off date.

9. We estimate equity betas with reference to both local/regional indices and a world index using 1-year, 2-year and 5-year estimation windows and a daily sampling frequency.

10. We perform a series of diagnostic tests to assess whether the equity beta estimates satisfy the standard conditions underlying the OLS regression. We test for autocorrelation using the Breusch-Godfrey test, and rely on a Generalized Least Squares (GLS) estimate of the beta parameter in the presence of autocorrelation. We test for the presence of heteroscedasticity using White's test and use White's-Huber robust standard errors. We further consider the Dimson adjustment, which accounts for the issue of asynchronous trading.

11. We unlever the equity betas using the standard Miller formula, which calculates the asset beta as the weighted average of an equity beta and a debt beta. Because firms with higher leverage and worse ratings will tend to have higher debt betas, we select a debt beta of 0.05 for companies with a credit rating of AAA to A-, and a debt beta of 0.1 for companies with a credit rating of BBB+ to BBB-. We calculate gearing based on the gross book value of long plus short term debt and the market value of equity.

12. We further consider the impact of IFRS 16, the new accounting rule affecting the treatment of operating leases, which became mandatory in 2019. IFRS 16 mandated that, starting in fiscal year 2019, companies were required to capitalize their operating lease commitments and report them as liabilities. The capitalisation of operating leases resulted in a one-off increase in measured debt and gearing for most companies, leading to a corresponding decrease in their measured asset betas. Importantly, introduction of the new rule distorted the time series of debt that is used to calculate gearing and to unlever the equity betas and affected different companies differently.

13. To account for the impact of the introduction of IFRS 16, we compute 'adjusted' gearing and asset betas by removing the capitalised operating leases from the reported debt after 2019 and report both unadjusted (including capitalised operating leases under IFRS 16) and adjusted gearing (excluding capitalised operating leases under IFRS 16) asset betas.

B. Peer Selection

14. We consider four comparator groups: UK Telecoms, UK Utilities, European Telecoms and ICT Comparators. We update the samples of European Telecoms and IXCT Comparators, and maintain the same sample as considered in the 2019 BCMR for UK Telecoms and UK Utilities.

15. We apply three general screening criteria to the candidate peers in the European Telecoms and ICT Comparator Groups to ensure a reliable beta estimate.

    a. *First*, we screen all candidate peers for sufficient liquidity.

    b. *Second*, we check whether the candidate peers were involved in any sizeable M&A transaction over the same reference period. We then verify whether the company's returns exhibit abnormal spikes and/or swings around the announcement date.

    c. *Third*, we check that the comparators are not below investment grade.

16. We further apply two specific screening criteria for inclusion in the sample of European Telecoms to ensure that the candidate peers are comparable in terms of their risk profile. We require that the peers:

    a. Earn a majority of their revenues in Europe.

    b. Earn a majority of their revenues from telecoms services.

17. We update the sample of European Telecoms firms starting from a comprehensive sample of known European telecom operators offering fixed telecommunications services in Europe. We further check

whether each candidate peer is an "incumbent" (i.e. the owner of the legacy copper network in at least one of the countries in which it operates) or an "alternative operator" of a fixed telecom or cable network competing with the national incumbents in all countries in which it operates. After applying the screening criteria, we end up with a sample of 22 comparators including BT, Vodafone and TalkTalk. Of these, we classify 14 as incumbents (including BT) and 7 as alternative operators (including Vodafone).[5]

18. We update the sample of ICT Comparators by applying the same sample selection procedure used for the 2019 BCMR. After applying the screening criteria, we end up with a sample of 13 comparators.

C. Overview of Results

19. Table II-1 and Table II-2 below provide a summary overview of our results. The two tables show the 1-year, 2-year, and 5-year equity beta, asset beta and gearing for BT, Vodafone, TalkTalk and the UK Utilities, European Telecoms and ICT Comparator groups, measured against both the local/regional indices (Table II-1) and the global index (Table II-2). The tables report both unadjusted (including capitalised operating leases under IFRS 16) and adjusted gearing (excluding capitalised operating leases under IFRS 16) asset betas.

    a. **BT:** BT's 5-year equity beta is equal to 0.94 when measured against the local index, and 0.97 when measured against the global index. BT's 1-year and 2-year equity betas are broadly aligned to the 5-year equity betas. BT's 5-year asset beta is equal to 0.60 when measured against the local index, and 0.62 when measured against the global index. BT's 1-year and 2-year asset betas are lower than the 5-year asset betas, largely reflecting a significant increase in gearing over the past several years, only in part attributable to IFRS 16. Adjusted asset betas are 0.01 to 0.06 higher than the unadjusted asset betas.

    b. **Vodafone**: Vodafone's 5-year equity beta is equal to 0.96 when measured against the local index and 0.97 when measured against the global index. Vodafone's 1-year and 2-year equity betas are broadly aligned to the 5-year equity beta. Vodafone's 5-year asset beta is equal to 0.54 when measured against both the local and the global indexes. Vodafone's adjusted asset betas are 0.01 to 0.04 higher than the unadjusted betas.

    c. **TalkTalk**: Talk Talk's 5-year equity beta is equal to 0.80 when measured against the local index and 1.32 when measured against the global index. TalkTalk's 1-year and 2-year equity betas are broadly aligned to the 5-year equity beta. TalkTalk's 5-year asset beta is equal to 0.54 when measured against the local index and 0.87 when measured against the global index. TalkTalk's adjusted asset betas are 0.01 to 0.06 higher than the unadjusted betas.

    d. **UK Utilities**: The average 5-year equity beta for the UK Utilities comparator group is equal to 0.60 when measured against the local index, and 0.68 when measured against the global index. Average 1-year and 2-year equity betas are aligned to the 5-year equity beta. The average 5-year asset beta

[5] Note that we exclude TalkTalk from the group of alternative operators because the company is below investment grade and was involved in significant M&A activity.

for UK Utilities is equal to 0.34 when measured against the local index, and to 0.37 when measured against the global index. Average 1-year and 2-year asset betas are broadly aligned to the 5-year asset beta. Adjusted asset betas are 0.00 to 0.02 higher than the unadjusted betas.

e. **European Telecoms**: The average 5-year equity beta of the European Telecoms comparator group is equal to 0.78 when measured against both the local and the global indexes. European Telecoms' average 1-year and 2-year equity betas are lower but in line with the 5-year equity beta. European Telecoms' average 5-year asset beta is equal to 0.52 when measured against both the local and the global indexes. Average 1-year and 2-year equity betas are lower but in line with the 5-year asset betas. Average adjusted asset betas are 0.01 to 0.03 higher than the unadjusted betas.

f. **ICT Comparators**: The 5-year equity beta of the ICT Comparator group is equal to 1.02 when measured against the local index, and 1.26 when measured against the global index. 1-year and 2-year equity betas are broadly aligned across estimation windows. ICT Comparators' 5-year asset beta is equal to 0.86 when measured against the local index, and to 1.06 when measured against the global index. 1-year and 2-year asset betas are broadly aligned across estimation windows. Adjusted asset betas are 0.01 to 0.04 higher than the unadjusted betas.

20. In the WFTMR consultation, Ofcom suggested that an FTTP network could have a higher asset beta than a copper-based network for two main reasons:

    a. Demand uncertainty. Demand for fibre may be more sensitive to changes in economic performance and household income; and

    b. Operating leverage. The fibre business requires large investments to build fibre networks. The investment requirements may increase beta, since they magnify the risk of the value of future assets onto the existing asset base.

21. These two factors would be reflected in an 'FTTP premium' over the beta of a legacy copper network.

22. In this report we consider an indirect measure of the FTTP premium, by comparing the average asset beta of incumbents and alternative operators. A key difference between these two groups is that incumbents operate a legacy copper network, while alternative operators do not. There are clearly other differences between these two groups of comparators. Any analysis of the 'FTTP premium' using this methodology should be interpreted as indicative only.

23. Table II-1 and Table II-2 also compare the average equity beta, asset beta and gearing of incumbents (including BT) and alternative operators (including Vodafone). The two tables show that:

    a. The asset beta of alternative operators is consistently higher than the asset beta of incumbents, using both local/regional indices and the global index.

    b. The current gap ranges between 0.07 and 0.12 using both local/regional and the global indexes.

TABLE II-1: SUMMARY TABLE VS. LOCAL INDEX

Comparators	Local Index					
	Equity Beta	Debt Beta	Gearing	Gearing Adjusted	Asset Beta	Asset Beta Adjusted
BT Group PLC						
1-Y	0.96	0.10	0.65	0.58	0.40	0.46
2-Y	0.94	0.10	0.55	0.51	0.48	0.51
5-Y	0.94	0.10	0.40	0.39	0.60	0.62
Vodafone Group PLC						
1-Y	0.96	0.10	0.65	0.61	0.40	0.44
2-Y	0.95	0.10	0.59	0.56	0.44	0.47
5-Y	0.96	0.10	0.49	0.48	0.54	0.55
TalkTalk Telecom Group PLC						
1-Y	0.78	0.10	0.49	0.44	0.45	0.48
2-Y	0.77	0.10	0.45	0.41	0.47	0.49
5-Y	0.80	0.10	0.37	0.36	0.54	0.55
UK Utilities						
1-Y	0.62	0.09	0.51	0.48	0.35	0.36
2-Y	0.61	0.09	0.53	0.51	0.33	0.34
5-Y	0.60	0.09	0.51	0.51	0.34	0.34
European Telecoms						
1-Y	0.74	0.09	0.42	0.36	0.46	0.49
2-Y	0.73	0.09	0.39	0.36	0.47	0.49
5-Y	0.78	0.09	0.35	0.34	0.52	0.53
Incumbents (including BT)						
1-Y	0.76	0.09	0.46	0.42	0.43	0.46
2-Y	0.74	0.09	0.44	0.41	0.44	0.46
5-Y	0.80	0.09	0.40	0.39	0.49	0.50
Alternative Operators (including Vodafone)						
1-Y	0.77	0.10	0.40	0.32	0.50	0.55
2-Y	0.78	0.10	0.36	0.31	0.53	0.57
5-Y	0.80	0.10	0.29	0.26	0.60	0.61
ICT Comparators						
1-Y	1.02	0.10	0.21	0.17	0.82	0.85
2-Y	1.06	0.10	0.18	0.16	0.87	0.89
5-Y	1.02	0.10	0.16	0.15	0.86	0.87

TABLE II-2: SUMMARY TABLE VS. GLOBAL INDEX

	Global Index					
Comparators	**Equity Beta**	**Debt Beta**	**Gearing**	**Gearing Adjusted**	**Asset Beta**	**Asset Beta Adjusted**
BT Group PLC						
1-Y	0.92	0.10	0.65	0.58	0.39	0.45
2-Y	0.90	0.10	0.55	0.51	0.46	0.49
5-Y	0.97	0.10	0.40	0.39	0.62	0.63
Vodafone Group PLC						
1-Y	0.98	0.10	0.65	0.61	0.41	0.44
2-Y	0.93	0.10	0.59	0.56	0.44	0.47
5-Y	0.97	0.10	0.49	0.48	0.54	0.56
TalkTalk Telecom Group PLC						
1-Y	1.28	0.10	0.49	0.44	0.70	0.76
2-Y	1.22	0.10	0.45	0.41	0.72	0.76
5-Y	1.32	0.10	0.37	0.36	0.87	0.88
UK Utilities						
1-Y	0.69	0.09	0.51	0.48	0.38	0.40
2-Y	0.65	0.09	0.53	0.51	0.35	0.36
5-Y	0.68	0.09	0.51	0.51	0.37	0.38
European Telecoms						
1-Y	0.71	0.09	0.42	0.36	0.44	0.47
2-Y	0.69	0.09	0.39	0.36	0.44	0.47
5-Y	0.78	0.09	0.35	0.34	0.52	0.53
Incumbents (including BT)						
1-Y	0.73	0.09	0.46	0.42	0.41	0.44
2-Y	0.70	0.09	0.44	0.41	0.41	0.43
5-Y	0.78	0.09	0.40	0.39	0.49	0.50
Alternative Operators (including Vodafone)						
1-Y	0.75	0.10	0.40	0.32	0.48	0.53
2-Y	0.74	0.10	0.36	0.31	0.51	0.54
5-Y	0.81	0.10	0.29	0.26	0.60	0.62
ICT Comparators						
1-Y	1.30	0.10	0.21	0.17	1.03	1.07
2-Y	1.30	0.10	0.18	0.16	1.06	1.09
5-Y	1.26	0.10	0.16	0.15	1.06	1.07

III. Methodology

24. In this section, we summarise our methodology for estimating equity and asset betas. Unless otherwise noted, we apply the same methodology used in the 2019 BCMR, as detailed in Annex 21 of the 2019 BCMR decision and in the reports prepared by NERA for the 2019 BCMR.[6]

A. Comparator Groups

25. We consider four comparator groups:

    a. UK Telecoms;

    b. UK Utilities;

    c. European Telecoms; and

    d. ICT.

26. We maintain the same UK Telecoms and UK Utilities samples as considered in the 2019 BCMR. We detail our approach to updating the sample of European Telecoms and ICT Comparators in Section IV.

B. Reference Indices

27. The systematic risk of BT and of each peer in the comparator groups, as summarised in their beta parameter, must be measured against an index representing 'the overall market'. If investor portfolios were fully diversified across the globe, then the use of a world index would be most appropriate. In practice, there tends to be some 'home bias', and investors tend to diversify their investments in markets that are closer to their home market and that they know well (for example, a European market rather than across the world). Capital markets are therefore not yet fully integrated. In this report we compute betas with reference to both local/regional indices and a world index, consistent with the methodology used in the 2019 BCMR and in previous engagements for Ofcom.[7]

28. We use the following local/regional market indices:

[6] See NERA, *Cost of Capital: Beta and Gearing for the 2019 BCMR,* October 2018 (NERA 2018 Report), and *Cost of Capital: Beta and Gearing for the 2019 BCMR – Update,* April 2019 (NERA 2019 Report).

[7] See, *e.g.*, Richard Caldwell and Ilinca Popescu, "Estimate of BT's Equity Beta", March 2014, and also "Estimates of Equity and Asset Betas for UK Mobile Owners", January 2015, The Brattle Group.

a. The FTSE All-Shares (ASX Index) that reflects all stocks trading on the London Stock Exchange market, and captures 98% of the UK's market capitalisation[8] to estimate betas for BT, UK Telecoms and UK Utilities.

b. The FTSE All World Europe ex. UK (FTAW12 Index), which comprises large and mid-cap stocks providing coverage of the developed and advanced emerging markets in Europe excluding the UK, to estimate betas for European Telecoms.[9]

c. Broad local and regional indices to estimate betas for ICT comparators located in Europe (FTSE All World Europe excl. UK Index (FTAW12)), the US (S&P 500 Index (SPX)) and Canada (S&P/TSX Composite Index (SPTSX)).

29. As the relevant world index we consider the FTSE All World Index (FTAW01 Index), a market-capitalisation weighted index representing the performance of the large and mid cap stocks from the FTSE Global Equity Index Series that covers 90-95% of value of world-wide investable stocks.[10]

C. Timing: Estimation Window, Sampling Frequency, and Measurement Date

30. The choice of the time horizon over which to estimate the beta involves a trade-off. As we extend the estimation window, we add more observations of returns to the calculation of beta, which will reduce the statistical error of the beta estimation. However, if the true level of beta changes over time, then the older data may be out-of-date and reflect a prior relationship between the returns of the firm and the return of the market index that is no longer relevant at the time of estimation and unrepresentative of the future beta.

31. Consistent with the methodology used in the 2019 BCMR, in this report we present beta estimates using 1-year, 2-year and 5-year estimation windows, and analyse their evolution over time. We do not recommend using a longer estimation window in the telecoms sector. Over the past 10 years, the telecoms sector has been characterized by rapid technological innovation, significant levels of investment, and substantial M&A activity. Therefore, the use of a longer term betas is likely to lead to an inaccurate estimate of the beta for the 2021-2026 regulatory period.

32. With respect to sampling frequency, we focus primarily on a daily sampling frequency. The use of a daily sampling frequency ensures that there are sufficient observations for the beta estimate to be statistically robust. However, using daily returns may present some challenges if the shares are not liquidly traded. Daily betas can sometimes produce lower beta estimates than a weekly beta if the firm's share-price does not react to market news at the same speed as the index. In this report we

[8] Source www.ftserussell.com.

[9] Source www.ftserussell.com. The NERA 2018 Report states that it is using the "FTSE All Europe Index" but does not provide a ticker for the index. We were not able to find an 'FTSE all Europe index' on Bloomberg, and an 'all Europe' index is not available on FTSE Russell website (see www.ftserussell.com).

[10] Source www.ftserussell.com.

screen all comparables for sufficient liquidity (see Section IV) and apply statistical tests for asynchronous trading (see Section III.D).

33. We source data on stock returns, index returns, equity and debt from Bloomberg, using 31 October 2020 as the cut-off date.

D. Equity Beta Estimation

34. We estimate equity betas based on an OLS regression of stock returns over market returns. We perform a series of diagnostic tests to assess whether the beta estimates satisfy the standard conditions underlying the OLS regression. We test for autocorrelation using the Breusch-Godfrey test, and rely on a Generalized Least Squares (GLS) estimate of the beta parameter in the presence of autocorrelation. We test for the presence of heteroscedasticity using White's test and use White's-Huber robust standard errors.

35. In addition to the above diagnostic tools and adjustment procedures, we further consider the Dimson adjustment. The Dimson adjustment accounts for the issue that prices may react to news the day before or the day after the market index reacts. This could occur because of differences in market opening times and trading hours, or differences in the liquidity of the firm's shares relative to the average liquidity of the market. If such an effect is present, a beta estimated using only the correlation between the daily return on the firm's share and the return on the market index on the same day may be biased.

36. The Dimson adjustment regresses a company's daily returns on both the market index return on the same day and those one day before and one day after. The Dimson adjusted beta is the sum of the three coefficients calculated by the regression. If the market in a particular stock is efficient, all of the relevant information should be factored on a given day. If the Dimson adjusted beta estimate is significantly different from the original beta estimate, this suggests that information about the true beta may be lost by considering only the simple regression. In this case, we use a Dimson adjusted beta estimated via OLS or GLS depending on the presence of autocorrelation.

37. Our final equity beta estimates therefore can either be OLS, GLS, Dimson OLS or Dimson GLS. In all cases we use heteroscedasticity robust standard errors.

E. Asset Beta and Debt Beta

38. As well as reflecting the systematic risk of the underlying business, equity betas also reflect the risk of debt or financial leverage. As debt is added to the company, the equity will become riskier as more cash from profits goes towards paying debt in each year before dividends can be distributed to equity. With more debt, increases or decreases in a firm's profit are magnified onto the value of equity. Hence if two firms engage in exactly the same activity, but one firm has more debt, that firm will have a higher equity beta than the firm with less debt.

39. To measure the relative risk of underlying assets on a consistent basis, it is necessary to 'unlever' the observed equity betas, effectively imagining that firms are funded entirely by equity. The resulting beta is referred to as an "asset" or "unlevered" beta.

40. In this report we unlever the equity betas using the standard Miller formula. According to Miller, the asset beta is just the weighted average of an equity beta and a debt beta:

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

41. In the 2019 BCMR, Ofcom adopted a debt beta of 0.1 for all peers.

42. Debt betas are likely to vary across firms depending on their leverage and debt ratings. Firms with higher leverage and worse ratings will tend to have higher debt betas, all else equal. In principle, debt betas could be estimated using traded bond data. However, the availability of traded bond data is relatively limited both across firms and time even for the largest firms. Furthermore, the available trading data also reflects relatively low liquidity, which often undermines the results. A theoretical alternative is to the use option pricing theory to back out a debt beta from a known equity beta. However, this alternative is relatively complex and the results relatively sensitive to input assumptions.

43. Given the empirical difficulties, in our 2016 report for the European Commission[11] we recommended some simpler 'rules of thumb'. We recommended using a debt beta of 0.05 for companies with a credit rating of AAA to A-, and a debt beta of 0.1 for companies with a credit rating of BBB+ to BBB-. We apply this approach in this report.

F. Gearing and IFRS 16

44. In line with the methodology adopted in the 2019 BCMR, we calculate gearing based on the gross book value of long plus short term debt and the market value of equity. More specifically, for BT and each one of the peers in the comparator groups, we collect data on gross quarterly debt and the daily value of shares outstanding from Bloomberg. We compute 1-year, 2-year, and 5-year gearing as the average of quarterly ratios of debt over debt plus equity over the relevant period.

45. Ofcom has also asked us to consider the impact of IFRS 16, the new accounting rule affecting the treatment of operating leases, which became mandatory in 2019.

46. Until the introduction of IFRS 16, statutory accounts treated finance leases and operating leases differently. Finance leases were capitalized and included as liabilities – so in other words debt – on the balance sheet, matched by an asset reflecting the right to use the underlying asset. The income statement then recognised a corresponding financing charge. In contrast, operating lease payments were expensed in the year incurred, with the stream of future operating lease commitments discussed in the notes to the financial statements but without any inclusion of a capitalised liability (or

[11] Dan Harris, Richard Caldwell, Lucia Bazzucchi, and Francesco Lo Passo, "Review of approaches to estimate a reasonable rate of return for investments in telecoms networks in regulatory proceedings and options for EU harmonization", The Brattle Group, prepared for the Directorate-General for Communications Networks, Content and Technology (DG CONNECT), Contract number: 30 – CE -0735332/00-55, 14 July 2017 (the "2016 Brattle Report").

corresponding asset) on the balance sheet. IFRS 16 mandated that, starting in fiscal year 2019, companies were required to capitalize their operating lease commitments and report them as liabilities (with an equivalent right-to-use asset which would be depreciated over the lease term), in effect increasing the reported debt of the company. All companies in the comparator groups have adopted IFRS 16 for fiscal year 2019. However, most of the comparators have not restated liabilities in prior years.

47. The capitalisation of operating leases has resulted in a one-off increase in measured debt and gearing for most companies, leading to a corresponding decrease in their measured asset betas. Importantly, introduction of the new accounting rule has, in effect, distorted the time series of debt that is used to calculate gearing and to unlever the equity betas. The introduction of the new rule has also affected different companies differently.

48. To account for the impact of the introduction of IFRS 16, we compute 'adjusted' gearing and asset betas by removing the capitalised operating leases from the reported debt after 2019 for BT and each of the comparators. This ensures a consistent series of debt figures. In Section V, we report both unadjusted (including capitalised operating leases under IFRS 16) and adjusted (excluding capitalised operating leases under IFRS 16) gearing and asset betas.

49. In Appendix B, we further detail a simplified approach to estimating a capitalised value for outstanding operating lease commitments in prior years, consistent with the new IFRS 16 provision. This simplified approach also ensures consistent treatment of operating leases over time, and provide estimates of gearing and 1-year, 2-year and 5-year asset betas, i.e. with operating lease liabilities capitalised over the full estimation window.

IV. Peer Selection

50. We consider four comparators groups: UK Telecoms, UK Utilities, European Telecoms and ICT Comparators.

51. With respect to UK Telecoms and UK Utilities we maintain the same sample as considered in the 2019 BCMR. We update the sample of European Telecoms by selecting an initial comprehensive sample of known European telecom operators offering fixed telecommunications services in Europe. We also update the sample of ICT Comparators applying the same sample selection procedure applied for the 2019 BCMR.[12]

52. We describe below how we screen the candidate peers in the European Telecoms and ICT Comparator groups. For European Telecoms, we further ensure that the candidate peers derive a majority of the revenues from telecoms services in Europe.

A. Screening Criteria

53. We apply three general screening criteria to the candidate peers in the European Telecoms and ICT Comparator Groups to ensure a reliable beta estimate.

54. *First*, we screen all candidate peers for sufficient liquidity. That is, we test that the shares of comparable companies are traded frequently and in sufficiently high volumes, so that the observed share prices are likely to incorporate all of the available information available at the relevant time. If shares are illiquid, they are unlikely to react to information as quickly as the market index, reducing the covariance between the individual firm returns and the corresponding market returns, and biasing the resulting beta estimate downwards. We apply three screens related to liquidity. First, we test that each firm's shares trades on more than 90% of days in which the relevant market index trades. Second, we calculate the bid-ask spread as a share of the mid price and verify that all companies are below the 1% threshold. Finally, we verify that the value of trades has been at least €50,000 in more than 50% of the trading days. We test for liquidity over the 5-year reference period 1 November 2015 through 31 October 2020.

55. *Second*, we check whether the candidate peers were involved in any sizeable M&A transaction over the same reference period. M&A activity can cause a share price to move independently from the index, and may depress the beta estimate below its true level. We collect information on potential and completed deals. We identify deals whose announced total value is at least 30% of the peer's market capitalisation in the month preceding the deal. We then verify whether the company's returns exhibit abnormal spikes and/or swings around the announcement date.

[12] See NERA, *Cost of Capital: Beta and Gearing for the 2019 BCMR – Update*, April 2019 (NERA 2019 Report).

56. *Third*, we check that the comparators are not below investment grade. That is, they have a credit rating of at least BBB-. This is because the share price of firms with below investment grade ratings tend to be very sensitive to news regarding the firm's credit quality and bankruptcy risk. This sensitivity can reduce the estimated beta in a way that is not representative for a firm with a higher credit rating.

57. We further apply two specific screening criteria for inclusion in the sample of European Telecoms. The two specific screens attempt to ensure that the candidate peers in the sample are comparable in terms of risk profile. We require that the peers:

    a. Earn a majority of their revenues in Europe.

    b. Earn a majority of their revenues from telecoms services.

58. We provide additional details on the screening tests in Appendix A.

B. European Telecoms

59. To update the sample of European Telecoms firms, we start with the list of companies Bloomberg Intelligence classifies as "EU telecom carriers". We also use the lists of peers considered in the 2019 BCMR and in a number of recent WACC reports for the telecoms sector.[13] From this broad list, we exclude non-European companies, and companies that do not provide fixed-telecom services.[14]

60. We then checked whether each candidate peer:

    a. Is the historical incumbent, i.e. it is the owner of the legacy copper network, in at least one of the countries in which it operates (Table IV-1, column [D]).

    b. Operates as an alternative fixed telecom operator competing with the national incumbent in at least one of the countries in which it operates (Table IV-1, column [E]).

    c. Operates a cable network in at least one of the countries in which it operates (Table IV-1, column [F]).

[13] See NERA, Cost of Capital: Beta and Gearing for the 2019 BCMR, October 2018 (NERA 2018 Report), and Cost of Capital: Beta and Gearing for the 2019 BCMR – Update, April 2019 (NERA 2019 Report); CEPA, "Cost of capital for regulated fibre telecommunications services in New Zealand: Asset beta, leverage, and credit rating", May 2019; WIK Consult, "Regulatory approaches to risky bottleneck assets: International case studies", February 2016; Harris, Caldwell, Lo Passo, and Bazzucchi, "Review of Approaches to Estimate a Reasonable Rate of Return for Investments in Telecoms Networks in Regulatory Proceedings and Options for EU Harmonization", The Brattle Group, prepared for Directorate-General for Communications Network (DG CONNECT), Contract number: 30 – CE -0735332/00-55, 14 July 2017 (the "2016 Brattle Report").

[14] We further exclude three companies – TDC, Com Hem, and Kcom – because they were acquired and subsequently delisted. In particular: TDC was acquired by the investment fund Macquarie and three Danish pension funds in February 2018; ComHem was acquired by Tele2 in October 2018; Kcom was acquired by a subsidiary of Macquarie in June 2019.

d. Offers mobile services in at least one of the countries in which it operates (Table IV-1, column [G]).[15]

e. Operates in multiple countries (Table IV-1, column [H]).

61. Based on this information, we further classify each of the candidate peers as either an incumbent or an alternative operator (Table IV-1, column [I]).[16]

62. As shown in Table IV-1, we start with an initial sample of 27 candidate peers including BT, Vodafone and TalkTalk. Of these, we classify 14 as incumbents and 13 as alternative operators. We included all 2019 BCMR comparators, plus an additional 13 comparators.

TABLE IV-1: EUROPEAN TELECOMS, INITIAL SAMPLE[17]

	Company	NERA Sample	Country	Incumbent	Alternative Operator	Cable	Mobile	Multiple countries	Brattle classification
	[A]	[B]	[C]	[D]	[E]	[F]	[G]	[H]	[I]
[1]	Bouygues SA	×	France		✓		✓		Alternative Telecom Operator
[2]	BT Group PLC	✓	United Kingdom	✓			✓		Incumbent
[3]	Deutsche Telekom AG	✓	Germany	✓			✓	✓	Incumbent
[4]	Elisa Oyj	×	Finland	✓	✓		✓	✓	Incumbent
[5]	Hellenic Telecommunications Organization SA	×	Greece	✓			✓		Incumbent
[6]	Iliad SA	✓	France		✓		✓	✓	Alternative Telecom Operator
[7]	Koninklijke KPN NV	✓	Netherlands	✓			✓		Incumbent
[8]	Liberty Global PLC	×	United Kingdom			✓	✓	✓	Alternative Telecom Operator
[9]	Masmovil Ibercom SA	×	Spain		✓		✓	✓	Alternative Telecom Operator
[10]	NOS SGPS SA	×	Portugal			✓	✓		Alternative Telecom Operator
[11]	Orange Belgium SA	✓	Belgium		✓		✓		Alternative Telecom Operator
[12]	Orange Polska SA	×	Poland	✓			✓		Incumbent
[13]	Orange SA	✓	France	✓	✓		✓	✓	Incumbent
[14]	Proximus SADP	✓	Belgium	✓			✓		Incumbent
[15]	Sunrise Communications Group AG	×	Switzerland		✓		✓		Alternative Telecom Operator
[16]	Swisscom AG	✓	Switzerland	✓	✓		✓	✓	Incumbent
[17]	TalkTalk Telecom Group PLC	✓	United Kingdom				✓		Alternative Telecom Operator
[18]	Tele2 AB	✓	Sweden		✓	✓	✓	✓	Alternative Telecom Operator
[19]	Telecom Italia SpA/Milano	✓	Italy	✓			✓		Incumbent
[20]	Telefonica Deutschland Holding AG	×	Germany		✓		✓		Alternative Telecom Operator
[21]	Telefonica SA	✓	Spain	✓	✓		✓	✓	Incumbent
[22]	Telekom Austria AG	×	Austria	✓			✓		Incumbent
[23]	Telenet Group Holding NV	×	Belgium			✓	✓		Alternative Telecom Operator
[24]	Telenor ASA	✓	Norway	✓	✓		✓	✓	Incumbent
[25]	Telia Co AB	×	Sweden	✓	✓		✓	✓	Incumbent
[26]	United Internet AG	×	Germany		✓		✓		Alternative Telecom Operator
[27]	Vodafone Group PLC	✓	United Kingdom		✓	✓	✓	✓	Alternative Telecom Operator

63. We have verified that all of the candidate peers are sufficiently liquid. We have further checked whether the candidate peers were involved in any M&A transactions with announced value greater than 30% of the peer's pre-merger market cap. We exclude a peer if we find a transaction which had a clear effect on the firm's stock price, potentially distorting the beta estimate. This 'M&A' criterion led us to exclude Masmovil Ibercom and Sunrise Communications Group from the comparator set.

