Body of European Regulators for Electronic Communications

BEREC

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BEREC Report on WACC parameter calculations according to the European Commission's WACC Notice of 6th November 2019

(WACC parameters Report 2021)

10 June, 2021

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Executive Summary

In this second BEREC Weighted Average Cost of Capital (WACC) parameters Report BEREC calculates the WACC parameters following the non-binding Commission's WACC Notice on the calculation of the cost of capital for legacy infrastructure in the context of the Commission's review of national notifications in the EU electronic communications sector of 6th Nov. 2019[1]. The cost of capital is the core element of any regulatory pricing decision NRAs take. The Notice aims to ensure a consistent calculation of the WACC by NRAs thereby contributing to the development of the internal electronic communications market.

As the Commission's Notice has not changed, BEREC is following the same methodology (incl. 'technical choices') as in last year's Report providing utmost continuity.

BEREC applied three general principles:

- Follow the Notice as closely as possible, which mainly refers to the methodologies to be used for the estimations;
- Be transparent, using publicly available data where possible or using data which is widely used and accepted in the financial markets, which refers to the data sources to be used for the estimations;
- Explain every step of the calculation and proceed in a straightforward manner, which refers to the calculations as such.

For each of the parameters of the WACC formula (using the CAPM approach) the Report sets out:

- the application of the methodologies according to the WACC Notice,
- the assumptions and choices made,
- the data and data sources used,
- the steps of the calculations,
- the results.

By explaining precisely and transparently how the results were derived NRAs will be able to follow the BEREC calculation steps from start to end and to fully understand the logic of the calculation process so that they can replicate the results shown in the WACC parameters Report. This ensures that NRAs are confident that the results are robust and were derived using state of the art professional standards as well as following the Notice as closely as possible taking into account also best regulatory practices where the Notice provides for NRAs' flexibility.

[1] https://ec.europa.eu/digital-single-market/en/news/commission-publishes-notice-calculation-cost-capital-legacy-infrastructure.

All results were cross checked and verified to ensure that no methodological mistakes have been made, no questionable data has been used and no calculation errors have occurred, so that BEREC was able to exclude any systematic bias. Only after these checks were carried out, BEREC was satisfied that the results were correct and NRAs will be confident to use