[15] Telecoms operators in the list may offer mobile services as either mobile network operators (MNOs) or mobile virtual network operators (MVNOs).

[16] We also considered an alternative classification separating between alternative telecoms operators and cable operators. However, we believe the systematic risk of alternative telecoms telecom and cable operators is very similar. Both groups offer similar services in terms of price, quality and intended use. Furthermore, they have a similar cost structure (customer acquisition costs, customer support and billing, and network maintenance) and similar capex requirements.

[17] Country (column [C]) refers the country in which the company is headquartered.

64. We note that the UK company TalkTalk was also involved in significant M&A activity, with an announced takeover by Toscafund Asset Management in October 2020, which was then confirmed in December 2020 with a delisting now confirmed for 15 March 2021. We do not exclude TalkTalk from the UK Telecoms group because the group consists of only two companies. However, we do exclude TalkTalk when calculating average betas for alternative operators (TalkTalk is also below investment grade).

65. We further exclude two companies with a credit rating below investment grade, Liberty Global (BB-) and Telenet (BB-). We do not exclude Telecom Italia, in spite of a credit rating of BB+, because its credit rating is borderline, and because Telecom Italia was selected as a comparator by BEREC and other regulators in recent WACC recommendations.[18]

66. We exclude Bouygues from the comparator set because it obtains only 15.9% of revenue from telecoms. All of the remaining comparators obtain a majority of their revenue from telecom activities.

67. Table IV-2 below summarizes the results of our screening tests. We provide additional details on the screening tests in Appendix A.

68. For the avoidance of doubt, in this report we will refer to the European Telecoms group excluding BT, Vodafone and TalkTalk. In contrast, we will refer to incumbents including BT and to alternative operators including Vodafone.

TABLE IV-2: EUROPEAN TELECOMS, SUMMARY OF THE SCREENING TESTS

	Company	Country	Revenue in Europe	Revenue From Telecommunications	Liquidity	M&A Activity	Investment Grade	Final Sample
	[A]	[B]	[C]	[E]	[F]	[G]	[H]	[I]
[1]	BT Group PLC	United Kingdom	✓	✓	✓	✓	✓	✓
[2]	Deutsche Telekom AG	Germany	✓	✓	✓	✓	✓	✓
[3]	Elisa Oyj	Finland	✓	✓	✓	✓	✓	✓
[4]	Hellenic Telecommunications Organization SA	Greece	✓	✓	✓	✓	✓	✓
[5]	Koninklijke KPN NV	Netherlands	✓	✓	✓	✓	✓	✓
[6]	Orange Polska SA	Poland	✓	✓	✓	✓	✓	✓
[7]	Orange SA	France	✓	✓	✓	✓	✓	✓
[8]	Proximus SADP	Belgium	✓	✓	✓	✓	✓	✓
[9]	Swisscom AG	Switzerland	✓	✓	✓	✓	✓	✓
[10]	Telecom Italia SpA/Milano	Italy	✓	✓	✓	✓	✓	✓
[11]	Telefonica SA	Spain	✓	✓	✓	✓	✓	✓
[12]	Telekom Austria AG	Austria	✓	✓	✓	✓	✓	✓
[13]	Telenor ASA	Norway	✓	✓	✓	✓	✓	✓
[14]	Telia Co AB	Sweden	✓	✓	✓	✓	✓	✓
[15]	Bouygues SA	France	✓	×	✓	✓	✓	×
[16]	Iliad SA	France	✓	✓	✓	✓	✓	✓
[17]	Masmovil Ibercom SA	Spain	✓	✓	✓	×	×	×
[18]	Orange Belgium SA	Belgium	✓	✓	✓	✓	✓	✓
[19]	Sunrise Communications Group AG	Switzerland	✓	✓	✓	×	×	×
[20]	TalkTalk Telecom Group PLC	United Kingdom	✓	✓	✓	✓	✓	✓
[21]	Telefonica Deutschland Holding AG	Germany	✓	✓	✓	✓	✓	✓
[22]	United Internet AG	Germany	✓	✓	✓	✓	✓	✓
[23]	Liberty Global PLC	United Kingdom	✓	✓	✓	✓	×	×
[24]	NOS SGPS SA	Portugal	✓	✓	✓	✓	✓	✓
[25]	Tele2 AB	Sweden	✓	✓	✓	✓	✓	✓
[26]	Telenet Group Holding NV	Belgium	✓	✓	✓	✓	×	×
[27]	Vodafone Group PLC	United Kingdom	✓	✓	✓	✓	✓	✓

[18] BEREC, *BEREC Report on WACC parameter calculations according to the European Commission's WACC Notice of 7th November 2019 (WACC parameters Report 2020),* June 2020.

C. ICT Comparators

69. BT's ICT business involves three main segments: Managed Networked IT Services, Unified Communications/IT Infrastructure, and Professional Services/IT Consulting. In order to select a group of ICT Comparators with a similar risk profile to that of BT's ICT business, we apply the same sample selection procedure used for the 2019 BCMR.[19]

70. More specifically, in line with the 2019 BCMR procedure, we selected an initial sample of ICT Comparators in three steps:

    a. *First,* we identify companies based in Europe, the US and Canada with over $1 billion in annual turnover and with at least 50% of turnover from ICT services.

    b. S*econd,* we exclude companies (i) heavily relying on a single client or (ii) focusing mainly on consulting services.

    c. *Third,* we identify the segment in which the companies operate and include only companies that operate in at least two of the three segments in which BT's ICT business operates.

71. Based on this procedure, we end up with a sample of 16 candidate peers (Table IV-3). Twelve of these companies overlap with the sample used in 2019. To these companies we add DXC Technology, Virtusa Corp., Softcat PLC, S&T AG.

TABLE IV-3: ICT COMPARATORS, INITIAL SAMPLE

	Company [A]	NERA Sample [B]	Country [C]	Revenue Last FY [D] USD Bn	% Revenue from ITS [E] %	No single client [F]	No focus on consulting [G]	Managed Networked ITS [H]	Comms/IT Infrastructure [I]	Professional Services/IT consulting [J]
[1]	Intl Business Machines Corp	✓	United States	77.15	57.7%	✓	✓	✓	✓	✓
[2]	DXC Technology Co	×	United States	19.58	100.0%	✓	✓	✓	×	✓
[3]	CDW Corp/DE	✓	United States	18.03	100.0%	✓	✓	×	✓	✓
[4]	Cognizant Tech Solutions-A	✓	United States	16.78	100.0%	✓	✓	×	✓	✓
[5]	Capgemini SE	✓	France	15.81	100.0%	✓	✓	×	✓	✓
[6]	Cgi INC	✓	Canada	9.13	100.0%	✓	✓	×	✓	✓
[7]	Sopra Steria Group	✓	France	4.96	94.2%	✓	✓	×	✓	✓
[8]	Amdocs Ltd	✓	United States	4.09	100.0%	✓	✓	✓	✓	✓
[9]	Indra Sistemas SA	✓	Spain	3.59	100.0%	✓	✓	✓	✓	✓
[10]	Unisys Corp	✓	United States	2.95	100.0%	✓	✓	✓	✓	✓
[11]	TietoEvry Oyj	✓	Finland	1.94	61.1%	✓	✓	×	✓	✓
[12]	Cancom SE	✓	Germany	1.73	80.6%	✓	✓	✓	✓	✓
[13]	Ttec Holdings Inc	✓	United States	1.64	100.0%	✓	✓	✓	✓	✓
[14]	Virtusa Corp	×	United States	1.31	100.0%	✓	✓	×	✓	✓
[15]	Softcat PLC	×	United Kingdom	1.28	100.0%	✓	✓	✓	✓	✓
[16]	S&T AG	×	Austria	1.26	54.9%	✓	✓	✓	✓	✓

72. We have screened the initial sample for liquidity, M&A activity and credit rating. Our screening criteria led to the exclusion of Unisys and Virtusa for significant M&A activity.

73. Table IV-4 summarizes the results of our screening tests. We provide additional details on the screening tests in Appendix A.

[19] See NERA, *Cost of Capital: Beta and Gearing for the 2019 BCMR – Update*, April 2019 (NERA 2019 Report).

TABLE IV-4: ICT COMPARATORS, SUMMARY OF THE SCREENING TESTS

	Company [A]	Country [B]	Liquidity [C]	M&A Activity [D]	Investment Grade [E]	Final Sample [I]
[1]	Intl Business Machines Corp	United States	✓	✓	✓	✓
[2]	DXC Technology Co	United States	×	✓	✓	×
[3]	CDW Corp/DE	United States	✓	✓	✓	✓
[4]	Cognizant Tech Solutions-A	United States	✓	✓	✓	✓
[5]	Capgemini SE	France	✓	✓	✓	✓
[6]	Cgi INC	Canada	✓	✓	✓	✓
[7]	Sopra Steria Group	France	✓	✓	✓	✓
[8]	Amdocs Ltd	United States	✓	✓	✓	✓
[9]	Indra Sistemas SA	Spain	✓	✓	✓	✓
[10]	Unisys Corp	United States	✓	×	×	×
[11]	TietoEvry Oyj	Finland	✓	✓	✓	✓
[12]	Cancom SE	Germany	✓	✓	✓	✓
[13]	Ttec Holdings Inc	United States	✓	✓	✓	✓
[14]	Virtusa Corp	United States	✓	×	×	×
[15]	Softcat PLC	United Kingdom	✓	✓	✓	✓
[16]	S&T AG	Austria	✓	✓	✓	✓

V. Equity Beta, Gearing and Asset Betas for BT and the Comparator Groups

74. In this section, we present equity betas, gearing, and asset betas for each of the comparator groups, and analyse the evolution of equity and asset betas over time. We report gearing and asset betas both as unadjusted and adjusted to exclude operating lease liabilities in 2019.[20]

A. BT

1. Equity Betas, Gearing and Asset Betas

75. In Table V-1, below, we show the 1-year, 2-year, and 5-year equity beta, asset beta and gearing for BT estimated against both the FTSE All Share and the FTSE All World indices as of 31 October 2020. Table V-1 further reports the value of adjusted gearing and asset beta – that is, excluding capitalised operating leases – to account for the impact of IFRS 16.

76. Table V-1 shows that:

a. BT's 5-year equity beta is equal to 0.94 when measured against the local index, and 0.97 when measured against the global index. BT's 1-year and 2-year equity betas are broadly aligned to the 5-year equity betas.

[20] In Appendix B, we detail a simplified approach to calculating lease liabilities and gearing had IFRS 16 been introduced in prior years and provide estimates of gearing and asset betas *including* operating lease liabilities.

b. BT's 5-year asset beta is equal to 0.60 when measured against the local index, and 0.62 when measured against the global index. BT's 1-year and 2-year asset betas are lower than the 5-year asset betas, largely reflecting a significant increase in gearing, only in part attributable to IFRS 16.

c. Adjusted asset betas are 0.01 to 0.06 higher than the unadjusted asset betas.

TABLE V-1: BT EQUITY BETA, ASSET BETA AND GEARING

	Equity Beta	Standard Error	Rating	Debt Beta	Gearing	Gearing Adjusted	Asset Beta	Asset Beta Adjusted
				Oct-20				
Local Index								
BT Group PLC								
1-Y	0.96	0.11	BBB	0.10	0.65	0.58	0.40	0.46
2-Y	0.94	0.10	BBB	0.10	0.55	0.51	0.48	0.51
5-Y	0.94	0.07	BBB	0.10	0.40	0.39	0.60	0.62
Global Index								
BT Group PLC								
1-Y	0.92	0.17	BBB	0.10	0.65	0.58	0.39	0.45
2-Y	0.90	0.15	BBB	0.10	0.55	0.51	0.46	0.49
5-Y	0.97	0.13	BBB	0.10	0.40	0.39	0.62	0.63

Source: Brattle elaboration of Bloomberg data.
Note: Adjusted gearing and asset beta are calculated by excluding operating lease liabilities from the calculation of debt.

77. We further analyse the evolution of BT's equity beta, gearing and asset beta over time in the following figures. More specifically:

a. Figure V-1 and Figure V-2 show the evolution of BT's equity beta measured against the local and global indices over the period January 2017-November 2020, respectively.

b. Figure V-3 shows the evolution of BT's gearing over the same time period.

c. Figure V-4 and Figure V-5 show the evolution of BT's asset beta measured against the local and global indices, respectively.

d. Figure V-6 shows the evolution of BT's 5-year equity beta and confidence interval measured against the local index over the longer period January 2012-November 2020.

78. These figures show that:

a. The 1-year, 2-year equity betas decoupled from the 5-year equity beta with a sharp decrease when the Brexit referendum fell out of the estimation window. The 1-year, 2-year and 5-year equity betas re-aligned over the past year. The Covid pandemic seems to have had only a minor impact on beta. The pattern is similar, though more pronounced, when measuring beta against the world index;

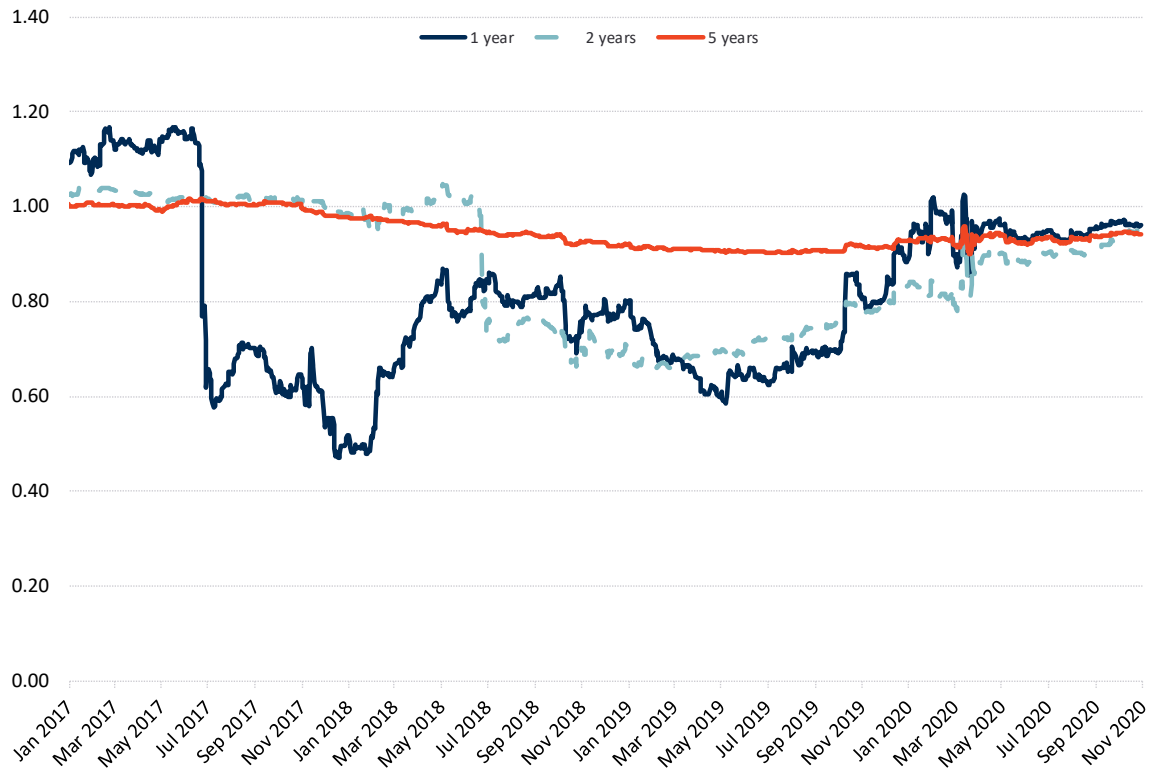
b. BT's gearing has been steadily increasing over the reference period, primarily due to a decline in BT's stock price, compounded in fiscal year 2019 by the application of IFRS 16;

c. 1-year and 2-year asset betas show a step-change with the Brexit referendum falling out of the estimation window and then continue to decline. The decline over the past year is compounded by the introduction of IFRS 16. The 5-year asset beta, broadly unaffected by the Brexit referendum, reflects a downward trend towards the level of the 1-year and 2-year asset betas.

d. Asset betas show a similar pattern when measured against the world index, though the pattern is more pronounced.

e. Over the period January 2012-November 2020, BT's 5-year equity beta measured against the local index has been relatively stable. Over this time period, the 95% confidence interval ranged between a minimum of 0.81 to a maximum of 1.11.[21]

FIGURE V-1: BT, EQUITY BETA VS. FTSE ALL SHARE



[21] Note that the rolling beta analysis is based on a simple OLS regression and simple standard errors. Accordingly, the 95% confidence interval is constructed based on the OLS standard error.

FIGURE V-2: BT, EQUITY BETA VS. FTSE ALL WORLD

FIGURE V-3: BT, GEARING

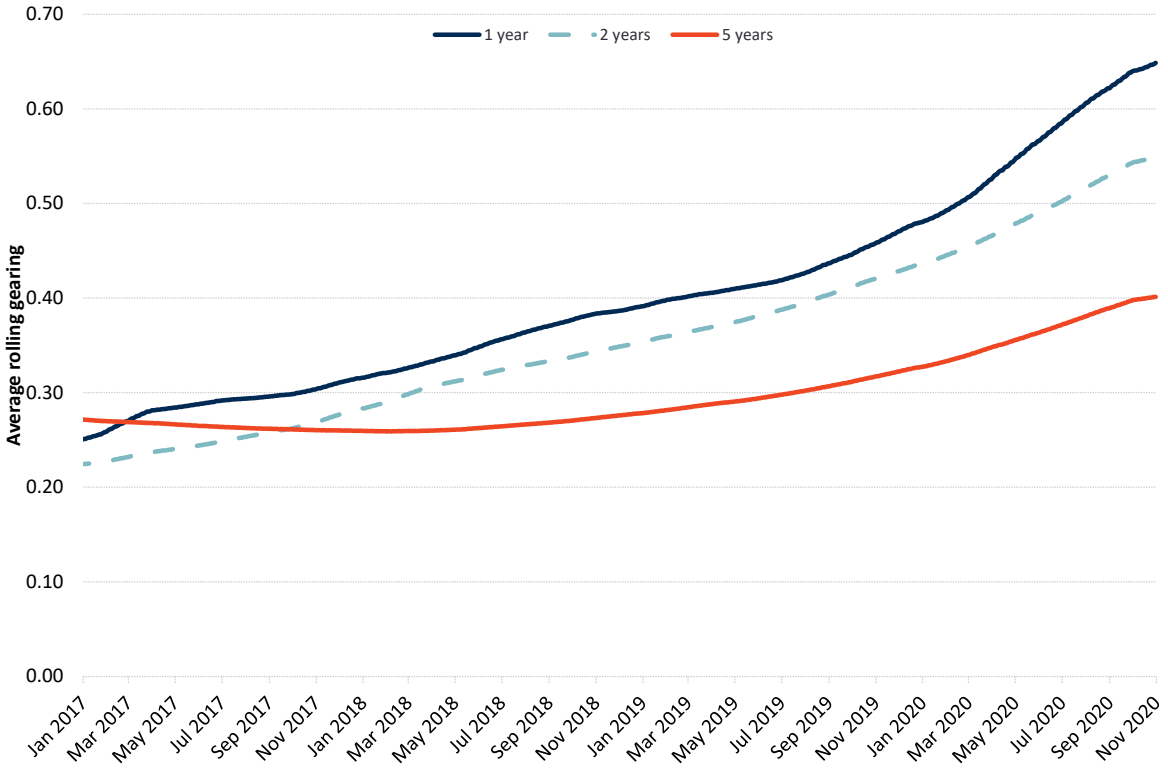


FIGURE V-4: BT, ASSET BETA VS. FTSE ALL SHARE

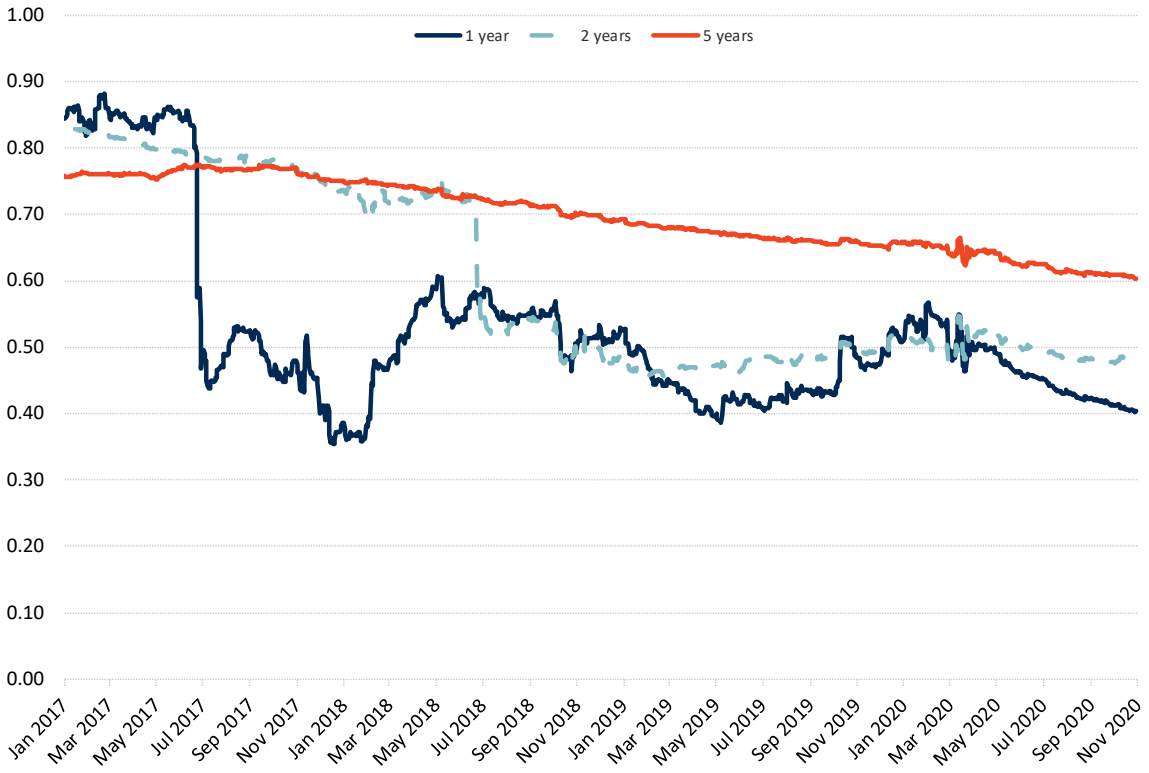
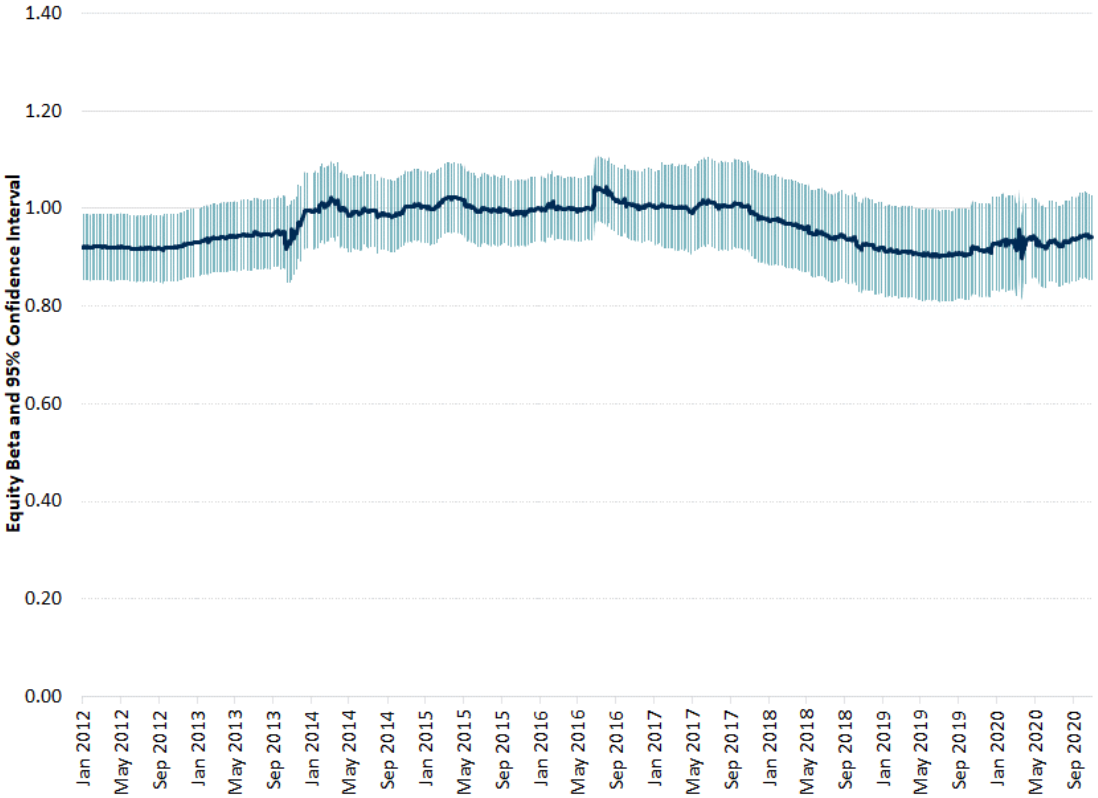


FIGURE V-5: BT, ASSET BETA VS. FTSE ALL WORLD

FIGURE V-6: BT, 5-YEAR EQUITY BETA AND CONFIDENCE INTERVAL VS. FTSE ALL SHARE



79. The evolution of BT's betas around the Brexit referendum seems to reflect a combination of both BT-specific events and UK market developments. In Figure V-7, below, we show the evolution of the 1-year, 2-year and 5-year betas of the FTSE All share measured against the FTSE All World. Figure V-7 clearly shows that the correlation between the two indices was high approaching the referendum, with the 1-year, 2-year and 5-year betas close to 1.0. However, after the Brexit referendum, we observe a decoupling of the UK market index from the world index, as indicated by the fall in the 1-year and 2-year betas (with the 2-year beta falling one year later than the 1-year beta). 'Recoupling' of the UK market index with the world index started at the end of 2019. The Covid pandemic appears to have completed the 'recoupling' in 2020.

FIGURE V-7: UK MARKET DEVELOPMENT, BETA OF THE FTSE ALL SHARE VS FTSE ALL WORLD

2. Equity Beta Decomposition

80. Ofcom has also asked us to analyse the evolution of BT's equity beta by means of a beta decomposition exercise.

81. BT's equity beta can be decomposed as the product between the stock-market correlation ($\rho_{BT,MKT}$) and the ratio of the volatility of returns on BT's stock (σ_{BT}) and returns on the market index (σ_{MKT}):

$$\beta_{BT} = \rho_{BT,MKT} \times \frac{\sigma_{BT}}{\sigma_{MKT}}$$

82. In Figure V-8, below, we show the evolution of BT's 1-year equity beta and its constituent parts over the period January 2012-October 2020. In Figure V-9 we plot daily returns on BT's stock.

83. Over the 2012-2020 period, the evolution of BT's equity beta appears to have been mainly driven by changes in stock-market correlation, with changes in stock and market volatilities largely offsetting each other. There are several events which appear to have had some impact on the estimated 1-year equity beta in recent years:

    a. The June 2016 increase coincides with the Brexit referendum, while the June 2017 decrease coincides with the Brexit referendum dropping out of the beta estimation window;

    b. The January 2017 increase was likely driven by the acquisition of EE and by the news surrounding the Italian accounting scandal, which led to an additional increase when the impact on results was

announced in July 2017. The February 2018 increase coincides with January 2017 dropping out of the beta estimation window;

c. The May 2019 increase, coincides with May 2018 dropping out of the beta estimation window. In May 2018, BT released its 2017/18 full-year results, including significant job cuts and the outcome of the latest triennial pension valuation;[22] and

d. The 2020 movements have been driven mainly by the impact of COVID-19.

84. Over the last few years, BT has also made several announcements regarding its fibre investment plans.[23] These do not appear to have had a material impact on the beta.

[22] BT's 2017/2018 financial results, available at: https://www.bt.com/about/investors/financial-reporting-and-news/results-events-and-financial-calendar/2017-18#tab-17-18-accordion-1.

[23] Specifically, there were four fibre announcements over the relevant period: 1) on 5 May 2016, BT announced a plan to expand its FTTP coverage to 2m homes. ("BT Pledge 2 Million UK Premises to Get 1Gbps Ultrafast FTTP Broadband", 5 May 2016, available at: https://www.ispreview.co.uk/index.php/2016/05/bt-pledge-2-million-uk-premises-get-1gbps-ultrafast-fttp-broadband.html); 2) on 1 February 2018, BT announced it would reach 3 million premises passed with FTTP in 8 major UK cities by 2020 through their new 'Fibre First' build programme, aspiring to 10 million by 2025 with investments ranging from £ 3 billion to £ 6 billion ("Openreach Aim FTTP Broadband for 3 Million Premises in 8 UK Cities", 1 February 2018, available at: https://www.ispreview.co.uk/index.php/2018/02/openreach-aim-fttp-broadband-3-million-premises-8-uk-cities.html); 3) on 9 May 2019, BT announced investments to cover over 15 million of FTTP broadband premises by 2025. ("Openreach Aim for 15 Million UK FTTP Broadband Premises by 2025", 9 May 2019, available at: https://www.ispreview.co.uk/index.php/2019/05/openreach-aim-for-15-million-uk-fttp-broadband-premises-by-2025.html); 4) on 7 May 2020, BT announced a plan to invest £ 12 billion on FTTP Broadband (see "BT Invest £12bn on FTTP Broadband for 20 Million UK Premises", 7 May 2020, available at: https://www.ispreview.co.uk/index.php/2020/05/bt-invest-12bn-on-fttp-broadband-for-20-million-uk-premises.html).

FIGURE V-8: BT BETA DECOMPOSITION (1-YEAR EQUITY BETA VS. FTSE ALL SHARE 2012-2020)

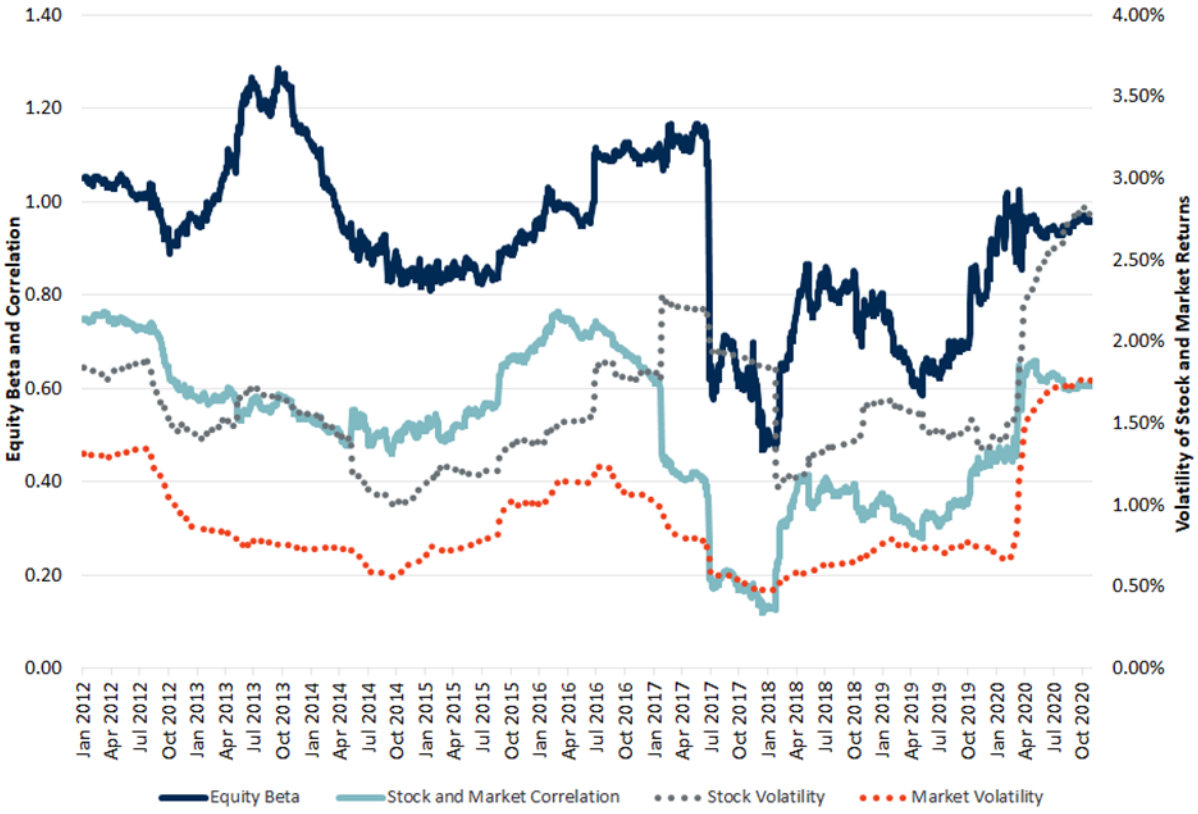
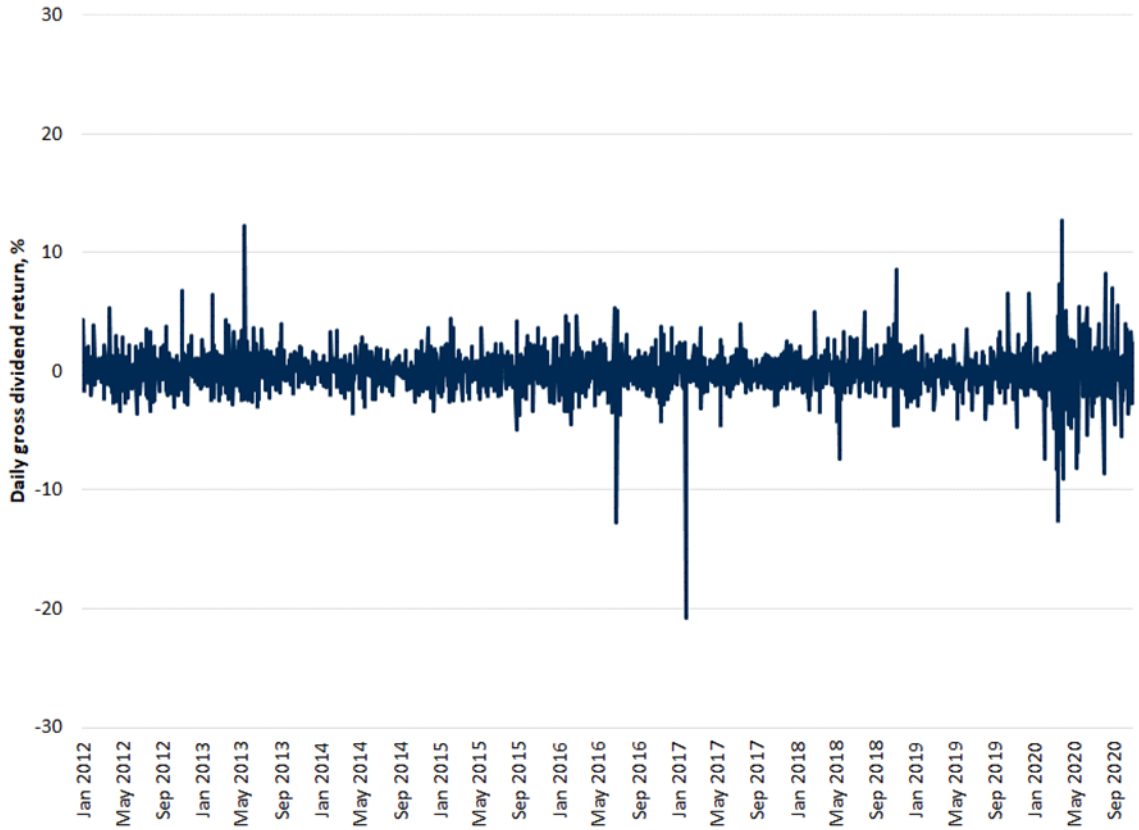


FIGURE V-9: BT STOCK RETURNS



B. UK Telecoms

85. In Table V-2, below, we show the 1-year, 2-year, and 5-year equity beta, asset beta and gearing for Vodafone and TalkTalk estimated against both the FTSE All Share and the FTSE All Word indices as of 31 October 2020. Table V-2 further reports the value of adjusted gearing and asset beta – that is, excluding operating leases – to account for the impact of IFRS 16.

86. Table V-2 shows that:

    a. Vodafone's 5-year equity beta is equal to 0.96 when measured against the local index and 0.97 when measured against the global index. Vodafone's 1-year and 2-year equity betas are broadly aligned to the 5-year equity beta.

    b. TalkTalk's 5-year equity beta is equal to 0.80 when measured against the local index and 1.32 when measured against the global index. There is also greater uncertainty around TalkTalk's equity betas measured against the global index, as evidenced by notably higher standard errors. TalkTalk's 1-year and 2-year equity betas are broadly aligned to the 5-year equity beta.

    c. Vodafone and TalkTalk exhibit both a substantial increase in gearing, resulting in lower asset betas for shorter windows. The introduction of IFRS 16 accounts for part of the increase in gearing.

    d. Vodafone's 5-year asset beta is equal to 0.54 when measured against both the local and the global indexes. Vodafone's adjusted asset betas are 0.01 to 0.04 higher than the unadjusted betas.

    e. TalkTalk's 5-year asset beta is equal to 0.54 when measured against the local index and 0.87 when measured against the global index. TalkTalk's adjusted asset betas are 0.01 to 0.06 higher than the unadjusted betas.

TABLE V-2: UK TELECOMS EQUITY BETA, ASSET BETA AND GEARING

	Equity Beta	Standard Error	Rating	Debt Beta	Gearing	Gearing Adjusted	Asset Beta	Asset Beta Adjusted
				Oct-20				
Local Index								
Vodafone Group PLC								
1-Y	0.96	0.10	BBB	0.10	0.65	0.61	0.40	0.44
2-Y	0.95	0.09	BBB	0.10	0.59	0.56	0.44	0.47
5-Y	0.96	0.06	BBB	0.10	0.49	0.48	0.54	0.55
TalkTalk Telecom Group PLC								
1-Y	0.78	0.08	BB-	0.10	0.49	0.44	0.45	0.48
2-Y	0.77	0.07	BB-	0.10	0.45	0.41	0.47	0.49
5-Y	0.80	0.06	BB-	0.10	0.37	0.36	0.54	0.55
Global Index								
Vodafone Group PLC								
1-Y	0.98	0.11	BBB	0.10	0.65	0.61	0.41	0.44
2-Y	0.93	0.10	BBB	0.10	0.59	0.56	0.44	0.47
5-Y	0.97	0.08	BBB	0.10	0.49	0.48	0.54	0.56
TalkTalk Telecom Group PLC								
1-Y	1.28	0.20	BB-	0.10	0.49	0.44	0.70	0.76
2-Y	1.22	0.17	BB-	0.10	0.45	0.41	0.72	0.76
5-Y	1.32	0.15	BB-	0.10	0.37	0.36	0.87	0.88

Source: Brattle elaboration of Bloomberg data.
Note: Adjusted gearing and asset beta are calculated by excluding operating lease liabilities from the calculation of debt.

87. We further illustrate the evolution of Vodafone's and TalkTalk's equity beta and asset beta over time in the following figures. More specifically:

    a. Figure V-10, Figure V-11, and Figure V-12 Figure V-13 and show the evolution of Vodafone's equity beta and asset betas measured against the local and global indices.

    b. Figure V-14, Figure V-15, Figure V-16 and Figure V-17 show the evolution of TalkTalk's equity beta and asset betas measured against the local and global indices.

FIGURE V-10: VODAFONE, EQUITY BETA VS. FTSE ALL SHARE

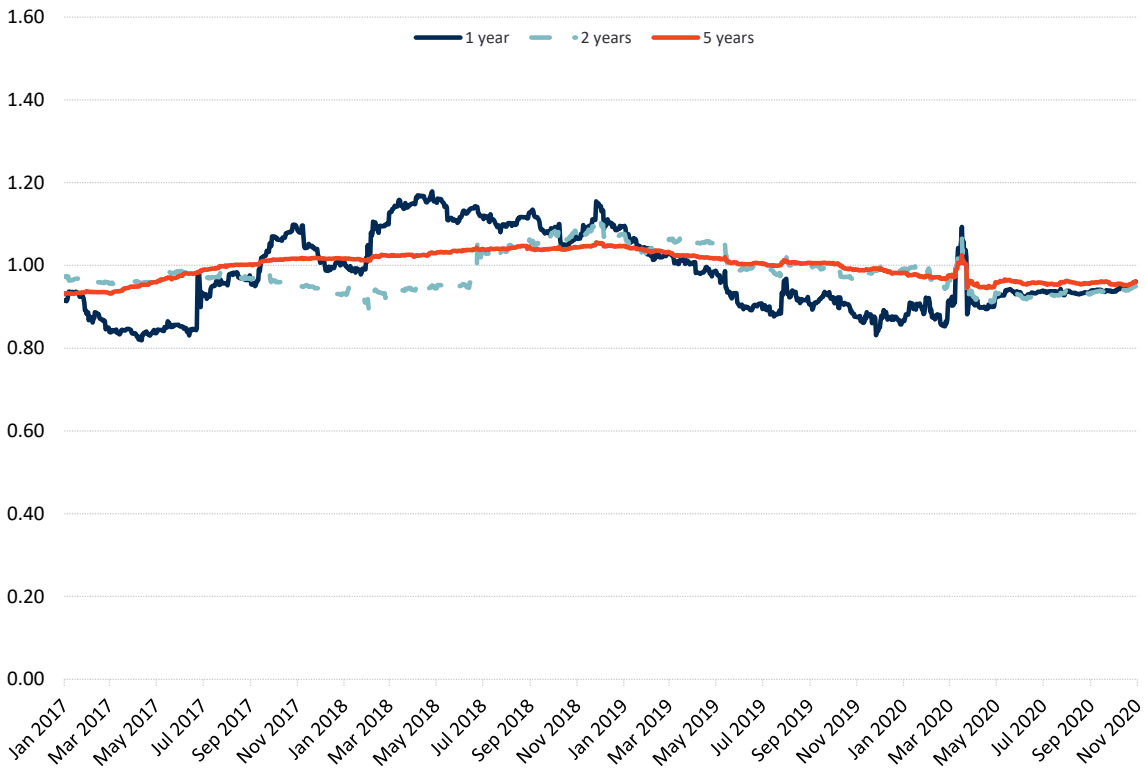


FIGURE V-11: VODAFONE, EQUITY BETA VS. FTSE ALL WORLD

FIGURE V-12: VODAFONE, ASSET BETA VS. FTSE ALL SHARE

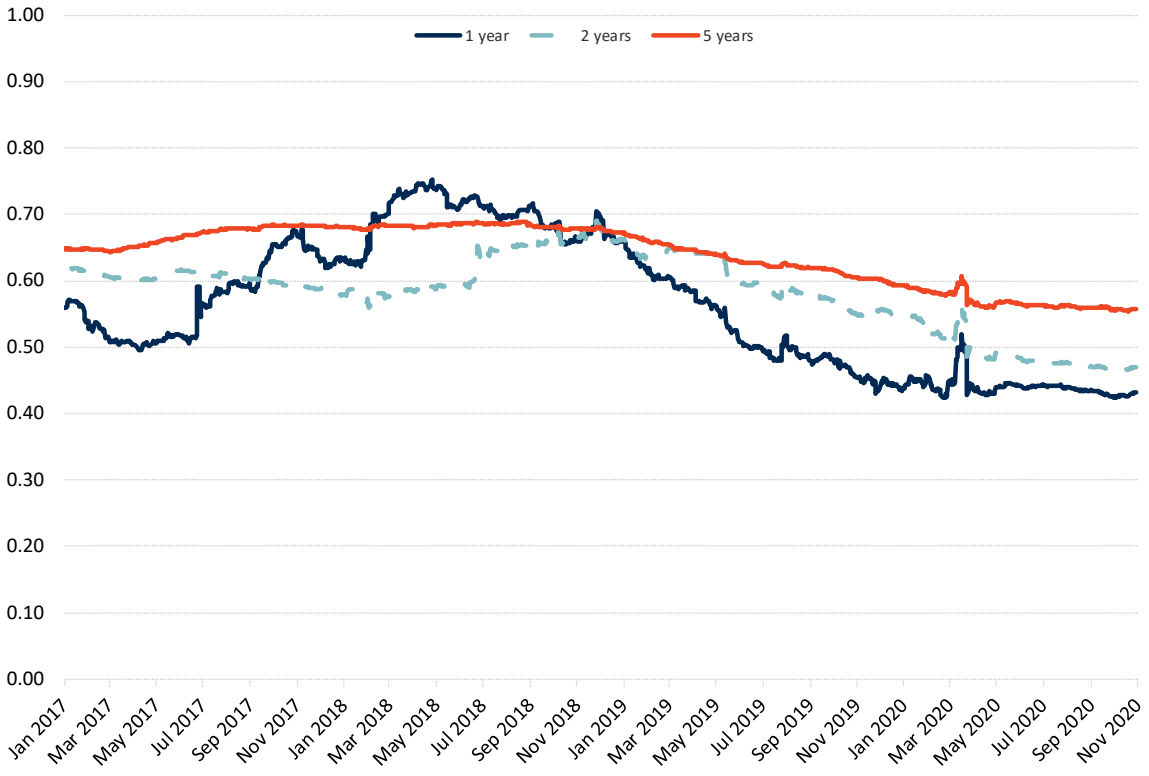


FIGURE V-13: VODAFONE, ASSET BETA VS. FTSE ALL WORLD

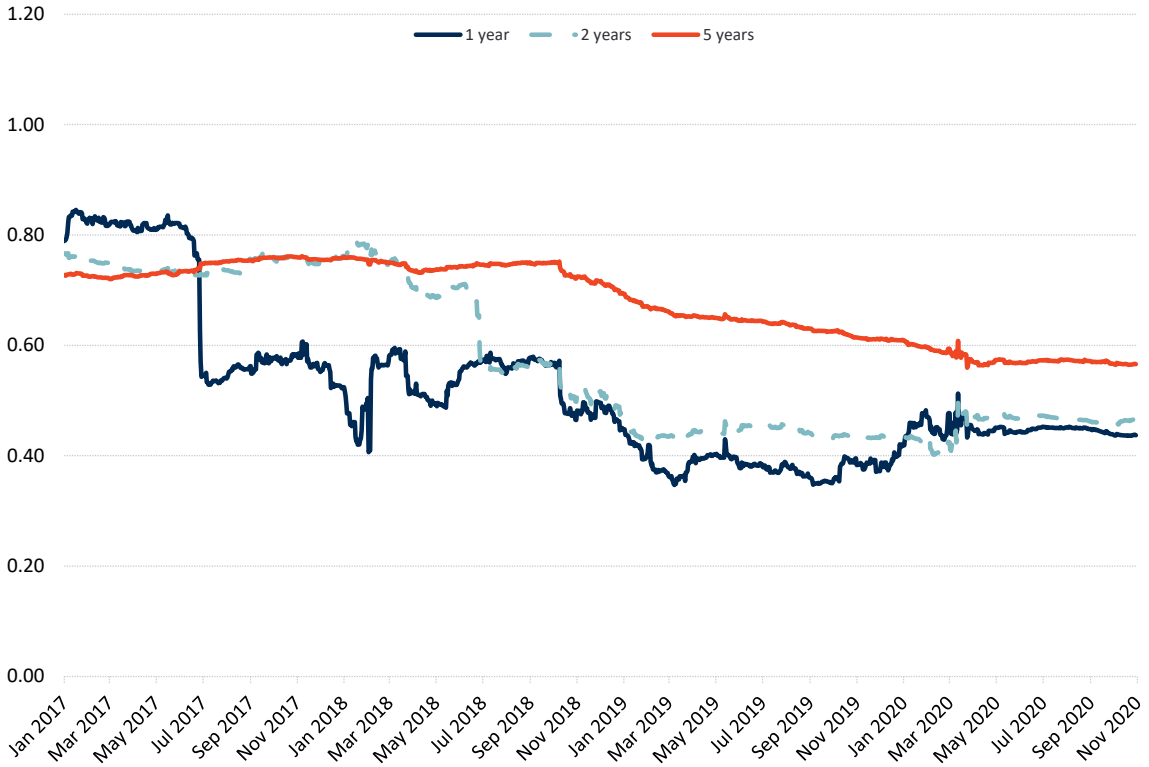


FIGURE V-14: TALKTALK, EQUITY BETA VS. FTSE ALL SHARE

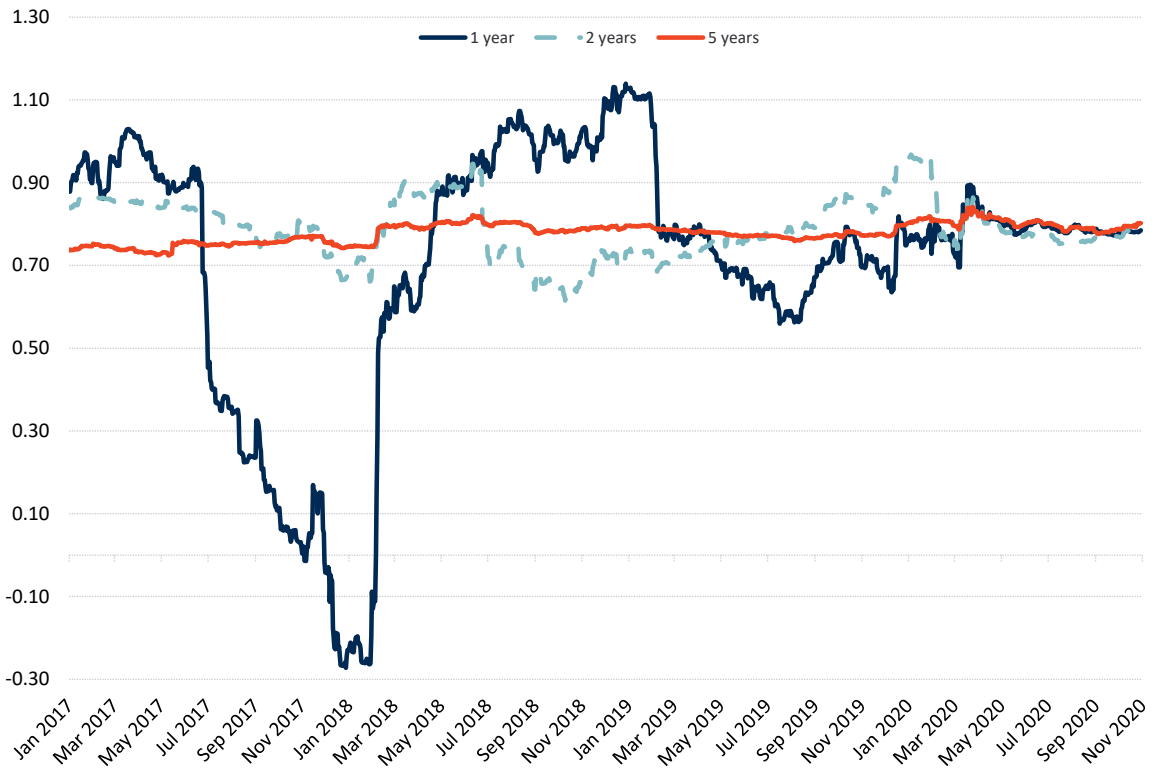


FIGURE V-15: TALKTALK, EQUITY BETA VS. FTSE ALL WORLD

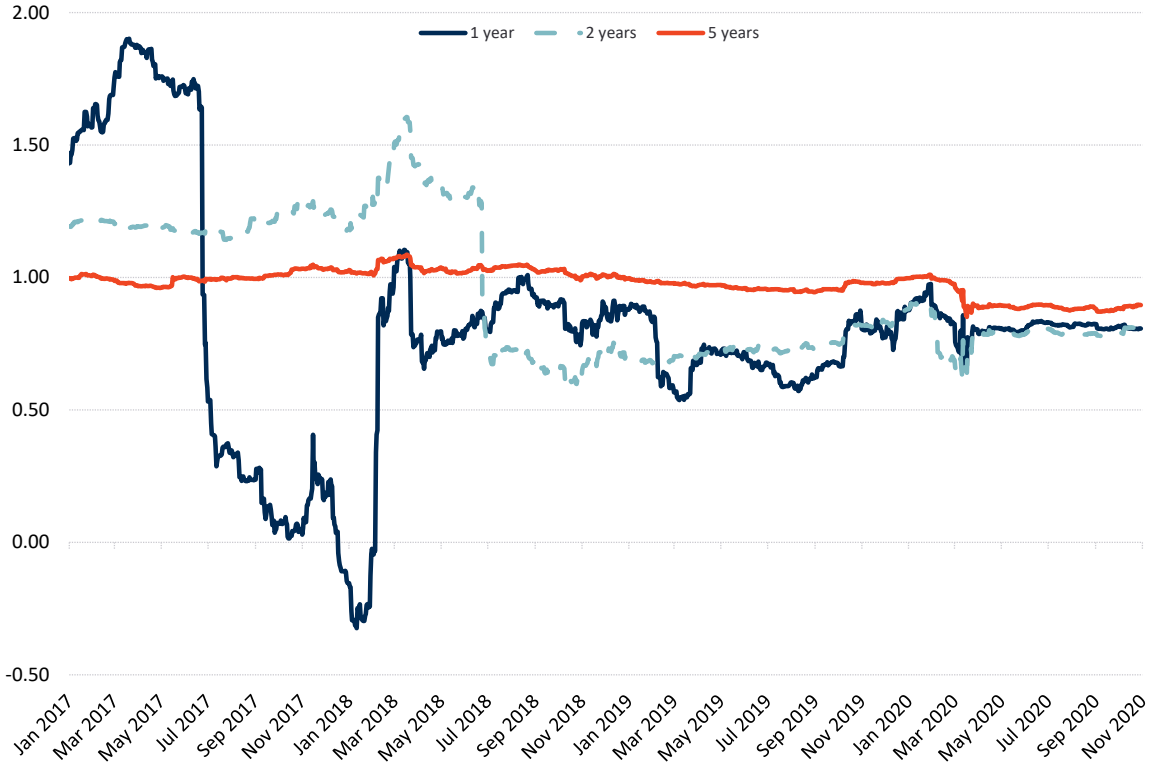


FIGURE V-16: TALKTALK, ASSET BETA VS. FTSE ALL SHARE

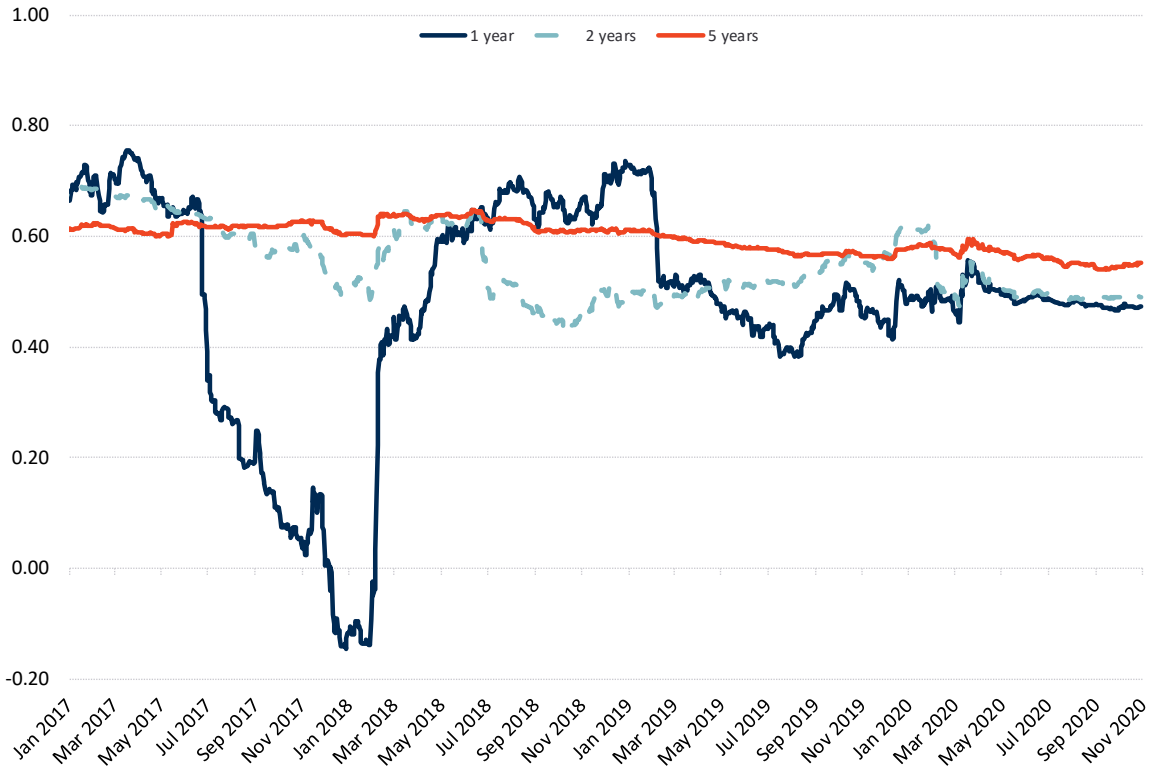
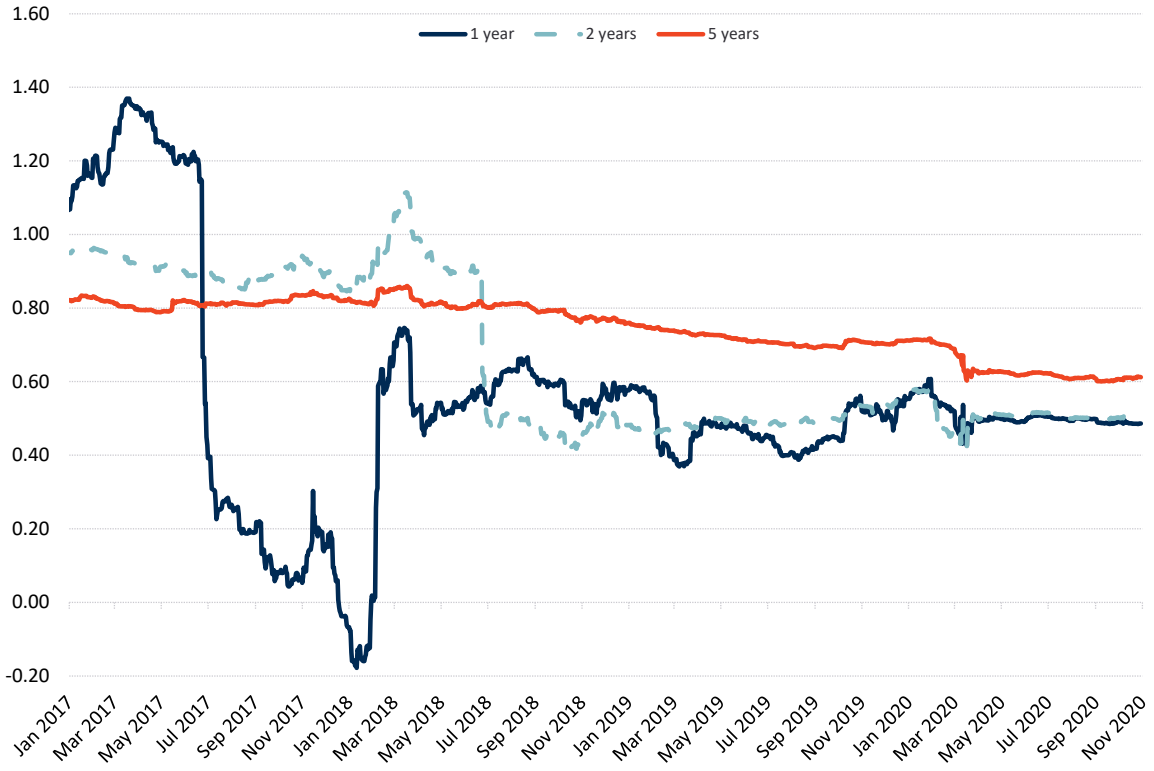


FIGURE V-17: TALKTALK, ASSET BETA VS. FTSE ALL WORLD



C. UK Utilities

88. In Table V-3, below, we show the 1-year, 2-year, and 5-year equity beta, asset beta and gearing for UK Utilities estimated against both the FTSE All Share and the FTSE All World indices measured as of 31 October 2020. Table V-3 further reports the value of adjusted gearing and asset beta – that is, excluding the capitalised value of operating leases – to account for the impact of IFRS 16.

89. Table V-3 shows that:

    a. UK Utilities' 5-year average equity beta is equal to 0.60 when measured against the local index, and 0.68 when measured against the global index. Average 1-year and 2-year equity betas are aligned to the 5-year equity beta.

    b. UK Utilities' average gearing has remained relatively stable, also indicating a limited impact of IFRS 16.

    c. UK Utilities' average 5-year asset beta is equal to 0.34 when measured against the local index, and to 0.37 when measured against the global index. Average 1-year and 2-year asset betas are broadly aligned to the 5-year asset beta.

    d. Adjusted asset betas are 0.00 to 0.02 higher than the unadjusted betas.

TABLE V-3: UK UTILITIES EQUITY BETA, ASSET BETAS AND GEARING

	Equity Beta	Standard Error	Rating	Debt Beta	Gearing	Gearing Adjusted	Asset Beta	Asset Beta Adjusted
				Oct-20				
Local Index								
National Grid PLC								
1-Y	0.70	0.08	A-	0.05	0.49	0.48	0.38	0.39
2-Y	0.67	0.07	A-	0.05	0.49	0.49	0.36	0.37
5-Y	0.64	0.05	A-	0.05	0.47	0.47	0.36	0.36
Pennon Group PLC								
1-Y	0.56	0.08	n/a	0.10	0.46	0.36	0.35	0.40
2-Y	0.55	0.07	n/a	0.10	0.50	0.44	0.33	0.35
5-Y	0.58	0.05	n/a	0.10	0.50	0.48	0.34	0.35
Severn Trent PLC								
1-Y	0.61	0.07	BBB	0.10	0.52	0.52	0.34	0.35
2-Y	0.59	0.06	BBB	0.10	0.54	0.54	0.33	0.33
5-Y	0.59	0.05	BBB	0.10	0.52	0.52	0.34	0.34
United Utilities Group PLC								
1-Y	0.62	0.08	n/a	0.10	0.58	0.57	0.32	0.32
2-Y	0.61	0.07	n/a	0.10	0.58	0.58	0.31	0.32
5-Y	0.61	0.05	n/a	0.10	0.57	0.57	0.32	0.32
Mean								
1-Y	0.62	0.08			0.51	0.48	0.35	0.36
2-Y	0.61	0.07			0.53	0.51	0.33	0.34
5-Y	0.60	0.05			0.51	0.51	0.34	0.34
Median								
1-Y	0.61	0.08			0.50	0.50	0.35	0.37
2-Y	0.60	0.07			0.52	0.51	0.33	0.34
5-Y	0.60	0.05			0.51	0.50	0.34	0.34
Global Index								
National Grid PLC								
1-Y	0.75	0.13	A-	0.05	0.49	0.48	0.41	0.41
2-Y	0.68	0.11	A-	0.05	0.49	0.49	0.37	0.37
5-Y	0.68	0.08	A-	0.05	0.47	0.47	0.38	0.38
Pennon Group PLC								
1-Y	0.62	0.10	n/a	0.10	0.46	0.36	0.38	0.44
2-Y	0.58	0.09	n/a	0.10	0.50	0.44	0.34	0.37
5-Y	0.65	0.07	n/a	0.10	0.50	0.48	0.38	0.39
Severn Trent PLC								
1-Y	0.66	0.10	BBB	0.10	0.52	0.52	0.37	0.37
2-Y	0.63	0.08	BBB	0.10	0.54	0.54	0.35	0.35
5-Y	0.67	0.07	BBB	0.10	0.52	0.52	0.38	0.38
United Utilities Group PLC								
1-Y	0.74	0.10	n/a	0.10	0.58	0.57	0.37	0.37
2-Y	0.70	0.09	n/a	0.10	0.58	0.58	0.35	0.35
5-Y	0.70	0.07	n/a	0.10	0.57	0.57	0.36	0.36
Mean								
1-Y	0.69	0.11			0.51	0.48	0.38	0.40
2-Y	0.65	0.09			0.53	0.51	0.35	0.36
5-Y	0.68	0.07			0.51	0.51	0.37	0.38
Median								
1-Y	0.70	0.10			0.50	0.50	0.38	0.39
2-Y	0.66	0.09			0.52	0.51	0.35	0.36
5-Y	0.68	0.07			0.51	0.50	0.38	0.38

Source: Brattle elaboration of Bloomberg data.
Note: Adjusted gearing and asset beta are calculated by excluding operating lease liabilities from the calculation of debt. The standard error of the mean and median denotes, respectively, the average and median standard errors of the peers' betas.

90. We further illustrate the evolution of UK Utilities' gearing and asset beta over time in the following figures. More specifically, Figure V-18 shows the evolution of UK Utilities' gearing. Figure V-19 and Figure V-20 show the evolution of UK Utilities' asset beta measured against the local and global indices, respectively.

FIGURE V-18: UK UTILITIES, GEARING

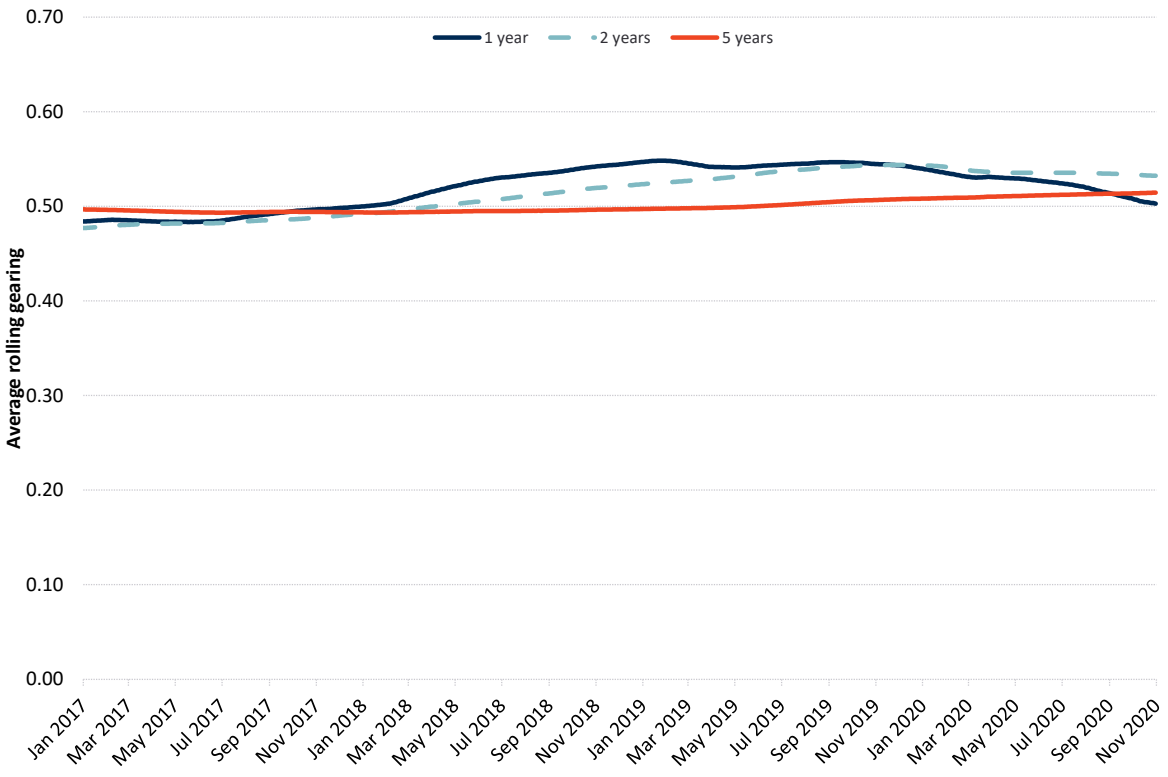


FIGURE V-19: UK UTILITIES, AVERAGE ASSET BETA VS. FTSE ALL SHARE

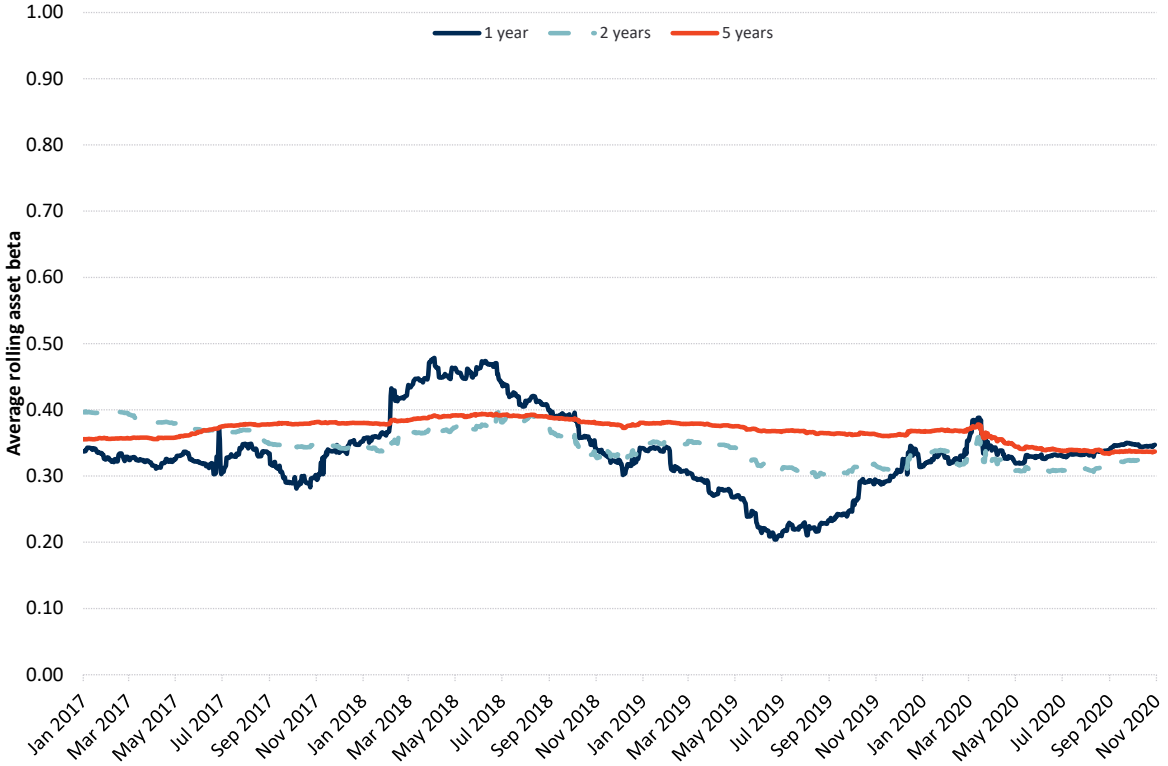


FIGURE V-20: UK UTILITIES, AVERAGE ASSET BETA VS. FTSE ALL WORLD

D. European Telecoms

91. In Table V-4, below, we report the average 1-year, 2-year, and 5-year equity beta, asset beta and gearing for the European Telecoms comparator group. We show equity and asset beta estimates against the FTSE All World Europe ex. UK and the FTSE All Word indices measured as of 31 October 2020. We further report the value of the average adjusted gearing and asset beta – that is, excluding operating leases – to account for the impact of IFRS 16.

92. Table V-4 shows that:

    a. European Telecoms' average 5-year equity beta is equal to 0.78 when measured against both the local and the global indexes. European Telecoms' average 1-year and 2-year equity betas are lower but in line with the 5-year equity beta.

    b. European Telecoms have experienced an increase in gearing, in part attributable to IFRS 16.

    c. European Telecoms' average 5-year asset beta is equal to 0.52 when measured against both the local and the global indexes. Average 1-year and 2-year equity betas are lower but in line with the 5-year asset betas. Average adjusted asset betas are 0.01 to 0.03 higher than the unadjusted betas.

TABLE V-4: EUROPEAN TELECOMS AVERAGE EQUITY BETA, ASSET BETA AND GEARING

	Equity Beta	Standard Error	Gearing	Gearing Adjusted	Asset Beta	Asset Beta Adjusted
			Oct-20			
Local Index						
European Telecoms (Full Sample)						
1-Y	0.74	0.10	0.42	0.36	0.46	0.49
2-Y	0.73	0.09	0.39	0.36	0.47	0.49
5-Y	0.78	0.05	0.35	0.34	0.52	0.53
Global Index						
European Telecoms (Full Sample)						
1-Y	0.71	0.14	0.42	0.36	0.44	0.47
2-Y	0.69	0.12	0.39	0.36	0.44	0.47
5-Y	0.78	0.10	0.35	0.34	0.52	0.53

Source: Brattle elaboration of Bloomberg data.
Note: Adjusted gearing and asset beta are calculated by excluding operating lease liabilities from the calculation of debt. The standard error denotes the average of the standard errors of the peers' betas.

93. Table V-5, Table V-6 and Table V-7 detail the 1-year, 2-year, and 5-year equity beta, and the unadjusted and adjusted asset beta and gearing for the individual peers in the comparator group as of 31 October 2020. Figure V-21 and Figure V-22 show the distribution of the 5-Y asset betas measured against the regional and global indices, respectively.

TABLE V-5: EUROPEAN TELECOMS EQUITY BETA AND DEBT BETA

	1 Year		2 Years		5 Years			
Comparators	**Eq. Beta**	**Standard Error**	**Eq. Beta**	**Standard Error**	**Eq. Beta**	**Standard Error**	**Rating**	**Debt beta**
Local Index								
Deutsche Telekom AG	0.83	0.08	0.78	0.07	0.80	0.04	BBB	0.10
Iliad SA	0.52	0.14	0.63	0.10	0.70	0.07	n/a	0.10
Koninklijke KPN NV	0.70	0.08	0.66	0.07	0.74	0.05	BBB	0.10
Orange Belgium SA	0.78	0.10	0.71	0.09	0.57	0.04	BBB+	0.10
Orange SA	0.75	0.05	0.73	0.05	0.80	0.04	BBB+	0.10
Proximus SADP	0.57	0.13	0.58	0.11	0.64	0.06	A	0.05
Swisscom AG	0.51	0.06	0.50	0.05	0.56	0.03	A	0.05
Tele2 AB	0.80	0.09	0.80	0.08	0.89	0.05	BBB	0.10
Telecom Italia SpA/Milano	0.98	0.18	1.00	0.15	1.20	0.10	BB+	0.10
Telefonica SA	0.98	0.08	0.96	0.07	1.09	0.07	BBB	0.10
Telenor ASA	0.83	0.07	0.79	0.06	0.85	0.04	A-	0.05
Elisa Oyj	0.43	0.10	0.44	0.08	0.58	0.05	BBB+	0.10
Hellenic Telecommunications Organization SA	0.70	0.11	0.66	0.10	0.73	0.07	BBB-	0.10
NOS SGPS SA	0.83	0.09	0.80	0.08	0.87	0.07	BBB-	0.10
Orange Polska SA	0.71	0.12	0.71	0.10	0.71	0.07	BBB+	0.10
Telefonica Deutschland Holding AG	0.61	0.08	0.61	0.06	0.66	0.04	BBB	0.10
Telekom Austria AG	0.86	0.10	0.80	0.09	0.62	0.04	BBB+	0.10
Telia Co AB	0.86	0.09	0.83	0.08	0.88	0.05	BBB+	0.10
United Internet AG	0.87	0.15	0.96	0.13	0.96	0.08	n/a	0.10
Mean	0.74	0.10	0.73	0.09	0.78	0.05		
Median	0.78	0.09	0.73	0.08	0.74	0.05		
Min	0.43	0.05	0.44	0.05	0.56	0.03		
Max	0.98	0.18	1.00	0.15	1.20	0.10		
Standard Deviation	0.16	0.03	0.15	0.03	0.17	0.02		
Global Index								
Deutsche Telekom AG	1.03	0.07	0.92	0.07	0.97	0.05	BBB	0.10
Iliad SA	0.54	0.17	0.61	0.14	0.68	0.11	n/a	0.10
Koninklijke KPN NV	0.65	0.13	0.61	0.11	0.68	0.08	BBB	0.10
Orange Belgium SA	0.83	0.15	0.75	0.13	0.76	0.10	BBB+	0.10
Orange SA	0.65	0.12	0.62	0.10	0.72	0.08	BBB+	0.10
Proximus SADP	0.56	0.17	0.54	0.15	0.61	0.11	A	0.05
Swisscom AG	0.47	0.11	0.44	0.10	0.51	0.07	A	0.05
Tele2 AB	0.67	0.14	0.66	0.12	0.79	0.09	BBB	0.10
Telecom Italia SpA/Milano	0.86	0.23	0.89	0.20	1.07	0.15	BB+	0.10
Telefonica SA	0.92	0.14	0.90	0.12	1.06	0.11	BBB	0.10
Telenor ASA	0.80	0.09	0.76	0.08	0.85	0.06	A-	0.05
Elisa Oyj	0.38	0.13	0.36	0.11	0.49	0.09	BBB+	0.10
Hellenic Telecommunications Organization SA	0.70	0.13	0.66	0.12	0.76	0.09	BBB-	0.10
NOS SGPS SA	0.84	0.12	0.82	0.11	0.93	0.10	BBB-	0.10
Orange Polska SA	0.56	0.24	0.59	0.21	0.65	0.16	BBB+	0.10
Telefonica Deutschland Holding AG	0.61	0.09	0.61	0.08	0.68	0.06	BBB	0.10
Telekom Austria AG	0.98	0.13	0.87	0.12	0.83	0.09	BBB+	0.10
Telia Co AB	0.73	0.17	0.70	0.14	0.81	0.11	BBB+	0.10
United Internet AG	0.75	0.15	0.82	0.13	0.90	0.10	n/a	0.10
Mean	0.71	0.14	0.69	0.12	0.78	0.10		
Median	0.70	0.13	0.66	0.12	0.76	0.09		
Min	0.38	0.07	0.36	0.07	0.49	0.05		
Max	1.03	0.24	0.92	0.21	1.07	0.16		
Standard Deviation	0.17	0.04	0.16	0.03	0.16	0.03		

Source: Brattle elaboration of Bloomberg data.

Note: The standard error of the mean and median denotes, respectively, the average and median standard errors of the peers' betas.

TABLE V-6: EUROPEAN TELECOMS GEARING

	Gearing Unadjusted			Gearing Adjusted		
Comparators	**1-Year**	**2-Year**	**5-Year**	**1-Year**	**2-Year**	**5-Year**
Local Index						
Deutsche Telekom AG	0.59	0.55	0.49	0.54	0.50	0.48
Iliad SA	0.50	0.48	0.28	0.39	0.42	0.26
Koninklijke KPN NV	0.42	0.41	0.41	0.39	0.38	0.40
Orange Belgium SA	0.35	0.29	0.27	0.20	0.21	0.23
Orange SA	0.57	0.53	0.49	0.53	0.50	0.48
Proximus SADP	0.29	0.26	0.23	0.27	0.24	0.22
Swisscom AG	0.27	0.27	0.26	0.23	0.24	0.25
Tele2 AB	0.26	0.25	0.23	0.22	0.23	0.22
Telecom Italia SpA/Milano	0.79	0.77	0.71	0.76	0.75	0.71
Telefonica SA	0.71	0.66	0.60	0.68	0.64	0.59
Telenor ASA	0.41	0.34	0.29	0.34	0.29	0.27
Elisa Oyj	0.13	0.15	0.16	0.12	0.14	0.16
Hellenic Telecommunications Organization SA	0.27	0.27	0.29	0.23	0.24	0.27
NOS SGPS SA	0.40	0.35	0.31	0.35	0.31	0.30
Orange Polska SA	0.50	0.52	0.50	0.43	0.47	0.48
Telefonica Deutschland Holding AG	0.40	0.36	0.23	0.25	0.24	0.18
Telekom Austria AG	0.44	0.44	0.41	0.37	0.39	0.39
Telia Co AB	0.43	0.40	0.37	0.39	0.38	0.36
United Internet AG	0.22	0.23	0.19	0.19	0.20	0.18
Mean	0.42	0.39	0.35	0.36	0.36	0.34
Median	0.41	0.36	0.29	0.35	0.31	0.27
Min	0.13	0.15	0.16	0.12	0.14	0.16
Max	0.79	0.77	0.71	0.76	0.75	0.71
Standard Deviation	0.17	0.16	0.15	0.17	0.16	0.15
Global Index						
Deutsche Telekom AG	0.59	0.55	0.49	0.54	0.50	0.48
Iliad SA	0.50	0.48	0.28	0.39	0.42	0.26
Koninklijke KPN NV	0.42	0.41	0.41	0.39	0.38	0.40
Orange Belgium SA	0.35	0.29	0.27	0.20	0.21	0.23
Orange SA	0.57	0.53	0.49	0.53	0.50	0.48
Proximus SADP	0.29	0.26	0.23	0.27	0.24	0.22
Swisscom AG	0.27	0.27	0.26	0.23	0.24	0.25
Tele2 AB	0.26	0.25	0.23	0.22	0.23	0.22
Telecom Italia SpA/Milano	0.79	0.77	0.71	0.76	0.75	0.71
Telefonica SA	0.71	0.66	0.60	0.68	0.64	0.59
Telenor ASA	0.41	0.34	0.29	0.34	0.29	0.27
Elisa Oyj	0.13	0.15	0.16	0.12	0.14	0.16
Hellenic Telecommunications Organization SA	0.27	0.27	0.29	0.23	0.24	0.27
NOS SGPS SA	0.40	0.35	0.31	0.35	0.31	0.30
Orange Polska SA	0.50	0.52	0.50	0.43	0.47	0.48
Telefonica Deutschland Holding AG	0.40	0.36	0.23	0.25	0.24	0.18
Telekom Austria AG	0.44	0.44	0.41	0.37	0.39	0.39
Telia Co AB	0.43	0.40	0.37	0.39	0.38	0.36
United Internet AG	0.22	0.23	0.19	0.19	0.20	0.18
Mean	0.42	0.39	0.35	0.36	0.36	0.34
Median	0.41	0.36	0.29	0.35	0.31	0.27
Min	0.13	0.15	0.16	0.12	0.14	0.16
Max	0.79	0.77	0.71	0.76	0.75	0.71
Standard Deviation	0.17	0.16	0.15	0.17	0.16	0.15

Source: Brattle elaboration of Bloomberg data.
Note: Adjusted gearing is calculated by excluding operating lease liabilities from the calculation of debt.

TABLE V-7: EUROPEAN TELECOMS ASSET BETA

	Asset beta Unadjusted			Asset beta Adjusted		
Comparators	**1-Year**	**2-Year**	**5-Year**	**1-Year**	**2-Year**	**5-Year**
Local Index						
Deutsche Telekom AG	0.40	0.41	0.46	0.44	0.44	0.47
Iliad SA	0.31	0.38	0.53	0.35	0.41	0.55
Koninklijke KPN NV	0.44	0.43	0.48	0.46	0.45	0.49
Orange Belgium SA	0.54	0.53	0.44	0.64	0.59	0.46
Orange SA	0.38	0.40	0.46	0.40	0.41	0.46
Proximus SADP	0.42	0.44	0.51	0.43	0.45	0.51
Swisscom AG	0.38	0.38	0.42	0.40	0.39	0.43
Tele2 AB	0.61	0.62	0.70	0.64	0.64	0.71
Telecom Italia SpA/Milano	0.29	0.31	0.42	0.31	0.32	0.42
Telefonica SA	0.36	0.39	0.49	0.38	0.41	0.50
Telenor ASA	0.51	0.54	0.62	0.57	0.58	0.64
Elisa Oyj	0.38	0.39	0.51	0.39	0.39	0.51
Hellenic Telecommunications Organization SA	0.54	0.51	0.55	0.56	0.53	0.56
NOS SGPS SA	0.54	0.56	0.63	0.57	0.58	0.64
Orange Polska SA	0.41	0.40	0.41	0.44	0.42	0.42
Telefonica Deutschland Holding AG	0.41	0.43	0.53	0.48	0.49	0.56
Telekom Austria AG	0.52	0.49	0.41	0.58	0.53	0.41
Telia Co AB	0.54	0.54	0.59	0.56	0.55	0.60
United Internet AG	0.70	0.77	0.80	0.73	0.79	0.81
Mean	0.46	0.47	0.52	0.49	0.49	0.53
Median	0.42	0.43	0.51	0.46	0.45	0.51
Min	0.29	0.31	0.41	0.31	0.32	0.41
Max	0.70	0.77	0.80	0.73	0.79	0.81
Standard Deviation	0.11	0.11	0.11	0.11	0.11	0.11
Global Index						
Deutsche Telekom AG	0.48	0.47	0.54	0.53	0.51	0.55
Iliad SA	0.32	0.37	0.52	0.37	0.40	0.53
Koninklijke KPN NV	0.42	0.40	0.44	0.44	0.42	0.45
Orange Belgium SA	0.57	0.56	0.58	0.68	0.61	0.60
Orange SA	0.33	0.35	0.42	0.36	0.36	0.42
Proximus SADP	0.42	0.42	0.48	0.43	0.42	0.48
Swisscom AG	0.36	0.33	0.39	0.37	0.34	0.39
Tele2 AB	0.52	0.52	0.63	0.54	0.54	0.63
Telecom Italia SpA/Milano	0.26	0.28	0.38	0.28	0.30	0.39
Telefonica SA	0.34	0.37	0.48	0.36	0.39	0.49
Telenor ASA	0.49	0.52	0.62	0.55	0.55	0.64
Elisa Oyj	0.34	0.32	0.43	0.34	0.32	0.43
Hellenic Telecommunications Organization SA	0.54	0.51	0.57	0.56	0.53	0.58
NOS SGPS SA	0.55	0.57	0.67	0.59	0.60	0.68
Orange Polska SA	0.33	0.34	0.37	0.36	0.36	0.38
Telefonica Deutschland Holding AG	0.41	0.43	0.55	0.49	0.49	0.58
Telekom Austria AG	0.59	0.53	0.53	0.65	0.57	0.55
Telia Co AB	0.46	0.46	0.54	0.48	0.48	0.55
United Internet AG	0.60	0.66	0.74	0.63	0.67	0.75
Mean	0.44	0.44	0.52	0.47	0.47	0.53
Median	0.42	0.43	0.53	0.48	0.48	0.55
Min	0.26	0.28	0.37	0.28	0.30	0.38
Max	0.60	0.66	0.74	0.68	0.67	0.75
Standard Deviation	0.10	0.10	0.10	0.12	0.11	0.11

Source: Brattle elaboration of Bloomberg data.
Note: Adjusted asset beta is calculated by excluding operating lease liabilities from the calculation of debt.

FIGURE V-21: DISTRIBUTION OF EUROPEAN TELECOMS' 5-Y ASSET BETA VS. FTSE ALL WORLD EUROPE EX. UK

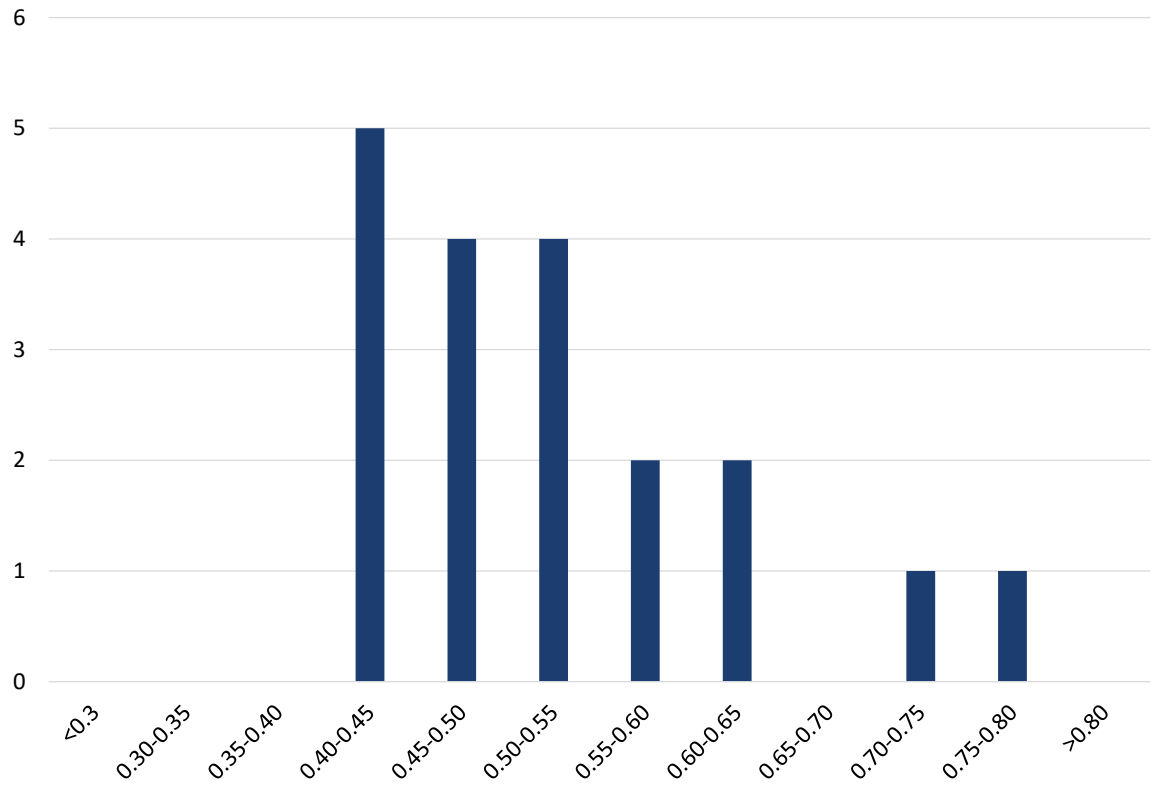
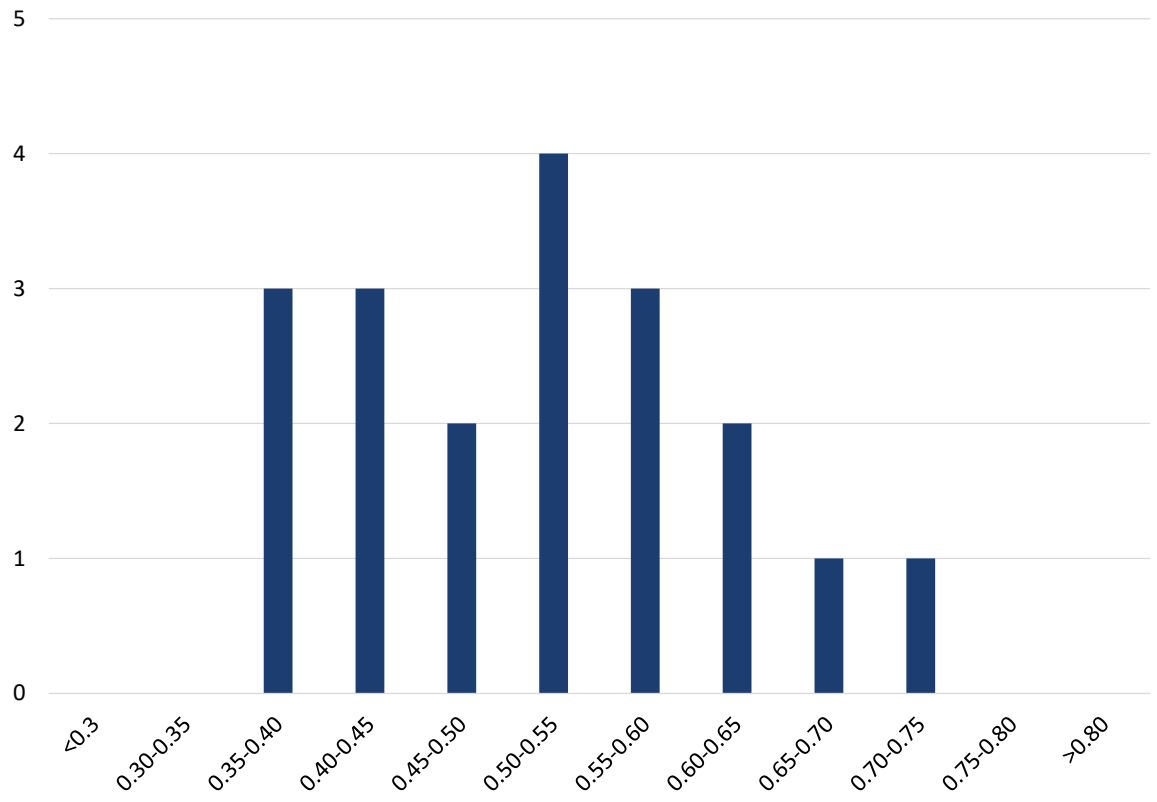


FIGURE V-22: DISTRIBUTION OF EUROPEAN TELECOMS' 5-Y ASSET BETA VS. FTSE ALL WORLD



94. We further illustrate the evolution of European Telecoms' gearing and asset beta over time in the following figures. More specifically, Figure V-23 shows the evolution of European Telecoms' gearing. Figure V-24 and Figure V-25 show the evolution of European Telecoms' asset beta measured against the local and global indices, respectively.

FIGURE V-23: EUROPEAN TELECOMS AVERAGE GEARING

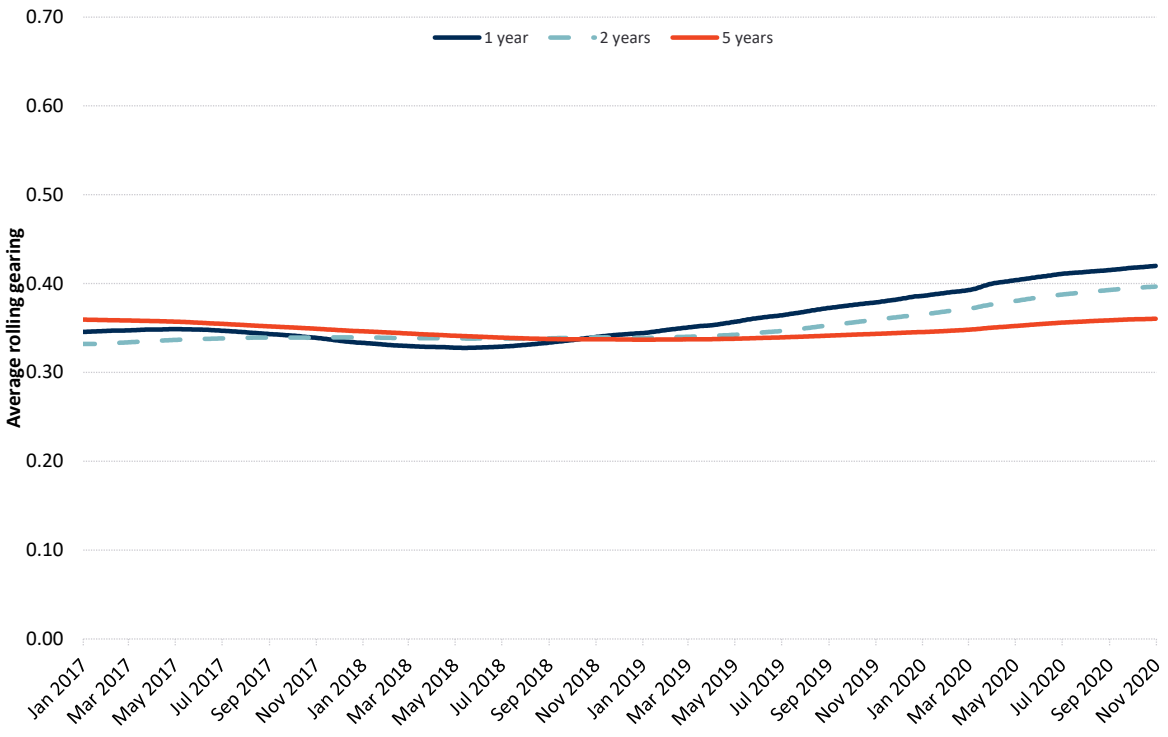


FIGURE V-24: EUROPEAN TELECOMS AVERAGE ASSET BETA VS. FTSE ALL WORLD EUROPE EX. UK

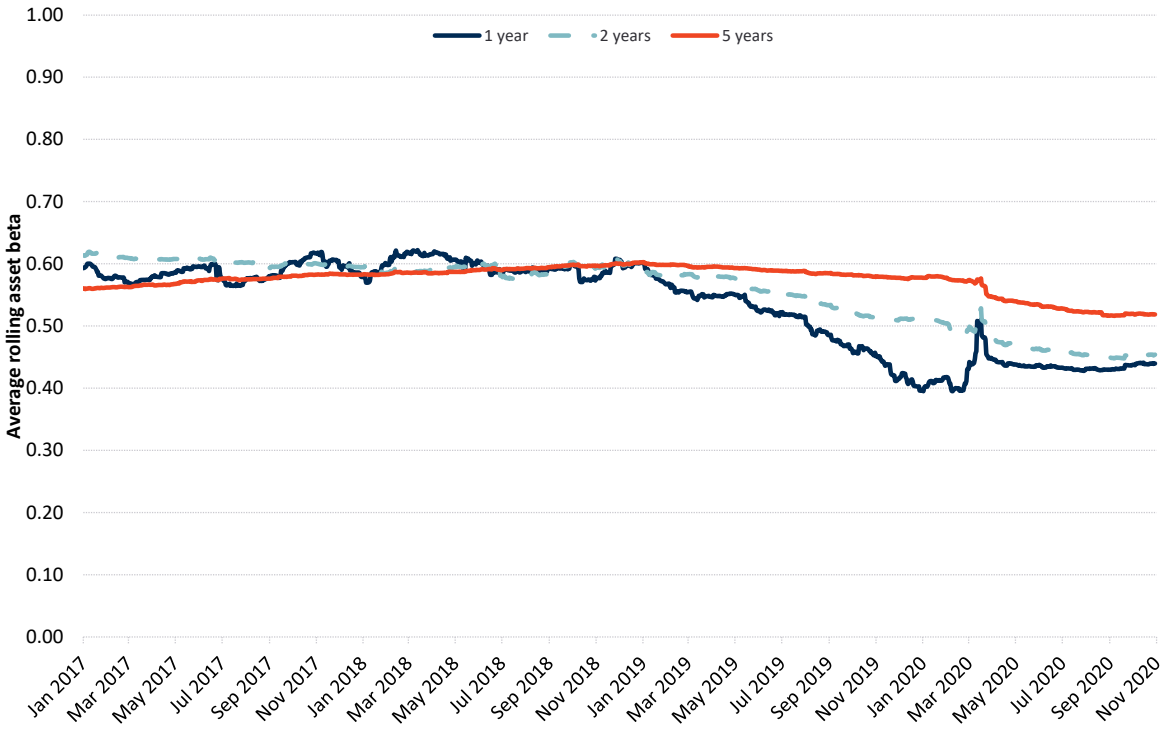
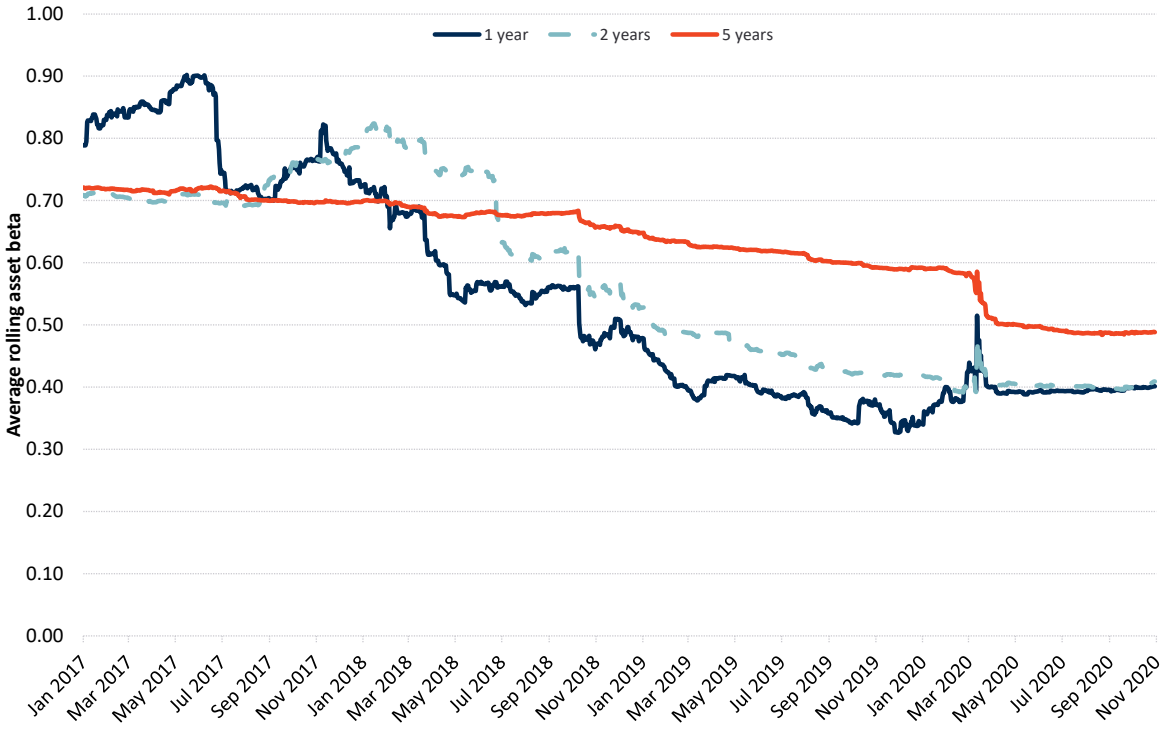


FIGURE V-25: EUROPEAN TELECOMS AVERAGE ASSET BETA VS. FTSE ALL WORLD



E. ICT Comparators

95. In Table V-8, below, we report the average 1-year, 2-year, and 5-year equity beta, asset beta and gearing for the ICT Comparator group. We show equity and asset beta estimates against local and global indices measured as of 31 October.[24] We further report the value of average adjusted gearing and asset beta – that is, excluding operating leases – to account for the impact of IFRS 16.

96. Table V-8 shows that:

    a. ICT Comparators' 5-year equity beta is equal to 1.02 when measured against the local index, and 1.26 when measured against the global index. 1-year and 2-year equity betas are broadly aligned across estimation windows.

    b. ICT Comparators' has experienced a slight increase in gearing, in part attributable to IFRS 16.

    c. ICT Comparators' 5-year asset beta is equal to 0.86 when measured against the local index, and to 1.06 when measured against the global index. 1-year and 2-year asset betas are broadly aligned across estimation windows.

    d. Adjusted asset betas are 0.01 to 0.04 higher than the unadjusted betas.

TABLE V-8: ICT COMPARATORS AVERAGE EQUITY BETA, ASSET BETA AND GEARING

	Equity Beta	Standard Error	Gearing	Gearing Adjusted	Asset Beta	Asset Beta Adjusted
			Oct-20			
Local Index						
ICT Comparators						
1-Y	1.02	0.09	0.21	0.17	0.82	0.85
2-Y	1.06	0.08	0.18	0.16	0.87	0.89
5-Y	1.02	0.06	0.16	0.15	0.86	0.87
Global Index						
ICT Comparators						
1-Y	1.30	0.13	0.21	0.17	1.03	1.07
2-Y	1.30	0.12	0.18	0.16	1.06	1.09
5-Y	1.26	0.10	0.16	0.15	1.06	1.07

Source: Brattle elaboration of Bloomberg data.
Note: Adjusted gearing and asset beta are calculated by excluding operating lease liabilities from the calculation of debt. The standard error denotes the average of the standard errors of the peers' betas.

97. Table V-9, Table V-10 and Table V-11 detail the 1-year, 2-year, and 5-year equity beta, and the unadjusted and adjusted asset beta and gearing for the individual peers in the comparator group as of 31 October 2020.

[24] Local reference indices are the FTSE All Share (ASX Index) and the FTSE All World Europe ex. UK (FTAW12 Index) for UK and European Companies, and broad local and regional indices (S&P 500 Index (SPX) and S&P/TSX Composite Index (SPTSX)) for companies in the US and Canada.

TABLE V-9: ICT COMPARATORS EQUITY BETA AND DEBT BETA[25]

	1 Year		2 Years		5 Years			
Comparators	**Eq. Beta**	**Standard Error**	**Eq. Beta**	**Standard Error**	**Eq. Beta**	**Standard Error**	**Rating**	**Debt beta**
Local Index								
Amdocs Ltd	0.80	0.07	0.77	0.06	0.76	0.05	BBB	0.10
CANCOM SE	0.98	0.11	1.08	0.10	1.03	0.06	n/a	0.10
Capgemini SE	1.13	0.09	1.20	0.08	1.16	0.05	BBB	0.10
CDW Corp/DE	1.21	0.07	1.19	0.06	1.15	0.05	BB+	0.10
CGI Inc	0.71	0.08	0.72	0.07	0.71	0.06	n/a	0.10
Cognizant Technology Solutions Corp	1.17	0.08	1.13	0.07	1.12	0.06	n/a	0.10
Indra Sistemas SA	1.12	0.10	1.16	0.09	1.32	0.12	n/a	0.10
International Business Machines Corp	0.99	0.07	1.00	0.06	0.98	0.05	A	0.05
S&T AG	1.23	0.11	1.36	0.11	1.26	0.07	n/a	0.10
Softcat PLC	0.58	0.07	0.66	0.06	0.67	0.07	n/a	0.10
Sopra Steria Group	1.17	0.10	1.26	0.09	1.18	0.06	n/a	0.10
TietoEVRY Oyj	1.03	0.09	1.03	0.09	0.92	0.07	n/a	0.10
TTEC Holdings Inc	1.18	0.10	1.17	0.09	1.09	0.07	n/a	0.10
Mean	1.02	0.09	1.06	0.08	1.02	0.06		
Median	1.12	0.09	1.13	0.08	1.09	0.06		
Min	0.58	0.07	0.66	0.06	0.67	0.05		
Max	1.23	0.11	1.36	0.11	1.32	0.12		
Standard Deviation	0.21	0.02	0.22	0.02	0.21	0.02		
Global Index								
Amdocs Ltd	1.00	0.09	0.97	0.08	0.91	0.06	BBB	0.10
CANCOM SE	1.07	0.13	1.18	0.11	1.22	0.09	n/a	0.10
Capgemini SE	1.53	0.23	1.55	0.19	1.53	0.15	BBB	0.10
CDW Corp/DE	1.41	0.11	1.44	0.09	1.34	0.07	BB+	0.10
CGI Inc	0.95	0.08	0.94	0.07	0.96	0.05	n/a	0.10
Cognizant Technology Solutions Corp	1.43	0.13	1.11	0.14	1.05	0.10	n/a	0.10
Indra Sistemas SA	1.56	0.25	1.61	0.21	1.56	0.16	n/a	0.10
International Business Machines Corp	1.23	0.07	1.24	0.06	1.17	0.05	A	0.05
S&T AG	1.38	0.09	1.54	0.08	1.57	0.07	n/a	0.10
Softcat PLC	1.17	0.13	1.17	0.11	1.22	0.15	n/a	0.10
Sopra Steria Group	1.52	0.19	1.57	0.18	1.54	0.15	n/a	0.10
TietoEVRY Oyj	1.12	0.12	1.08	0.11	1.03	0.09	n/a	0.10
TTEC Holdings Inc	1.48	0.12	1.47	0.11	1.28	0.09	n/a	0.10
Mean	1.30	0.13	1.30	0.12	1.26	0.10		
Median	1.38	0.12	1.24	0.11	1.22	0.09		
Min	0.95	0.07	0.94	0.06	0.91	0.05		
Max	1.56	0.25	1.61	0.21	1.57	0.16		
Standard Deviation	0.21	0.06	0.24	0.05	0.24	0.04		

Source: Brattle elaboration of Bloomberg data.

Note: The standard error of the mean and median denotes, respectively, the average and median standard errors of the peers' betas.

[25] Note that when estimating the equity betas against both the local and the global indices, the statistical testing leads to the selection of Dimson betas for six of the 13 ICT comparators. The selected Dimson betas are generally higher than the OLS betas.

TABLE V-10: ICT COMPARATORS GEARING

	Gearing Unadjusted			Gearing Adjusted		
Comparators	**1-Year**	**2-Year**	**5-Year**	**1-Year**	**2-Year**	**5-Year**
Local Index						
Amdocs Ltd	0.06	0.03	0.02	0.04	0.02	0.01
CANCOM SE	0.08	0.07	0.06	0.05	0.04	0.05
Capgemini SE	0.21	0.19	0.19	0.17	0.17	0.18
CDW Corp/DE	0.18	0.18	0.23	0.17	0.18	0.23
CGI Inc	0.13	0.10	0.09	0.10	0.08	0.08
Cognizant Technology Solutions Corp	0.08	0.05	0.04	0.05	0.03	0.03
Indra Sistemas SA	0.53	0.51	0.44	0.51	0.49	0.44
International Business Machines Corp	0.38	0.34	0.26	0.36	0.32	0.25
S&T AG	0.21	0.16	0.14	0.18	0.14	0.13
Softcat PLC	0.00	0.00	0.00	0.00	0.00	0.00
Sopra Steria Group	0.30	0.30	0.26	0.23	0.26	0.24
TietoEVRY Oyj	0.28	0.22	0.14	0.22	0.16	0.12
TTEC Holdings Inc	0.25	0.21	0.15	0.20	0.16	0.14
Mean	0.21	0.18	0.16	0.17	0.16	0.15
Median	0.21	0.18	0.14	0.17	0.16	0.13
Min	0.00	0.00	0.00	0.00	0.00	0.00
Max	0.53	0.51	0.44	0.51	0.49	0.44
Standard Deviation	0.15	0.14	0.12	0.14	0.14	0.12
Global Index						
Amdocs Ltd	0.06	0.03	0.02	0.04	0.02	0.01
CANCOM SE	0.08	0.07	0.06	0.05	0.04	0.05
Capgemini SE	0.21	0.19	0.19	0.17	0.17	0.18
CDW Corp/DE	0.18	0.18	0.23	0.17	0.18	0.23
CGI Inc	0.13	0.10	0.09	0.10	0.08	0.08
Cognizant Technology Solutions Corp	0.08	0.05	0.04	0.05	0.03	0.03
Indra Sistemas SA	0.53	0.51	0.44	0.51	0.49	0.44
International Business Machines Corp	0.38	0.34	0.26	0.36	0.32	0.25
S&T AG	0.21	0.16	0.14	0.18	0.14	0.13
Softcat PLC	0.00	0.00	0.00	0.00	0.00	0.00
Sopra Steria Group	0.30	0.30	0.26	0.23	0.26	0.24
TietoEVRY Oyj	0.28	0.22	0.14	0.22	0.16	0.12
TTEC Holdings Inc	0.25	0.21	0.15	0.20	0.16	0.14
Mean	0.21	0.18	0.16	0.17	0.16	0.15
Median	0.21	0.18	0.14	0.17	0.16	0.13
Min	0.00	0.00	0.00	0.00	0.00	0.00
Max	0.53	0.51	0.44	0.51	0.49	0.44
Standard Deviation	0.15	0.14	0.12	0.14	0.14	0.12

Source: Brattle elaboration of Bloomberg data.
Note: Adjusted gearing is calculated by excluding operating lease liabilities from the calculation of debt.

TABLE V-11: ICT COMPARATORS ASSET BETA[26]

	Asset beta Unadjusted			Asset beta Adjusted		
Comparators	**1-Year**	**2-Year**	**5-Year**	**1-Year**	**2-Year**	**5-Year**
Local Index						
Amdocs Ltd	0.76	0.75	0.75	0.78	0.76	0.75
CANCOM SE	0.91	1.02	0.97	0.94	1.04	0.98
Capgemini SE	0.92	0.99	0.96	0.95	1.02	0.97
CDW Corp/DE	1.01	0.99	0.90	1.02	0.99	0.91
CGI Inc	0.63	0.66	0.65	0.65	0.67	0.66
Cognizant Technology Solutions Corp	1.08	1.07	1.08	1.11	1.09	1.09
Indra Sistemas SA	0.58	0.62	0.78	0.60	0.64	0.79
International Business Machines Corp	0.63	0.68	0.74	0.65	0.69	0.75
S&T AG	0.99	1.16	1.10	1.03	1.19	1.11
Softcat PLC	0.58	0.66	0.66	0.58	0.66	0.67
Sopra Steria Group	0.84	0.91	0.90	0.92	0.96	0.92
TietoEVRY Oyj	0.78	0.82	0.80	0.83	0.88	0.82
TTEC Holdings Inc	0.91	0.95	0.93	0.96	1.00	0.95
Mean	0.82	0.87	0.86	0.85	0.89	0.87
Median	0.84	0.91	0.90	0.92	0.96	0.91
Min	0.58	0.62	0.65	0.58	0.64	0.66
Max	1.08	1.16	1.10	1.11	1.19	1.11
Standard Deviation	0.17	0.18	0.15	0.18	0.19	0.15
Global Index						
Amdocs Ltd	0.94	0.95	0.90	0.97	0.96	0.90
CANCOM SE	0.99	1.11	1.15	1.02	1.14	1.17
Capgemini SE	1.23	1.28	1.26	1.28	1.31	1.27
CDW Corp/DE	1.17	1.19	1.05	1.18	1.20	1.05
CGI Inc	0.84	0.85	0.88	0.87	0.88	0.89
Cognizant Technology Solutions Corp	1.33	1.06	1.02	1.36	1.08	1.02
Indra Sistemas SA	0.78	0.84	0.91	0.81	0.86	0.92
International Business Machines Corp	0.78	0.84	0.89	0.80	0.86	0.89
S&T AG	1.12	1.31	1.37	1.16	1.34	1.38
Softcat PLC	1.17	1.16	1.22	1.17	1.17	1.22
Sopra Steria Group	1.09	1.13	1.16	1.19	1.19	1.19
TietoEVRY Oyj	0.84	0.86	0.90	0.90	0.92	0.92
TTEC Holdings Inc	1.14	1.18	1.10	1.21	1.24	1.12
Mean	1.03	1.06	1.06	1.07	1.09	1.07
Median	1.09	1.11	1.05	1.16	1.14	1.05
Min	0.78	0.84	0.88	0.80	0.86	0.89
Max	1.33	1.31	1.37	1.36	1.34	1.38
Standard Deviation	0.18	0.17	0.16	0.19	0.17	0.17

Source: Brattle elaboration of Bloomberg data.

[26] Note that when estimating the equity betas against both the local and the global indices, the statistical testing leads to the selection of Dimson betas for six of the 13 ICT comparators. The selected Dimson betas are generally higher than the OLS betas.

Note: Adjusted asset beta is calculated by excluding operating lease liabilities from the calculation of debt.

98. We further illustrate the evolution of ICT Comparators' gearing and asset beta over time in the following figures. More specifically, Figure V-26 shows the evolution of ICT Comparators' gearing. Figure V-27 and Figure V-28 show the evolution of ICT Comparators' asset beta measured against the local and global indices, respectively.

FIGURE V-26: ICT COMPARATORS, GEARING

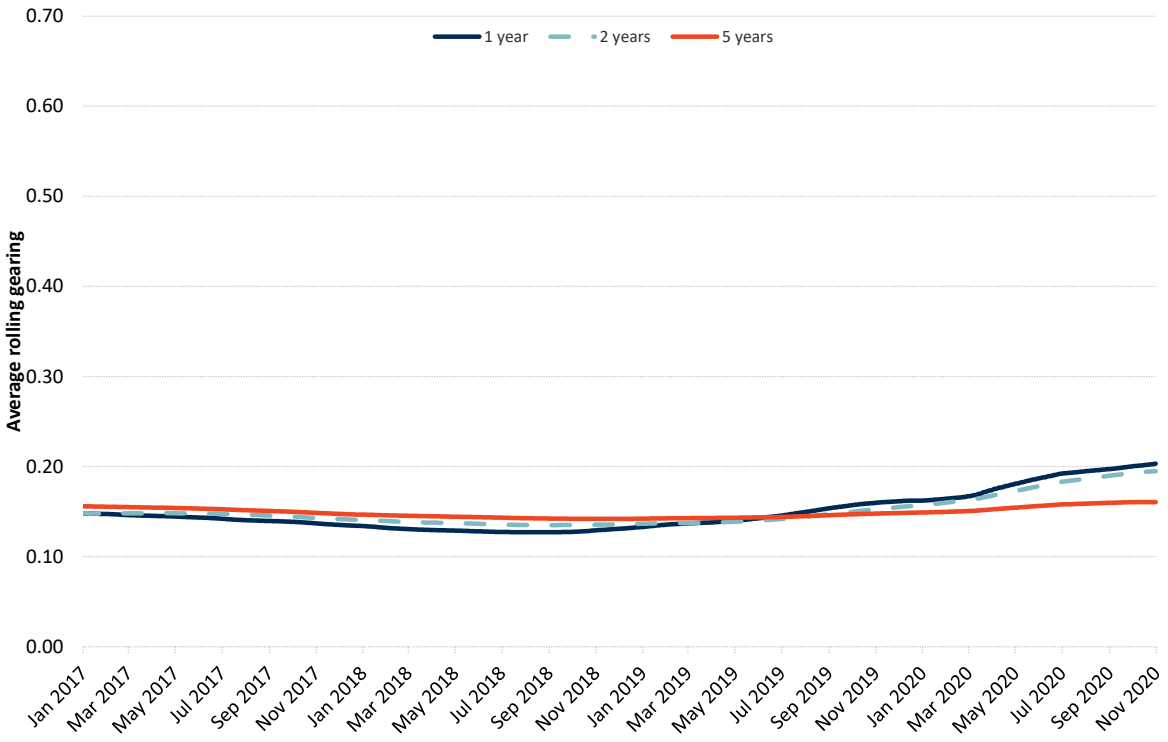
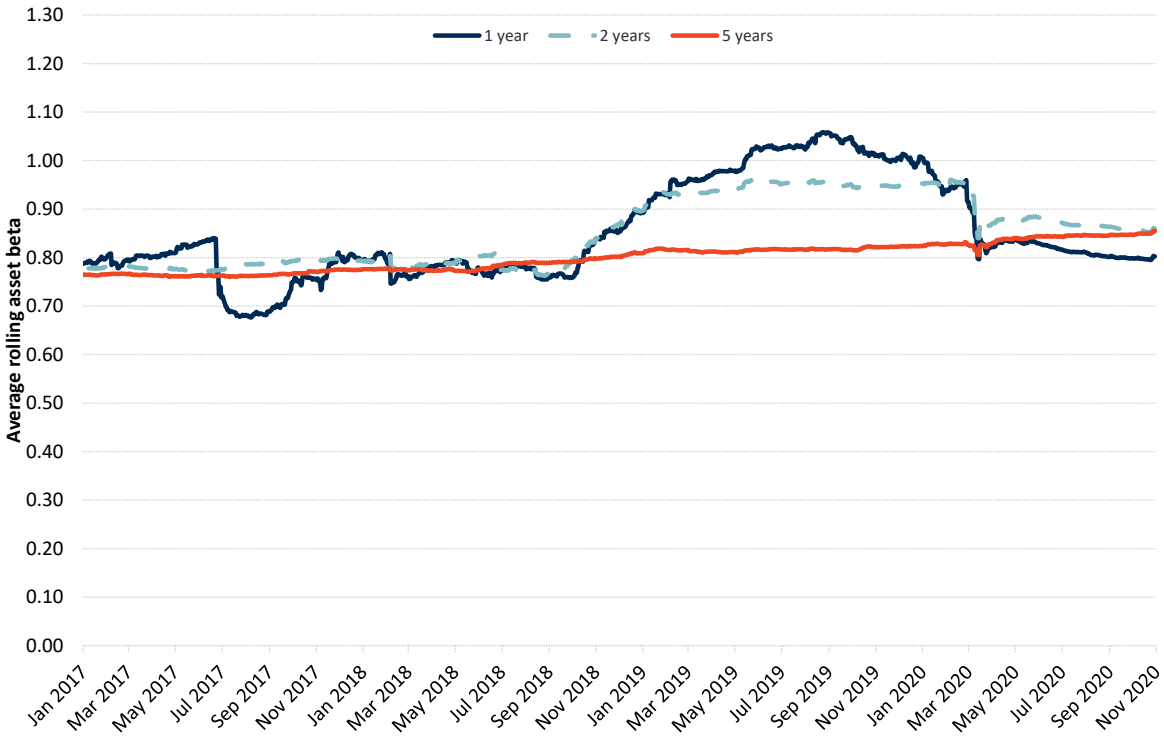
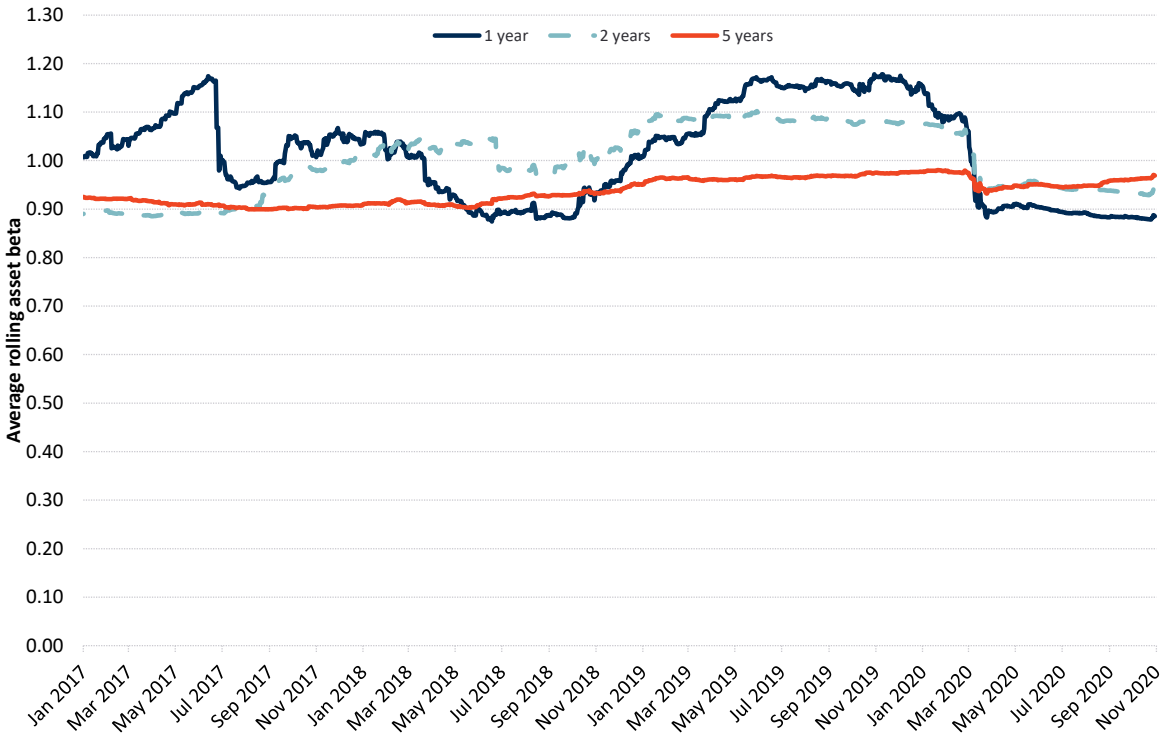


FIGURE V-27: ICT COMPARATORS, ASSET BETA VS. LOCAL/REGIONAL INDEX[27]



[27] Note that Figure V-27 is based on OLS estimates of the comparators equity betas. Accordingly, the average asset beta as of 31 October2020 reported in the figure is lower than the average asset beta as of 31 October2020 reported in Table V-11. As noted above, several of the beta estimates in Table V-11 where Dimson betas, which are generally higher than the OLS betas.

FIGURE V-28: ICT COMPARATORS, ASSET BETA VS. FTSE ALL WORLD[28]



VI. Evidence on FTTP premium

99. Ofcom has also asked us to investigate the implications for systematic risk from next generation, full-fibre networks (a.k.a. fibre-to-the-premises or FTTP). In the WFTMR consultation, Ofcom suggested that an FTTP network could have a higher asset beta than a copper-based network for two main reasons:

    a. Demand uncertainty. Demand for fibre may be more sensitive to changes in economic performance and household income; and

    b. Operating leverage. The fibre business requires large investments to build fibre networks. The investment requirements may increase beta, since they magnify the risk of the value of future assets onto the existing asset base.

100. These two factors would be reflected in an 'FTTP premium' over the beta of a legacy copper network.

[28] Note that Figure V-28 is based on OLS estimates of the comparators equity betas. Accordingly, the average asset beta as of 31 October2020 reported in the figure is lower than the average asset beta as of 31 October2020 reported in Table V-11. As noted above, several of the beta estimates in Table V-11 where Dimson betas, which are generally higher than the OLS betas.

101. In principle, the simplest approach to estimate the FTTP premium would be to compare the beta for a pure-play copper network and the beta for a pure-play FTTP network. However, such an approach is not feasible in practice, because there are no 'pure play' copper or fibre telecoms operators from which we can estimate the respective betas. In reality, as shown in Section IV.B (Table IV-1), European telecoms operators are increasingly converged operators offering a variety of fixed and mobile services and incumbents operate a mix of fibre and legacy copper networks.

102. In this report we consider instead an indirect measure of the FTTP premium, by comparing the average asset beta of incumbents and alternative operators. A key difference between these two groups is that incumbents operate a legacy copper network, while alternative operators do not. There are clearly other differences between these two groups of comparators. Any analysis of the 'FTTP premium' using this methodology should be interpreted as indicative only.

103. In Table VI-1, below, we compare the 1-year, 2-year, and 5-year average equity betas, gearing and asset betas for incumbents (including BT) and alternative operators (including Vodafone, but excluding TalkTalk) estimated against both the local/regional index and the world index as of 31 October 2020. Table VI-1 further reports the value of the adjusted gearing and asset betas – that is, excluding operating leases – to account for the impact of IFRS 16.

104. Table V-1 shows that:

    a. The asset beta of alternative operators is consistently higher than the asset beta of incumbents, using both local/regional indices and the global index.

    b. The current gap ranges between 0.07 and 0.12 using both local/regional and the global indexes.

TABLE VI-1: INCUMBENTS AND ALTERNATIVE OPERATORS AVERAGE EQUITY BETA, GEARING AND ASSET BETA

	Equity Beta	Gearing	Gearing Adjusted	Asset Beta	Asset Beta Adjusted
			Oct-20		
Local Index					
Incumbents					
1-Y	0.76	0.46	0.42	0.43	0.46
2-Y	0.74	0.44	0.41	0.44	0.46
5-Y	0.80	0.40	0.39	0.49	0.50
Alternative Operators					
1-Y	0.77	0.40	0.32	0.50	0.55
2-Y	0.78	0.36	0.31	0.53	0.57
5-Y	0.80	0.29	0.26	0.60	0.61
Global Index					
Incumbents					
1-Y	0.73	0.46	0.42	0.41	0.44
2-Y	0.70	0.44	0.41	0.41	0.43
5-Y	0.78	0.40	0.39	0.49	0.50
Alternative Operators					
1-Y	0.75	0.40	0.32	0.48	0.53
2-Y	0.74	0.36	0.31	0.51	0.54
5-Y	0.81	0.29	0.26	0.60	0.62

Source: Brattle elaboration of Bloomberg data.
Note: Adjusted gearing and asset beta are calculated by excluding operating lease liabilities from the calculation of debt.

105. Table D-1 and Table D-2 in Appendix D further detail the company specific 5-year equity and asset beta estimates (both unadjusted and adjusted) and their 95% confidence intervals for the UK and European Telecoms, also distinguishing between incumbent and alternative telecoms operators.

106. Figure VI-1, Figure VI-2, Figure VI-3 and Figure VI-4 show the distribution of the 5-year equity and asset betas of incumbents and alternative operators measured against the local/regional and global indexes, respectively.

FIGURE VI-1: 5-YEAR EQUITY BETA OF INCUMBENTS AND ALTERNATIVE OPERATORS VS. LOCAL/REGIONAL INDEX

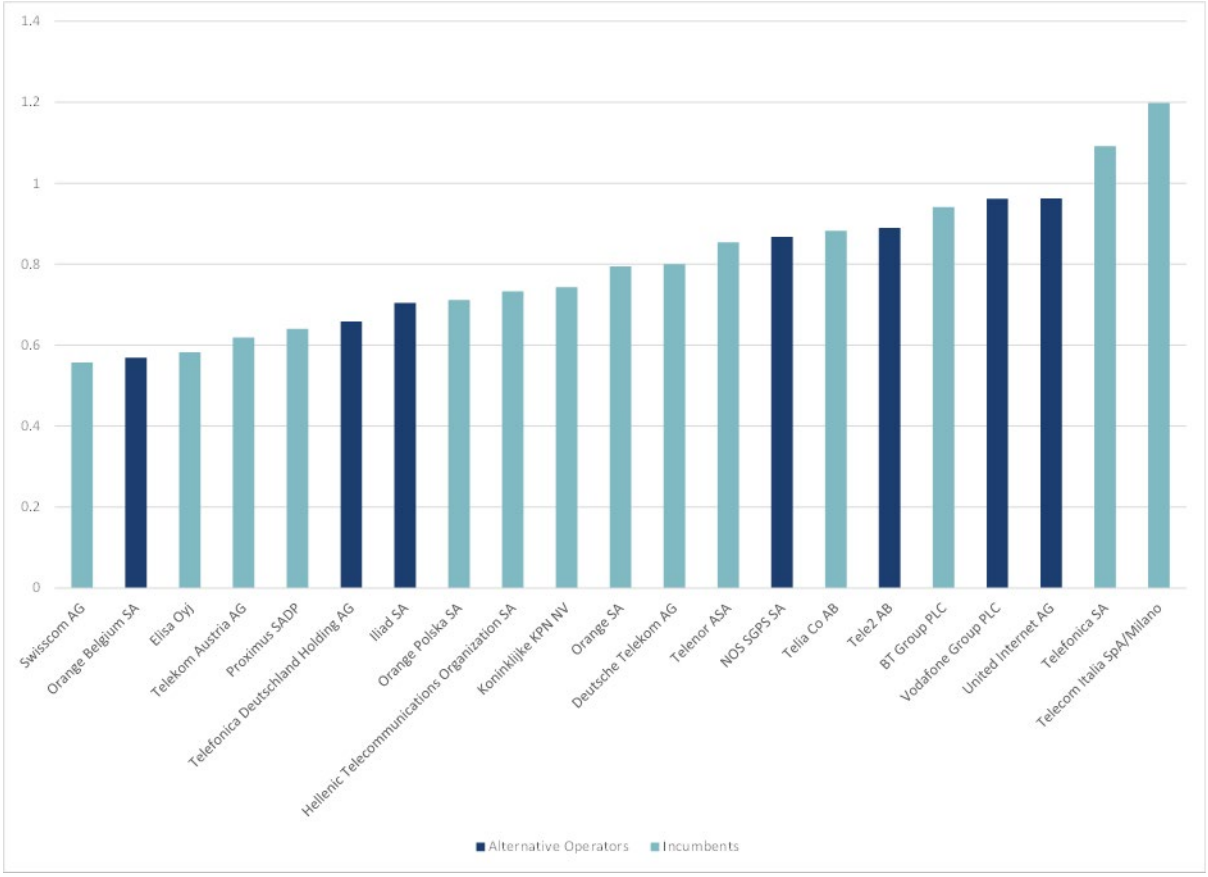


FIGURE VI-2: 5-YEAR EQUITY BETA OF INCUMBENTS AND ALTERNATIVE OPERATORS VS. FTSE ALL WORLD

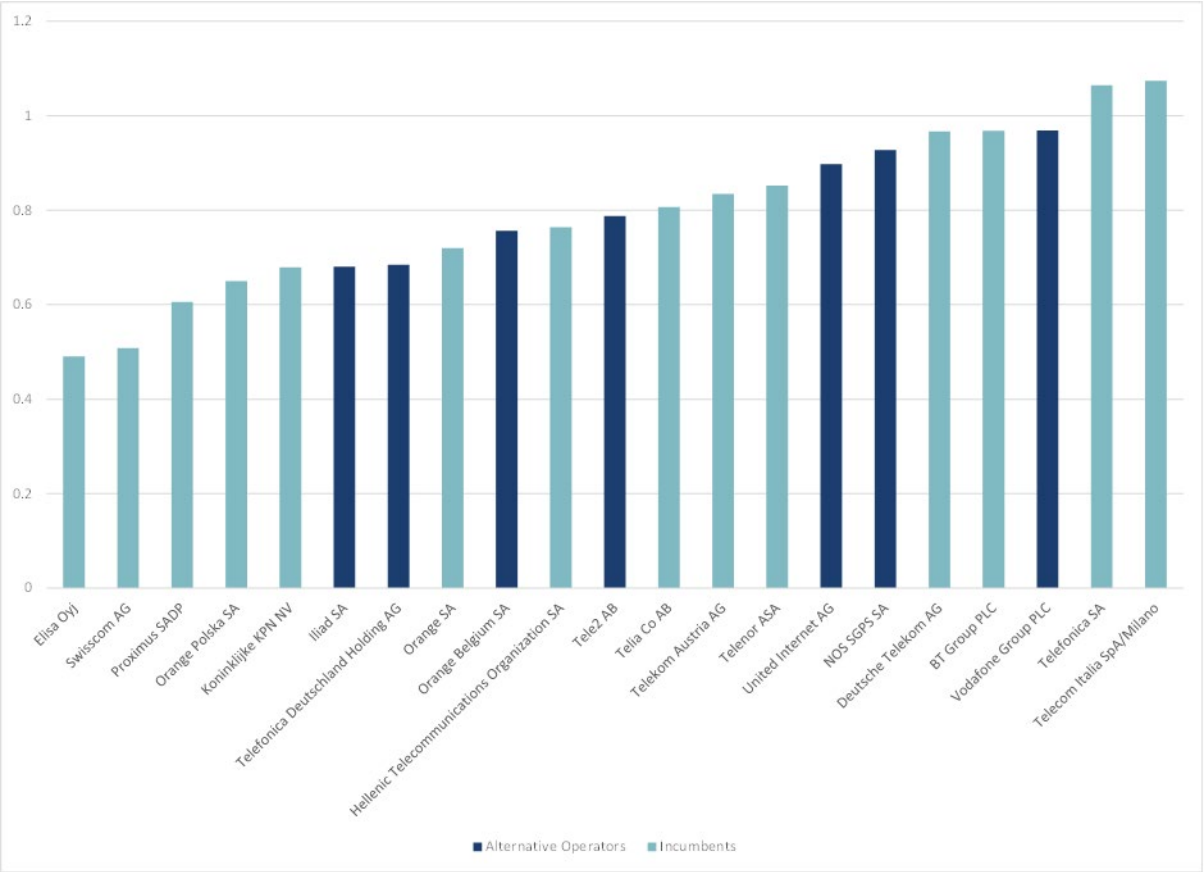


FIGURE VI-3: 5-YEAR ASSET BETA OF INCUMBENTS AND ALTERNATIVE OPERATORS VS. LOCAL/REGIONAL INDEX

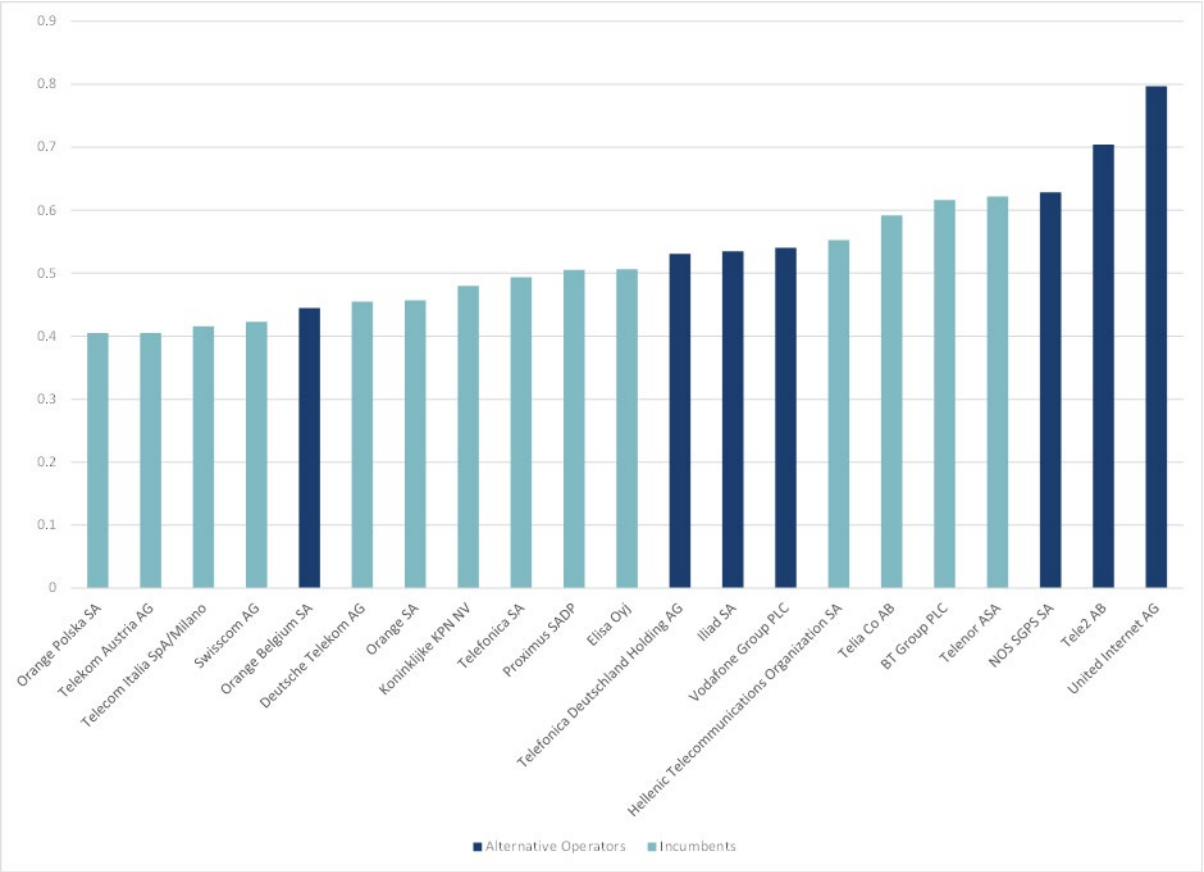
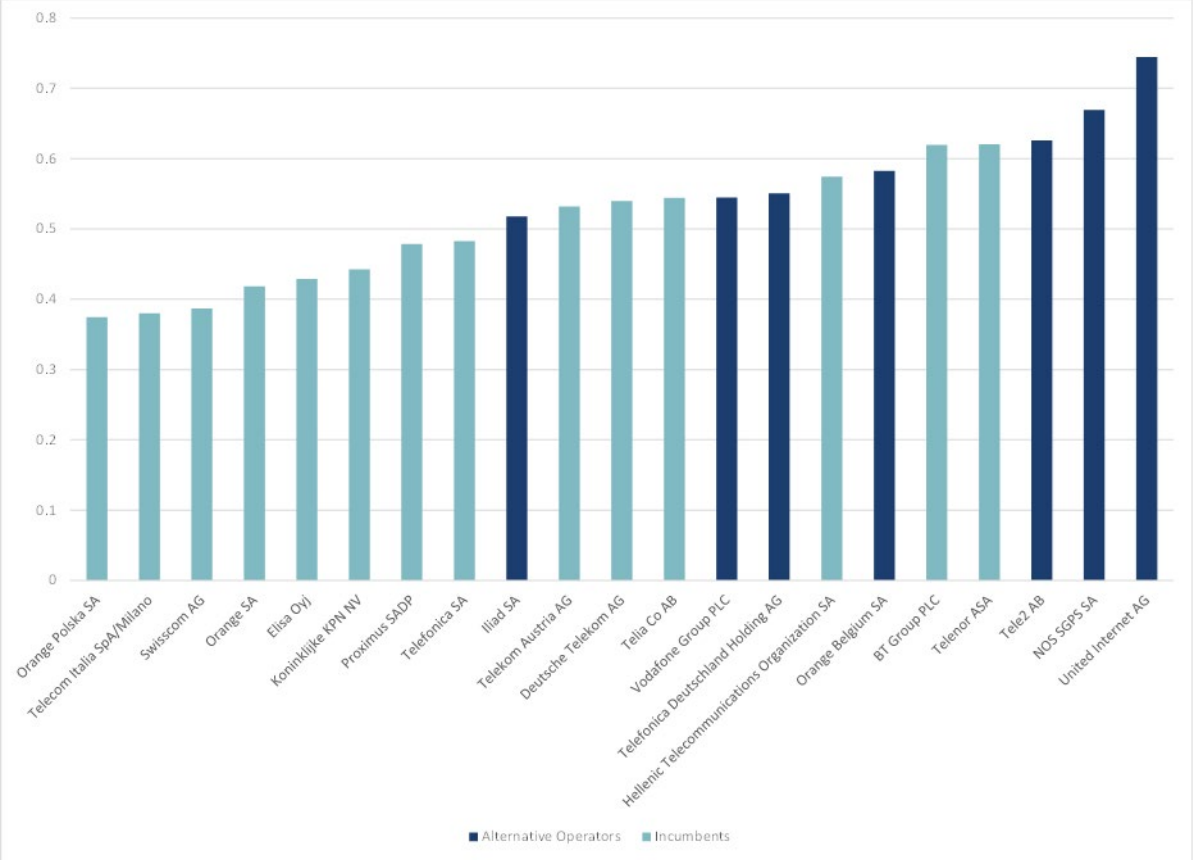


FIGURE VI-4: 5-YEAR ASSET BETA OF INCUMBENTS AND ALTERNATIVE OPERATORS VS. FTSE ALL WORLD



107. Ofcom has also asked us to analyse whether there is any clear relationship between the asset beta and the degree of FTTP coverage and take-up, and the prospective capex plans of operators. In principle, low FTTP coverage may signal a higher level of demand risk and higher prospective capex requirement, both factors potentially contributing to higher systematic risk and higher beta.

108. In Figure VI-5, below, we plot national FTTP coverage against the 5-year asset beta of incumbents. While in theory we would expect higher beta for lower penetration rates, we observe no statistically significant relationship between FTTP coverage and beta.

FIGURE VI-5: FTTP COVERAGE VS. 5-YEAR ASSET BETA (VS. LOCAL/REGIONAL INDEX)

Source: Brattle elaboration of Analysys Mason data.

109. Figure VI-6 plots national FTTP take-up, defined as active connections over premises passed, against incumbents' 5-year asset betas. Again, we would expect higher beta for lower take-up, but observe no statistically significant relationship between FTTP take-up and beta.

FIGURE VI-6: FTTP TAKE-UP VS. 5-YEAR ASSET BETA (VS. LOCAL/REGIONAL INDEX)[29]

Source: Brattle elaboration of Analysys Mason data.

110. In Figure VI-7 and Figure VI-8 we further show historical and planned 'capex intensity' for incumbents and alternative operators. The figures indicate our estimates of the companies' 5-year asset betas measured against the local/regional index. We define capex intensity as the ratio of annual capex to revenues. For each incumbent and alternative operator for which data are available we construct historical capital intensity as the average capex intensity over the past five years. We calculate planned capex intensity as the ratio between (i) the average annual capex forecast from the companies 3-year capex plans (if available) and (ii) average annual revenues over last 5-years.

111. Figure VI-7 and Figure VI-8 indicate that:

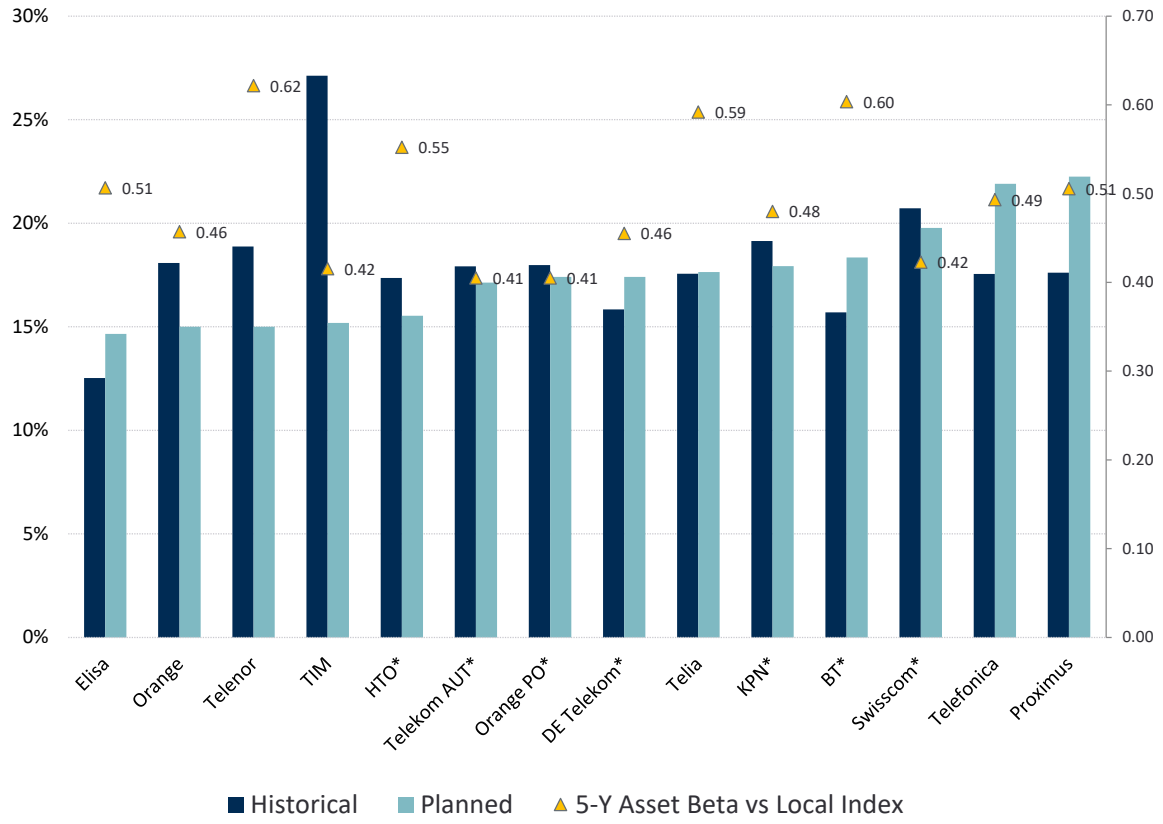
a. The typical capex intensity for incumbents ranges between 15% and 20% of revenues. Cross sectional variation across incumbents is modest, and historical and forecast capex intensity are comparable for individual firms.

b. The cross-sectional variation in capex intensity is larger among alternative operators – 5% to 20%. Historical and forecast capex intensity are comparable for individual firms.

112. The larger asset base and the need for replacement investments may explain the higher capex intensity of incumbents. However, we see no clear relationship between capex intensity and asset betas.

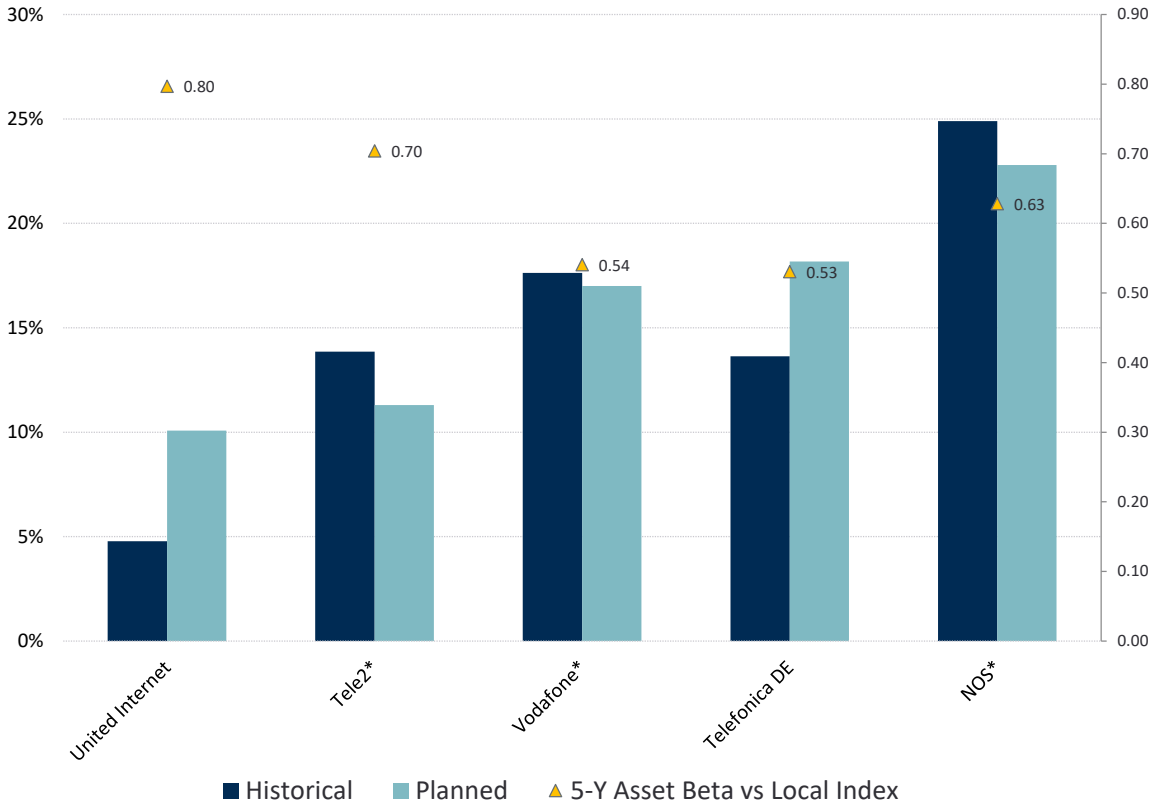
[29] In the Figure, FTTP take-up is defined as active connections over premises passed.

FIGURE VI-7: CAPEX INTENSITY AND ASSET BETA OF INCUMBENTS (VS. LOCAL/REGIONAL INDEX)



Source: Brattle calculations using data from investor presentations and annual accounts 2015-2020.

FIGURE VI-8: CAPEX INTENSITY AND ASSET BETA OF ALTERNATIVE OPERATORS (VS. LOCAL/REGIONAL INDEX)



Source: Brattle calculations using data from investor presentations and annual accounts 2015-2020.

* Planned investment intensity based on forecast investment for the next year

Appendix A: Results of the Screening Tests

A.1 European Telecoms

113. Table A-1 provides the rating and revenue breakdown for the candidate peers in the European Telecoms comparator group.

a. We exclude Liberty Global (BB-) and Telenet (BB-) because they have a rating below investment grade. Masmovil Ibercom (BB-) is also excluded because of significant M&A activity. We do not exclude Telecom Italia (BB+) because its credit is borderline and because the company has been selected as a comparator by BEREC and other regulators in recent WACC recommendations.

b. We further exclude Bouygues, because it derives only 15.9% of its revenue from telecoms.

TABLE A-1: EUROPEAN TELECOMS, REVENUE BREAKDOWN AND RATING

		Country	% Revenue in Europe	% Revenue in Telecommunications services (fixed, mobile, sales of equipment)	Rating
[1]	BT Group PLC	United Kingdom	93.3%	80.7%	BBB
[2]	Deutsche Telekom AG	Germany	49.8%	90.6%	BBB
[3]	Elisa Oyj	Finland	100.0%	100.0%	BBB+
[4]	Hellenic Telecommunications Organization SA	Greece	100.0%	100.0%	BBB-
[5]	Koninklijke KPN NV	Netherlands	100.0%	86.0%	BBB
[6]	Orange Polska SA	Poland	100.0%	93.0%	BBB+
[7]	Orange SA	France	83.8%	90.5%	BBB+
[8]	Proximus SADP	Belgium	100.0%	89.3%	A
[9]	Swisscom AG	Switzerland	100.0%	91.1%	A
[10]	Telecom Italia SpA/Milano	Italy	76.9%	100.0%	BB+
[11]	Telefonica SA	Spain	62.3%	100.0%	BBB
[12]	Telekom Austria AG	Austria	100.0%	97.9%	BBB+
[13]	Telenor ASA	Norway	42.3%	92.2%	A-
[14]	Telia Co AB	Sweden	100.0%	98.9%	BBB+
[15]	Bouygues SA	France	76.9%	15.9%	A-
[16]	Iliad SA	France	100.0%	100.0%	n/a
[17]	Masmovil Ibercom SA	Spain	100.0%	100.0%	BB- *-
[18]	Orange Belgium SA	Belgium	100.0%	94.6%	BBB+
[19]	Sunrise Communications Group AG	Switzerland	100.0%	100.0%	BBB- *-
[20]	TalkTalk Telecom Group PLC	United Kingdom	100.0%	100.0%	BB-
[21]	Telefonica Deutschland Holding AG	Germany	100.0%	100.0%	BBB
[22]	United Internet AG	Germany	100.0%	85.4%	n/a
[23]	Liberty Global PLC	United Kingdom	100.0%	100.0%	BB-
[24]	NOS SGPS SA	Portugal	100.0%	91.3%	BBB-
[25]	Tele2 AB	Sweden	100.0%	100.0%	BBB
[26]	Telenet Group Holding NV	Belgium	100.0%	100.0%	BB-
[27]	Vodafone Group PLC	United Kingdom	77.3%	84.2%	BBB

Source: Bloomberg, Companies financial statements

Notes: Rating is calculated when available from S&P, Fitch or Moody's. For subsidiaries (Orange Polska, Orange Belgium, Telefonica Deutschland), the rating is the one of the parent company.

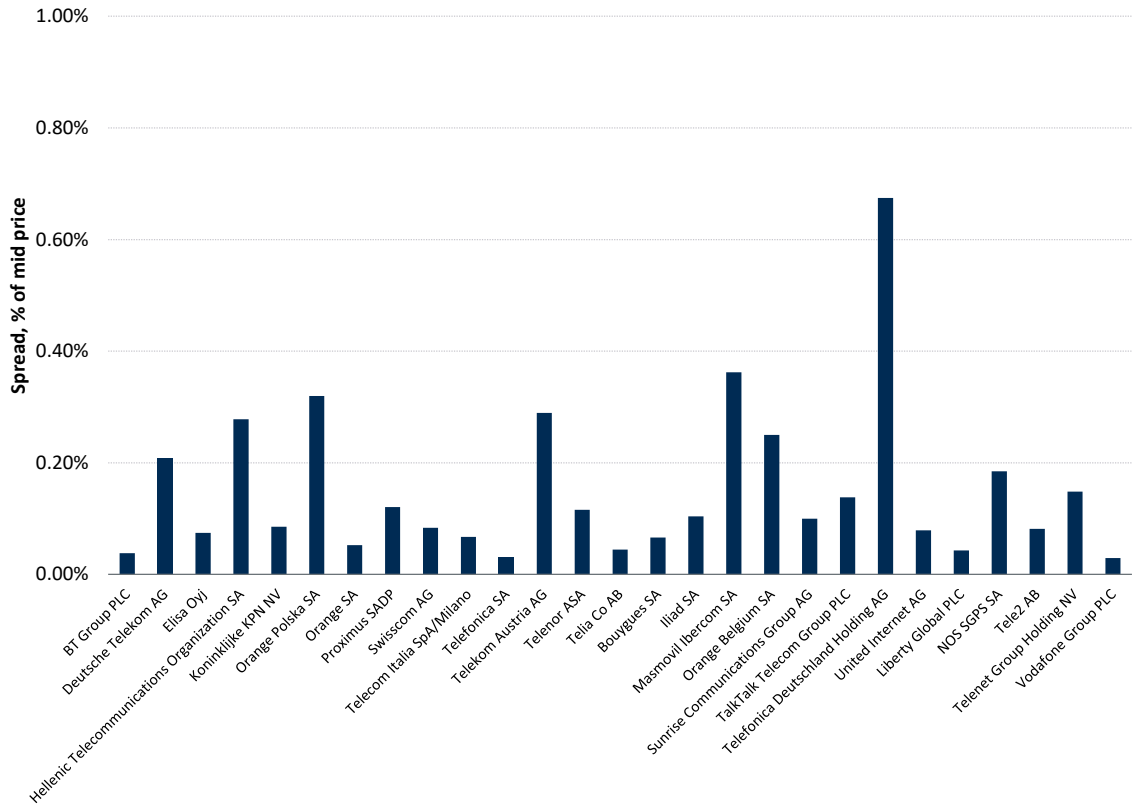
[10]: Telecom Italia doesn't show the breakdown of services revenues, however approximately all services refer to telecommunications activities. See 2019 Annual report, p. 12.

[11]: Telefonica doesn't show the breakdown of services revenues, however approximately all services refer to telecommunications activities. See 2019 Annual report, p. 31.

[24]: NOS doesn't show the breakdown of communications service revenues, however approximately all services refer to telecommunications activities. See 2019 Annual report, p. 112.

114. Figure A-1 shows the bid-ask spread of European Telecoms. All comparators show a spread lower than 1%.

FIGURE A-1: EUROPEAN TELECOMS, BID-ASK SPREAD



Source: Brattle elaboration of Bloomberg data.

115. As explained in Section IV.B, we exclude Masmovil Ibercom and Sunrise communications Group for significant M&A activity. We further indicate that the UK company TalkTalk was also involved in significant M&A activity, with the takeover by Toscafund Asset Management agreed in December 2020 with a delisting from the market confirmed for 15 March 2021. We do not exclude TalkTalk when considering UK Telecoms, but do exclude it when calculating averages betas for alternative operators (TalkTalk is also below investment grade).

116. Figure A-2, Figure A-3 and Figure A-4 show the evolution of the stock returns of Masmovil Ibercom, Sunrise and TalkTalk around the announcement dates.

FIGURE A-2: MASMOVIL, M&A ACTIVITY

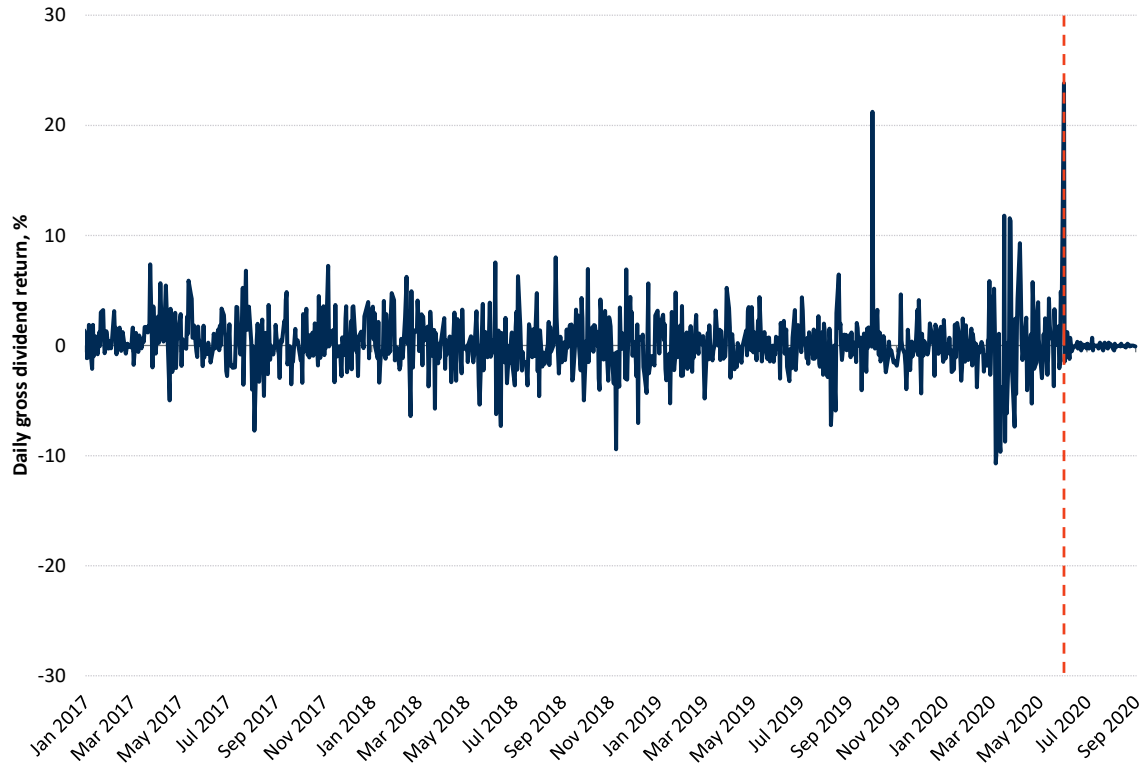


FIGURE A-3: SUNRISE, M&A ACTIVITY

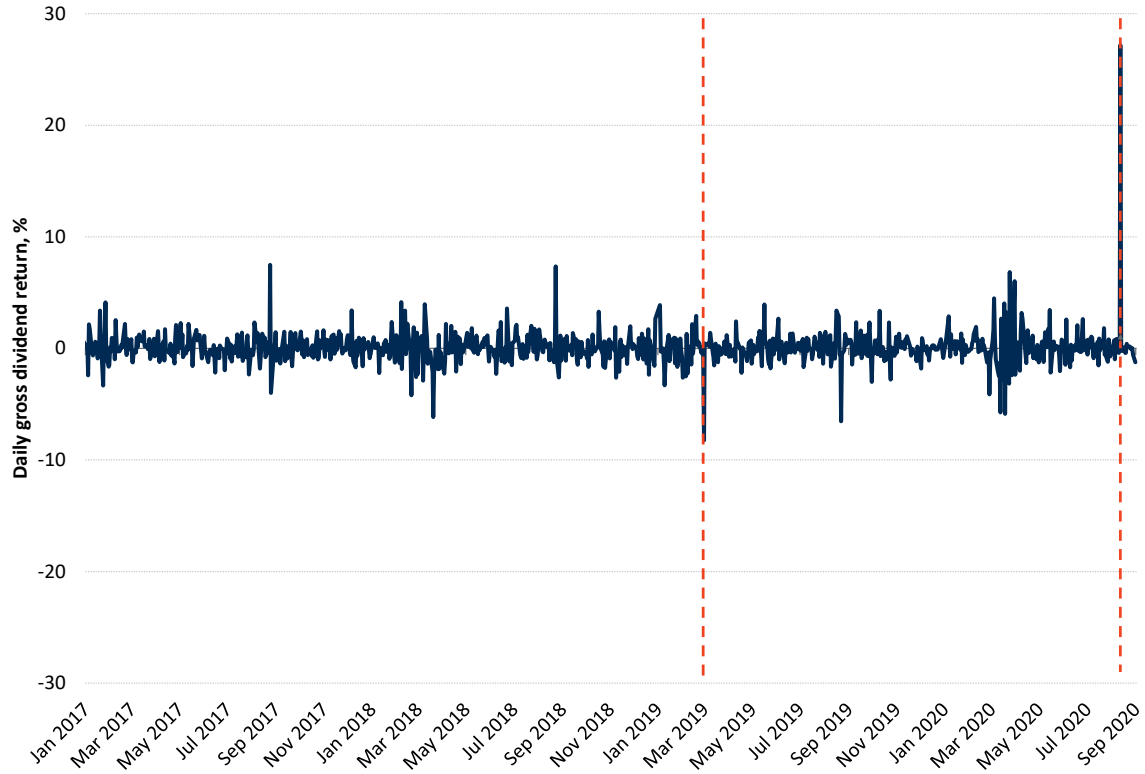
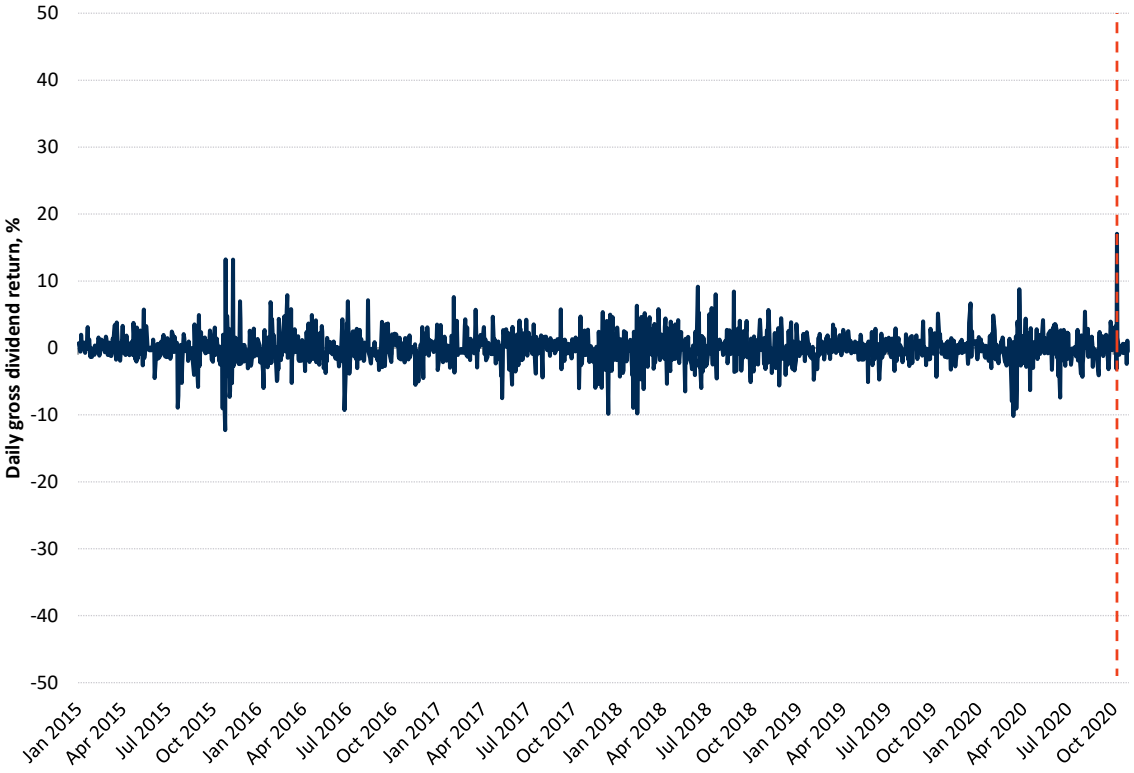


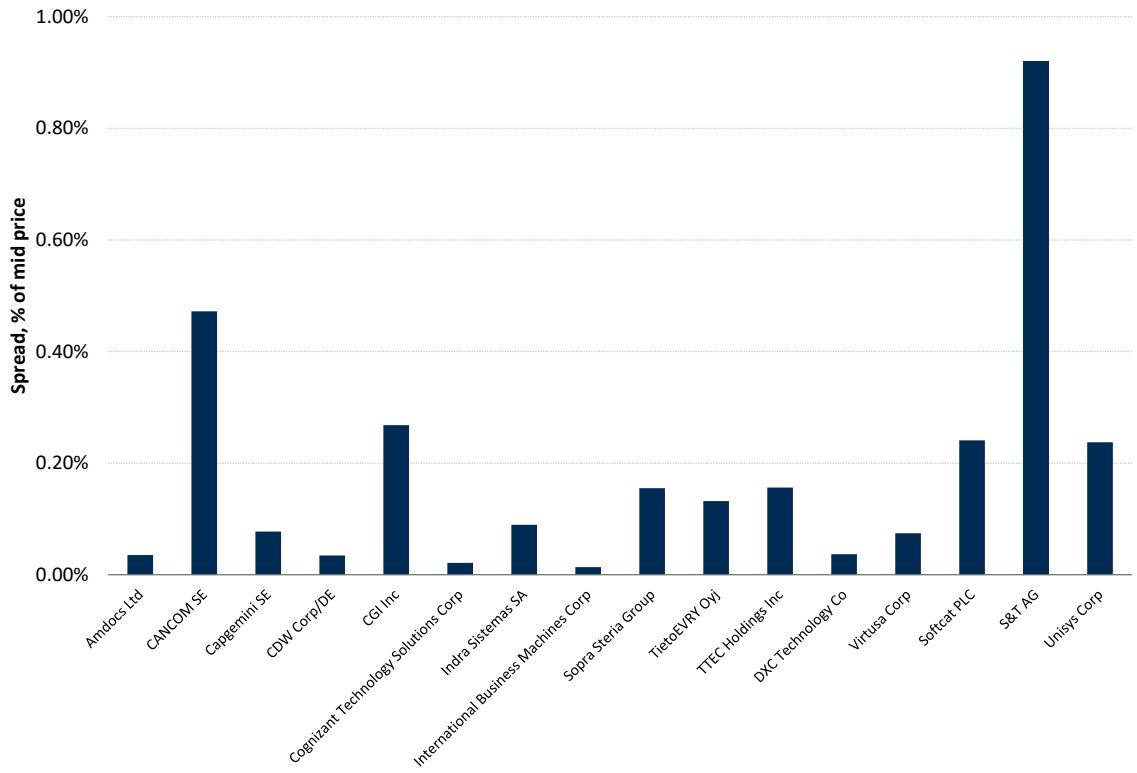
FIGURE A-4: TALKTALK, M&A ACTIVITY



A.2 ICT Comparators

117. Figure A-5 shows the bid-ask spread of ICT Comparators. All comparators show a spread lower than 1%.

FIGURE A-5: ICT COMPARATORS, BID-ASK SPREAD



118. As explained in Section IV.C, we exclude Unisys and Virtusa for significant M&A activity. Figure A-6 and Figure A-7 show the evolution of the stock returns of Unisys and Virtusa around the announcement dates.

FIGURE A-6: UNISYS, M&A ACTIVITY

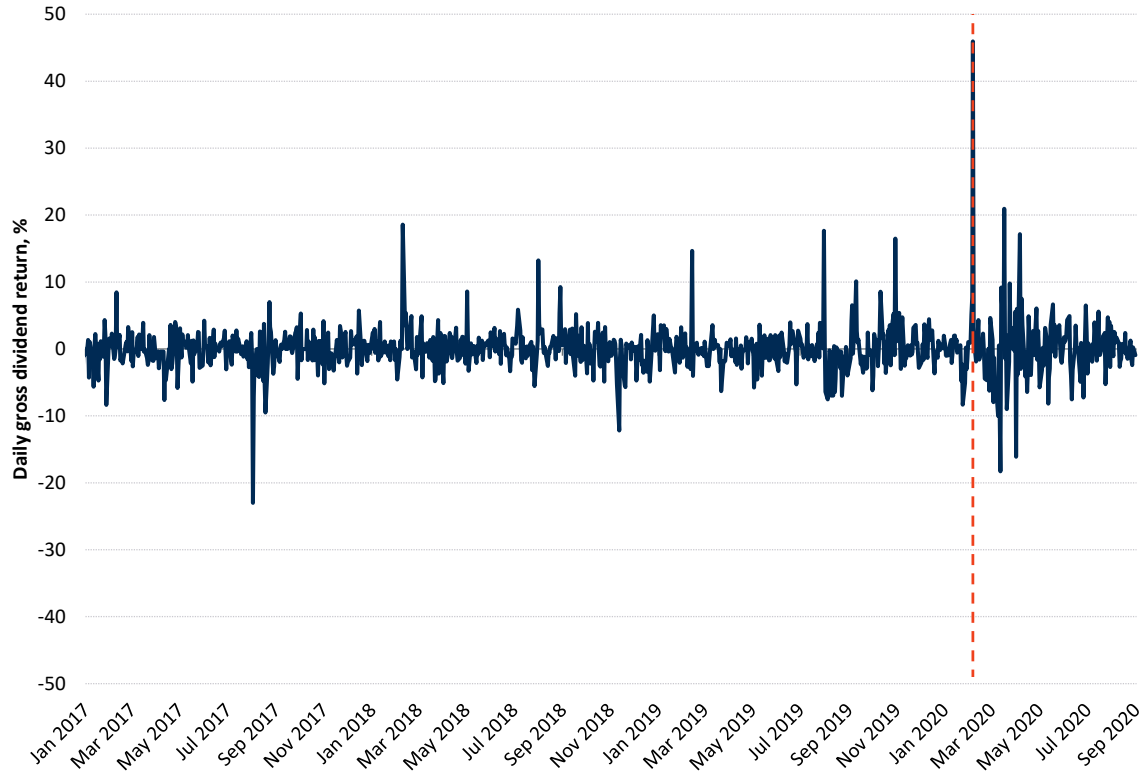
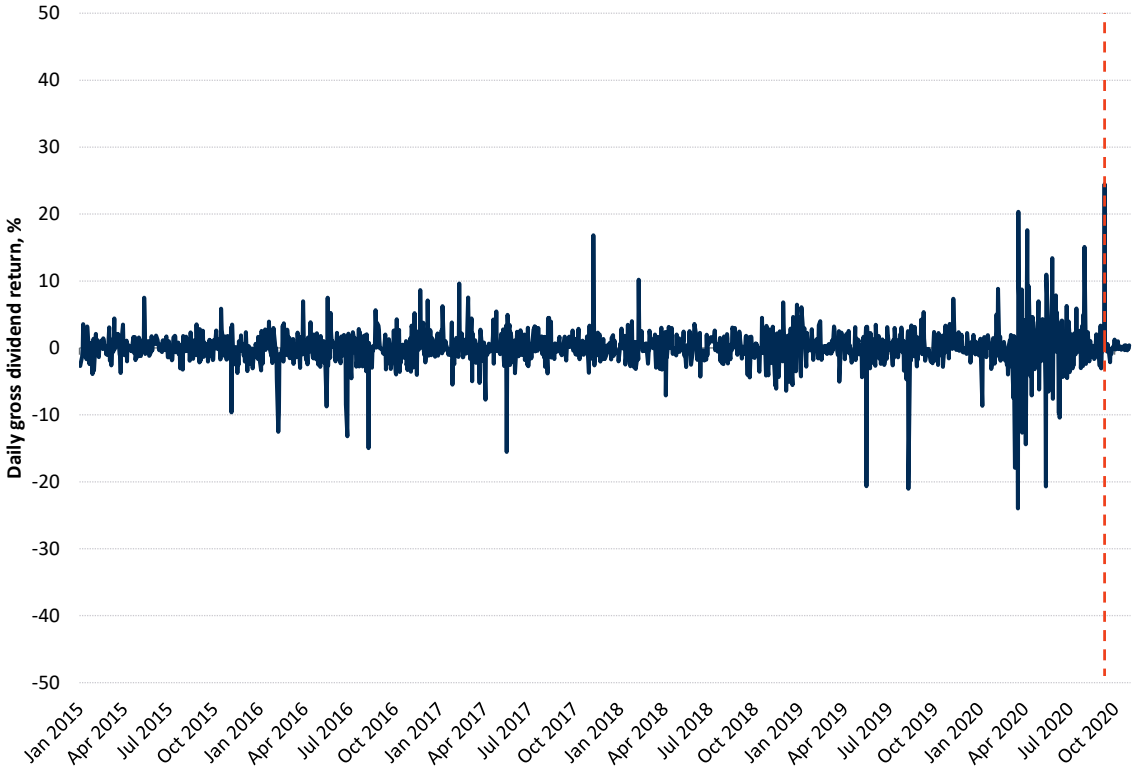


FIGURE A-7: VIRTUSA, M&A ACTIVITY



Appendix B: Adjusted Gearing and Asset Betas Including Operating Leases

B.1 Methodology

119. IFRS 16 became mandatory in 2019, affecting the treatment of operating leases.

120. Until the introduction of IFRS 16, there was a differential treatment between finance leases and operating leases. Finance leases were capitalized and included as liabilities on the balance sheet (along with a corresponding asset). An annual finance expense was then recorded on the income statement. In contrast, annual operating lease payments were expensed in the year incurred. No corresponding capitalised liability (and corresponding asset) were recorded. Disclosure of the future stream of operating lease commitments occurred in the detailed notes to the financial statements.

121. IFRS 16 now requires the same treatment of finance and operating leases. Starting in fiscal year 2019, companies were required to capitalize their operating leases and report them as liabilities. BT and all companies in the comparator groups have adopted IFRS 16 in fiscal year 2019. However, they generally have not restated liabilities in prior years.

122. In Section V we presented adjusted gearing and asset beta estimates for BT and the comparator groups by removing the impact of operating leases in 2019 from the time series of quarterly debt. In this appendix we develop a simplified approach to estimating capitalised operating lease liabilities and gearing had IFRS 16 applied in prior years, and provide estimates of the 1-year, 2-year and 5-year gearing and asset betas including capitalised values of operating lease liabilities.

123. There are two practical issues for calculating the capitalised value of operating lease liabilities before 2019. First, pre-2019 accounts report operating lease commitments with different levels of detail. Second, the capitalised value of operating lease liabilities represents the present value of future lease obligations, discounted to the reporting date at a company's borrowing rate. Pre-2019 accounts do not report average borrowing rates.

124. We construct annual operating lease liabilities by multiplying the simple sum of future operating lease obligations by a company-specific present value (PV) factor. We calculate the PV factor as the ratio of the simple sum of operating lease commitments to operating lease liabilities in fiscal year 2019. This approach has several advantages:

    a. First, a majority of operating lease commitments generally have a maturity of less than 5 years, implying that the present value factor will be close to one.

    b. Second, the term structure of operating leases generally remains stable over time, so that the ratio of operating lease commitments to liabilities is likely to be relatively stable.

    c. Third, the approach is able to capture any stable company specific pattern.

125. Table B-1, below, illustrates our calculation for Vodafone.

TABLE B-1: VODAFONE, YEARLY OPERATING LEASES

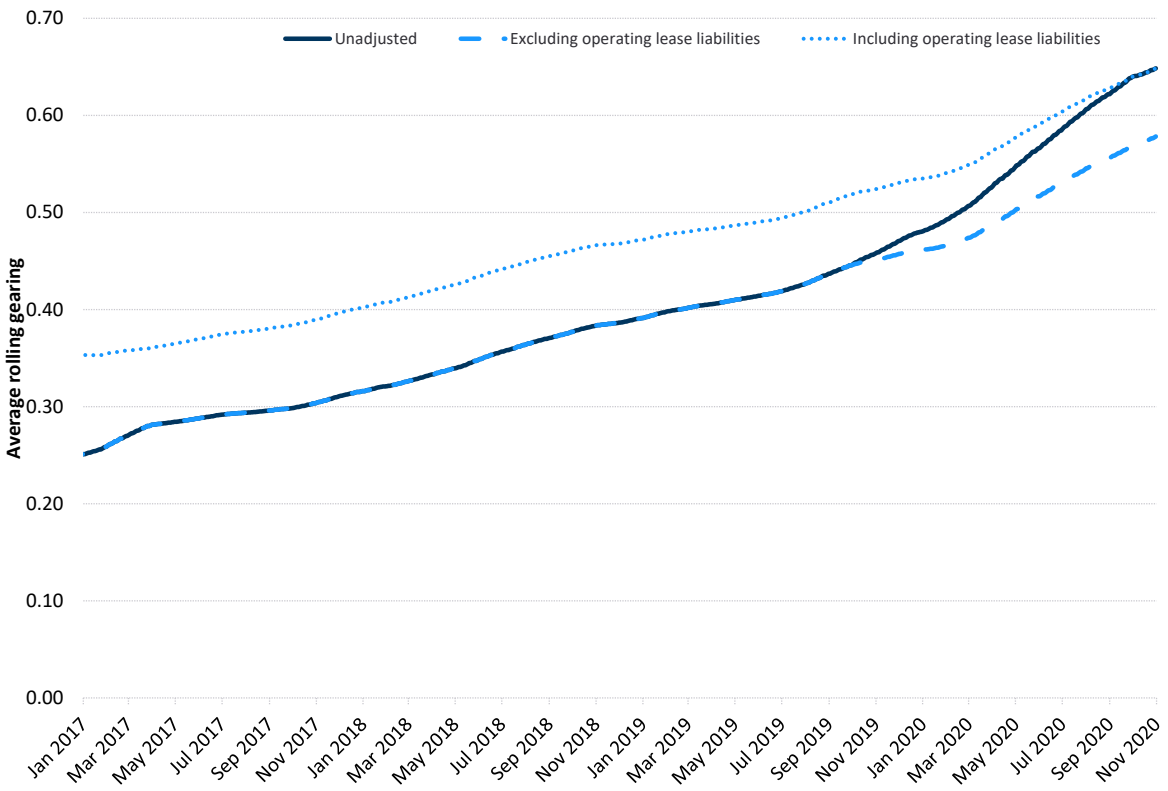
				2016 [A]	2017 [B]	2018 [C]	2019 [D]	2020 [E]
Operating Lease liabilities as of 31 March	[1]	€ mln						12,063
Operating lease commitments as of 31 March	[2]	€ mln		7,862	9,429	9,694	10,816	13,591
Ratio of operating lease liabilities to commitments	[3]	See note	88.8%					88.8%
Operating lease liabilities (as of 31 March)	**[4]**	See note		**6,978**	**8,369**	**8,604**	**9,600**	**12,063**

Notes:
[3]: calculated as the ratio between the 2020 operating lease commitments and the 2020 operating lease liabilities
[4]: 2016,2017,2018,2019 data are calculated as the product between the ratio of operating lease liabilities to commitments and the operating lease commitments of the relative year

126. Overall, our estimated PV factors fall within a reasonable range (70% to 95%) for all companies. The only exception is United Utilities Group PLC (18.6%) due to prevalence of a very long term lease.

127. Figure B-1 illustrates the way IFRS 16 increases BT's 1-Year gearing over time.

FIGURE B-1: BT, 1-YEAR AVERAGE GEARING INCLUDING AND EXCLUDING OPERATING LEASE LIABILITIES



B.2 Results

128. The following tables report gearing and 1-year, 2-year and 5-year asset betas adjusted to including capitalised values of operating leases for BT and each of the comparator groups.

TABLE B-2: BT, ADJUSTED GEARING AND ASSET BETAS INCLUDING OPERATING LEASES

	Gearing With OL	Asset Beta With OL
Local Index		
BT Group PLC		
1-Y	0.65	0.40
2-Y	0.58	0.45
5-Y	0.48	0.53
Global Index		
BT Group PLC		
1-Y	0.65	0.39
2-Y	0.58	0.43
5-Y	0.48	0.55

Source: Brattle elaboration of Bloomberg data and BT's annual reports.

TABLE B-3: UK TELECOMS, ADJUSTED GEARING AND ASSET BETAS INCLUDING OPERATING LEASES

	Gearing With OL	Asset Beta With OL
Local Index		
Vodafone Group PLC		
1-Y	0.65	0.40
2-Y	0.60	0.44
5-Y	0.52	0.51
TalkTalk Telecom Group PLC		
1-Y	0.49	0.45
2-Y	0.45	0.47
5-Y	0.40	0.52
Global Index		
Vodafone Group PLC		
1-Y	0.65	0.41
2-Y	0.60	0.43
5-Y	0.52	0.51
TalkTalk Telecom Group PLC		
1-Y	0.49	0.70
2-Y	0.45	0.72
5-Y	0.40	0.83

Source: Brattle elaboration of Bloomberg data and companies' annual reports.

TABLE B-4: UK UTILITIES, ADJUSTED GEARING AND ASSET BETAS INCLUDING OPERATING LEASES

	Gearing With OL	Asset Beta With OL	Asset Beta With OL
		Local Index	Global Inde
National Grid PLC			
1-Y	0.49	0.38	0.41
2-Y	0.49	0.36	0.37
5-Y	0.48	0.35	0.38
Pennon Group PLC			
1-Y	0.46	0.35	0.38
2-Y	0.50	0.33	0.34
5-Y	0.50	0.34	0.37
Severn Trent PLC			
1-Y	0.52	0.34	0.37
2-Y	0.54	0.33	0.35
5-Y	0.52	0.33	0.37
United Utilities Group PLC			
1-Y	0.58	0.32	0.37
2-Y	0.58	0.31	0.35
5-Y	0.57	0.32	0.36
Mean			
1-Y	0.51	0.35	0.38
2-Y	0.53	0.33	0.35
5-Y	0.52	0.34	0.37
Median			
1-Y	0.50	0.35	0.38
2-Y	0.52	0.33	0.35
5-Y	0.51	0.34	0.37

Source: Brattle elaboration of Bloomberg data and companies' annual reports.

TABLE B-5: EUROPEAN TELECOMS, ADJUSTED GEARING AND ASSET BETAS INCLUDING OPERATING LEASES

	Gearing With OL			Asset beta With OL		
Comparators	**1-Year**	**2-Year**	**5-Year**	**1-Year**	**2-Year**	**5-Year**
Local Index						
Deutsche Telekom AG	0.59	0.56	0.53	0.40	0.40	0.43
Iliad SA	0.50	0.50	0.32	0.31	0.37	0.51
Koninklijke KPN NV	0.42	0.42	0.42	0.44	0.43	0.47
Orange Belgium SA	0.35	0.35	0.39	0.54	0.50	0.39
Orange SA	0.57	0.54	0.52	0.38	0.39	0.44
Proximus SADP	0.29	0.27	0.24	0.42	0.44	0.50
Swisscom AG	0.27	0.27	0.28	0.38	0.38	0.42
Tele2 AB	0.26	0.26	0.27	0.61	0.62	0.68
Telecom Italia SpA/Milano	0.79	0.77	0.72	0.29	0.31	0.41
Telefonica SA	0.71	0.66	0.63	0.36	0.39	0.47
Telenor ASA	0.41	0.35	0.31	0.51	0.53	0.60
Elisa Oyj	0.13	0.15	0.16	0.38	0.39	0.50
Hellenic Telecommunications Organization SA	0.27	0.28	0.32	0.54	0.50	0.53
NOS SGPS SA	0.40	0.36	0.34	0.54	0.55	0.61
Orange Polska SA	0.50	0.52	0.53	0.41	0.39	0.39
Telefonica Deutschland Holding AG	0.40	0.39	0.33	0.41	0.41	0.48
Telekom Austria AG	0.44	0.44	0.42	0.52	0.49	0.40
Telia Co AB	0.43	0.40	0.38	0.54	0.54	0.58
United Internet AG	0.22	0.23	0.20	0.70	0.76	0.79
Mean	0.42	0.41	0.38	0.46	0.46	0.50
Median	0.41	0.39	0.34	0.42	0.43	0.48
Min	0.13	0.15	0.16	0.29	0.31	0.39
Max	0.79	0.77	0.72	0.70	0.76	0.79
Standard Deviation	0.17	0.16	0.15	0.11	0.11	0.11
Global Index						
Deutsche Telekom AG	0.59	0.56	0.53	0.48	0.46	0.50
Iliad SA	0.50	0.50	0.32	0.32	0.36	0.50
Koninklijke KPN NV	0.42	0.42	0.42	0.42	0.40	0.43
Orange Belgium SA	0.35	0.35	0.39	0.57	0.52	0.50
Orange SA	0.57	0.54	0.52	0.33	0.34	0.40
Proximus SADP	0.29	0.27	0.24	0.42	0.41	0.47
Swisscom AG	0.27	0.27	0.28	0.36	0.33	0.38
Tele2 AB	0.26	0.26	0.27	0.52	0.52	0.60
Telecom Italia SpA/Milano	0.79	0.77	0.72	0.26	0.28	0.37
Telefonica SA	0.71	0.66	0.63	0.34	0.37	0.46
Telenor ASA	0.41	0.35	0.31	0.49	0.51	0.60
Elisa Oyj	0.13	0.15	0.16	0.34	0.32	0.43
Hellenic Telecommunications Organization SA	0.27	0.28	0.32	0.54	0.51	0.55
NOS SGPS SA	0.40	0.36	0.34	0.55	0.56	0.65
Orange Polska SA	0.50	0.52	0.53	0.33	0.33	0.36
Telefonica Deutschland Holding AG	0.40	0.39	0.33	0.41	0.41	0.49
Telekom Austria AG	0.44	0.44	0.42	0.59	0.53	0.52
Telia Co AB	0.43	0.40	0.38	0.46	0.46	0.54
United Internet AG	0.22	0.23	0.20	0.60	0.65	0.73
Mean	0.42	0.41	0.38	0.44	0.44	0.50
Median	0.41	0.39	0.34	0.42	0.41	0.50
Min	0.13	0.15	0.16	0.26	0.28	0.36
Max	0.79	0.77	0.72	0.60	0.65	0.73
Standard Deviation	0.17	0.16	0.15	0.10	0.10	0.10

Source: Brattle elaboration of Bloomberg data and companies' annual reports.

TABLE B-6: ICT COMPARATORS, ADJUSTED GEARING AND ASSET BETAS INCLUDING OPERATING LEASES

	Gearing With OL			Asset beta With OL		
Comparators	**1-Year**	**2-Year**	**5-Year**	**1-Year**	**2-Year**	**5-Year**
Local Index						
Amdocs Ltd	0.07	0.05	0.04	0.76	0.74	0.73
CANCOM SE	0.08	0.07	0.08	0.91	1.01	0.96
Capgemini SE	0.21	0.20	0.21	0.92	0.99	0.93
CDW Corp/DE	0.18	0.18	0.23	1.01	0.99	0.90
CGI Inc	0.13	0.11	0.12	0.63	0.65	0.64
Cognizant Technology Solutions Corp	0.08	0.06	0.05	1.08	1.07	1.07
Indra Sistemas SA	0.53	0.52	0.46	0.58	0.61	0.76
International Business Machines Corp	0.38	0.34	0.28	0.63	0.67	0.72
S&T AG	0.21	0.17	0.16	0.99	1.15	1.07
Softcat PLC	0.00	0.00	0.00	0.58	0.66	0.66
Sopra Steria Group	0.30	0.33	0.31	0.84	0.88	0.84
TietoEVRY Oyj	0.28	0.23	0.18	0.78	0.81	0.77
TTEC Holdings Inc	0.25	0.22	0.20	0.91	0.94	0.89
Mean	0.21	0.19	0.18	0.82	0.86	0.84
Median	0.21	0.18	0.18	0.84	0.88	0.84
Min	0.00	0.00	0.00	0.58	0.61	0.64
Max	0.53	0.52	0.46	1.08	1.15	1.07
Standard Deviation	0.14	0.14	0.13	0.17	0.18	0.14
Global Index						
Amdocs Ltd	0.07	0.05	0.04	0.94	0.93	0.88
CANCOM SE	0.08	0.07	0.08	0.99	1.10	1.13
Capgemini SE	0.21	0.20	0.21	1.23	1.27	1.23
CDW Corp/DE	0.18	0.18	0.23	1.17	1.19	1.05
CGI Inc	0.13	0.11	0.12	0.84	0.85	0.86
Cognizant Technology Solutions Corp	0.08	0.06	0.05	1.33	1.05	1.01
Indra Sistemas SA	0.53	0.52	0.46	0.78	0.83	0.89
International Business Machines Corp	0.38	0.34	0.28	0.78	0.83	0.86
S&T AG	0.21	0.17	0.16	1.12	1.30	1.34
Softcat PLC	0.00	0.00	0.00	1.17	1.16	1.22
Sopra Steria Group	0.30	0.33	0.31	1.09	1.08	1.09
TietoEVRY Oyj	0.28	0.23	0.18	0.84	0.85	0.86
TTEC Holdings Inc	0.25	0.22	0.20	1.14	1.16	1.04
Mean	0.21	0.19	0.18	1.03	1.05	1.03
Median	0.21	0.18	0.18	1.09	1.08	1.04
Min	0.00	0.00	0.00	0.78	0.83	0.86
Max	0.53	0.52	0.46	1.33	1.30	1.34
Standard Deviation	0.14	0.14	0.13	0.18	0.17	0.16

Source: Brattle elaboration of Bloomberg data and companies' annual reports.

Appendix C: FTTP Benchmarking, Regulatory Precedent on Fibre Premium

TABLE C-1: REGULATORY PRECEDENT ON FIBRE PREMIUM

NRA		Decision Year	Regulatory period	Premium applied	FTTP	FTTC	Systematic risk premium?	Nominal pre-tax WACC (excluding premium)	Description
AGCOM (Italy)	[1]	2019	2018-2021	3.20%	✓	✓	Non systematic	8.64%	In 2019, AGCOM applied a risk premium of 3.2% to the WACC for FTTP for the 2018-2021 period. The premium was intended to compensate NGA investments due to additional uncertainty in relation to demand, future market dynamics and sunk costs, with AGCOM noting that these risks would not be captured through the beta. AGCOM used a real options theory approach to estimate the risk premium.
CNMC (Spain)	[2]	2018	2018	4.81%	✓	✓	Systematic and Non systematic	6.63%	CNMC applies a single WACC to all fixed line services. In 2013, the CNMC applied a WACC premium for FTTP bitstream access, but this applied only to speeds >30 Mbps. The premium was based on a discounted cash flow model that assessed the difference in the IRR of an FTTP network investment and an alternative ADSL broadband service. This resulted in a 4.81% premium. BEREC indicates that the CNMC still applies the 4.81% premium, but we found no evidence to confirm it.
ComReg (Ireland)	[3]	2019	2019	n/a	×	×	No premium	6.42%	ComReg applies a single WACC to all fixed line services. It believes that no premium is required for FTTP at this point in time because access charges are not cost-oriented. However, should FTTP rental charges become cost oriented ComReg is seeking the views of operators as to how a risk premium, if any, should be determined.
Anacom (Portugal)	[4]	2019	2019	n/a	×	×	FTTP not regulated	7.40%	No regulation of FTTP.
Bnetza (Germany)	[5]	2016	2016-2018	n/a	×	×	No premium	7.01%	Germany currently applies no premium. However, in a 2017 consultation on assessing the investment risk in fiber deployment, the Authority stated that uncertainties in demand, network expansion costs, technical progress, and competitive situation should be considered. Germany currently sets the WACC for fixed services based on a report by [Prof. Stehle (2016). This report also informs the NRA on the nature and quantification of FTTP risks: non diversifiable, and higher than fixed/mobile business. Risks are expected to decrease after the first years. A rough estimate of the real WACC for FTTP networks is 2.78 percentage points higher than the WACC-estimate for the traditional fixed and the mobile network. It is based on a higher equity beta (1.3 vs 0.78), the use of the arithmetic mean in the estimation of the risk premium and a higher debt spread (2.5 vs 1.70 %).
Arcep (France)	[6]	2017	2018-2020	n/a	✓	✓	Systematic and Non systematic	7.60%	ARCEP applies a premium to both FTTP and FTTC. The premium is calculated in a DCF framework as the add-on to the discount rate such that the NPV of a fiber based network project is zero.
DBA (Denmark)	[7]	2019	2019	2%	✓	✓	Systematic	4.72%	2% uplift to nominal WACC before tax. Heterogeneity in the application of the premium based on the geographical area. Beta for fiber derived from the uplifted nominal WACC ceteris paribus.
ACM (Netherlands)	[8]	2016	2016-2018	2%	✓	×	Systematic	6.06%	The ACM applied a 2% premium on the WACC for FTTP untill 2019. The ACM has recently removed price control for fiber access services. Therefore, no premium will apply starting in 2020.

Notes and sources:
[1]: AGCM Del. n. 348/19/CONS.
[2]: Body of European Regulators for Electronic Communications, BoR 19 (240), 2019.
[3]: ComReg consultation 19-54, 31/05/2019.
[4]: European Commission, Commission Decision concerning Case PT/2019/2195: Weighted Average Cost of Capital for MEO (2019) in Portugal, 20/09/2019.
[5]: Stehle 2010, 2016. Bnetza calculates a real pre-tax WACC (5.63%) as a weighted average between a current WACC estimate (5.02%) and the WACC for the previous regulatory period (5.90%). The nominal pre-tax WACC is equal to the sum of the real pre-tax WACC and the inflation rate (1.38%).
[6]: Body of European Regulators for Electronic Communications, BoR 19 (240), 2019.
[7]: Body of European Regulators for Electronic Communications, BoR 19 (240), 2019.
[8]: The Brattle Group, The WACC for KPN and FttH, July 2015.

Appendix D: 5-Year Equity and Asset Betas and 95% Confidence Intervals for UK and European Telecoms

TABLE D-1: UK AND EUROPEAN TELECOMS 5-YEAR EQUITY BETA, ASSET BETA AND 95% CONFIDENCE INTERVALS VS. LOCAL/REGIONAL INDEX

Comparators	5Y Equity Beta	Standard Error	95% Confidence Interval		Debt Beta	Gearing	Local Index Gearing Adjusted	5Y Asset Beta	95% Confidence Interval		5Y Asset Beta Adjusted	95% Confidence Interval	
			Lower Bound	Upper Bound					Lower Bound	Upper Bound		Lower Bound	Upper Bound
UK Telecoms													
BT Group PLC	0.94	0.07	0.80	1.09	0.10	0.40	0.39	0.60	0.52	0.69	0.62	0.53	0.70
Vodafone Group PLC	0.96	0.06	0.84	1.08	0.10	0.49	0.48	0.54	0.48	0.60	0.55	0.49	0.61
TalkTalk Telecom Group PLC	0.80	0.06	0.68	0.92	0.10	0.37	0.36	0.54	0.47	0.61	0.55	0.47	0.62
Incumbents (excluding UK Telecoms)													
Elisa Oyj	0.58	0.05	0.49	0.68	0.10	0.16	0.16	0.51	0.43	0.59	0.51	0.43	0.59
Swisscom AG	0.56	0.03	0.50	0.62	0.05	0.26	0.25	0.42	0.38	0.47	0.43	0.38	0.47
Proximus SADP	0.64	0.06	0.52	0.76	0.05	0.23	0.22	0.51	0.41	0.60	0.51	0.41	0.60
Orange Polska SA	0.71	0.07	0.58	0.85	0.10	0.50	0.48	0.41	0.34	0.47	0.42	0.35	0.49
Koninklijke KPN NV	0.74	0.05	0.65	0.84	0.10	0.41	0.40	0.48	0.42	0.54	0.49	0.43	0.54
Orange SA	0.80	0.04	0.73	0.86	0.10	0.49	0.48	0.46	0.42	0.49	0.46	0.43	0.50
Hellenic Telecommunications Organization SA	0.73	0.07	0.60	0.86	0.10	0.29	0.27	0.55	0.46	0.64	0.56	0.47	0.65
Telia Co AB	0.88	0.05	0.79	0.98	0.10	0.37	0.36	0.59	0.53	0.65	0.60	0.54	0.66
Telekom Austria AG	0.62	0.04	0.55	0.69	0.10	0.41	0.39	0.41	0.36	0.45	0.41	0.37	0.46
Telenor ASA	0.85	0.04	0.78	0.93	0.05	0.29	0.27	0.62	0.57	0.68	0.64	0.58	0.69
Deutsche Telekom AG	0.80	0.04	0.72	0.88	0.10	0.49	0.48	0.46	0.41	0.50	0.47	0.42	0.51
Telefonica SA	1.09	0.07	0.96	1.22	0.10	0.60	0.59	0.49	0.44	0.54	0.50	0.45	0.55
Telecom Italia SpA/Milano	1.20	0.10	1.01	1.39	0.10	0.71	0.71	0.42	0.36	0.47	0.42	0.37	0.48
Alternative Operators (excluding UK Telecoms)													
Iliad SA	0.70	0.07	0.57	0.83	0.10	0.28	0.26	0.53	0.44	0.63	0.55	0.45	0.64
Telefonica Deutschland Holding AG	0.66	0.04	0.57	0.74	0.10	0.23	0.18	0.53	0.46	0.60	0.56	0.49	0.63
Orange Belgium SA	0.57	0.04	0.49	0.65	0.10	0.27	0.23	0.44	0.38	0.50	0.46	0.40	0.52
Tele2 AB	0.89	0.05	0.79	0.98	0.10	0.23	0.22	0.70	0.63	0.78	0.71	0.64	0.79
United Internet AG	0.96	0.08	0.81	1.11	0.10	0.19	0.18	0.80	0.67	0.92	0.81	0.68	0.93
NOS SGPS SA	0.87	0.07	0.73	1.00	0.10	0.31	0.30	0.63	0.53	0.72	0.64	0.54	0.74
European Telecoms													
Average	0.78		0.68	0.89	0.09	0.35	0.34	0.52	0.46	0.59	0.53	0.46	0.60
Min	0.56		0.49	0.62	0.05	0.16	0.16	0.41	0.34	0.45	0.41	0.35	0.46
Max	1.20		1.01	1.39	0.10	0.71	0.71	0.80	0.67	0.92	0.81	0.68	0.93
Incumbents (including BT)													
Average	0.80		0.69	0.90	0.09	0.40	0.39	0.49	0.43	0.56	0.50	0.44	0.56
Min	0.56		0.49	0.62	0.05	0.16	0.16	0.41	0.34	0.45	0.41	0.35	0.46
Max	1.20		1.01	1.39	0.10	0.71	0.71	0.62	0.57	0.69	0.64	0.58	0.70
Alternative Operators (including Vodafone)													
Average	0.80		0.69	0.92	0.10	0.29	0.26	0.60	0.52	0.68	0.61	0.53	0.69
Min	0.57		0.49	0.65	0.10	0.19	0.18	0.44	0.38	0.50	0.46	0.40	0.52
Max	0.96		0.84	1.11	0.10	0.49	0.48	0.80	0.67	0.92	0.81	0.68	0.93

TABLE D-2: UK AND EUROPEAN TELECOMS 5-YEAR EQUITY BETA, ASSET BETA AND CONFIDENCE INTERVAL VS. GLOBAL INDEX

Comparators	5Y Equity Beta	Standard Error	95% Confidence Interval		Debt Beta	Gearing	Global Index Gearing Adjusted	5Y Asset Beta	95% Confidence Interval		5Y Asset Beta Adjusted	95% Confidence Interval	
			Lower Bound	Upper Bound					Lower Bound	Upper Bound		Lower Bound	Upper Bound
UK Telecoms													
BT Group PLC	0.97	0.13	0.72	1.22	0.10	0.40	0.39	0.62	0.47	0.77	0.63	0.48	0.79
Vodafone Group PLC	0.97	0.08	0.82	1.12	0.10	0.49	0.48	0.54	0.47	0.62	0.56	0.48	0.63
TalkTalk Telecom Group PLC	1.32	0.15	1.02	1.62	0.10	0.37	0.36	0.87	0.68	1.05	0.88	0.69	1.07
Incumbents (excluding UK Telecoms)													
Elisa Oyj	0.49	0.09	0.32	0.66	0.10	0.16	0.16	0.43	0.28	0.57	0.43	0.28	0.57
Swisscom AG	0.51	0.07	0.36	0.65	0.05	0.26	0.25	0.39	0.28	0.49	0.39	0.28	0.50
Proximus SADP	0.61	0.11	0.39	0.82	0.05	0.23	0.22	0.48	0.32	0.64	0.48	0.32	0.65
Orange Polska SA	0.65	0.16	0.34	0.96	0.10	0.50	0.48	0.37	0.22	0.53	0.38	0.23	0.54
Koninklijke KPN NV	0.68	0.08	0.51	0.84	0.10	0.41	0.40	0.44	0.34	0.54	0.45	0.35	0.55
Orange SA	0.72	0.08	0.56	0.88	0.10	0.49	0.48	0.42	0.34	0.50	0.42	0.34	0.50
Hellenic Telecommunications Organization SA	0.76	0.09	0.58	0.94	0.10	0.29	0.27	0.57	0.45	0.70	0.58	0.45	0.71
Telia Co AB	0.81	0.11	0.60	1.02	0.10	0.37	0.36	0.54	0.41	0.68	0.55	0.42	0.69
Telekom Austria AG	0.83	0.09	0.65	1.02	0.10	0.41	0.39	0.53	0.42	0.64	0.55	0.43	0.66
Telenor ASA	0.85	0.06	0.73	0.98	0.05	0.29	0.27	0.62	0.53	0.71	0.64	0.55	0.73
Deutsche Telekom AG	0.97	0.05	0.86	1.07	0.10	0.49	0.48	0.54	0.48	0.59	0.55	0.50	0.61
Telefonica SA	1.06	0.11	0.85	1.28	0.10	0.60	0.59	0.48	0.40	0.57	0.49	0.40	0.58
Telecom Italia SpA/Milano	1.07	0.15	0.78	1.37	0.10	0.71	0.71	0.38	0.29	0.46	0.39	0.30	0.47
Alternative Operators (excluding UK Telecoms)													
Iliad SA	0.68	0.11	0.46	0.90	0.10	0.28	0.26	0.52	0.36	0.67	0.53	0.37	0.69
Telefonica Deutschland Holding AG	0.68	0.06	0.56	0.81	0.10	0.23	0.18	0.55	0.45	0.65	0.58	0.47	0.68
Orange Belgium SA	0.76	0.10	0.57	0.94	0.10	0.27	0.23	0.58	0.44	0.72	0.60	0.46	0.75
Tele2 AB	0.79	0.09	0.61	0.96	0.10	0.23	0.22	0.63	0.49	0.76	0.63	0.50	0.77
United Internet AG	0.90	0.10	0.70	1.10	0.10	0.19	0.18	0.74	0.58	0.91	0.75	0.59	0.92
NOS SGPS SA	0.93	0.10	0.74	1.11	0.10	0.31	0.30	0.67	0.54	0.80	0.68	0.55	0.81
European Telecoms													
Average	0.78		0.59	0.96	0.09	0.35	0.34	0.52	0.40	0.64	0.53	0.41	0.65
Min	0.49		0.32	0.65	0.05	0.16	0.16	0.37	0.22	0.46	0.38	0.23	0.47
Max	1.07		0.86	1.37	0.10	0.71	0.71	0.74	0.58	0.91	0.75	0.59	0.92
Incumbents (including BT)													
Average	0.78		0.59	0.98	0.09	0.40	0.39	0.49	0.37	0.60	0.50	0.38	0.61
Min	0.49		0.32	0.65	0.05	0.16	0.16	0.37	0.22	0.46	0.38	0.23	0.47
Max	1.07		0.86	1.37	0.10	0.71	0.71	0.62	0.53	0.77	0.64	0.55	0.79
Alternative Operators (including Vodafone)													
Average	0.81		0.64	0.99	0.10	0.29	0.26	0.60	0.48	0.73	0.62	0.49	0.75
Min	0.68		0.46	0.81	0.10	0.19	0.18	0.52	0.36	0.62	0.53	0.37	0.63
Max	0.97		0.82	1.12	0.10	0.49	0.48	0.74	0.58	0.91	0.75	0.59	0.92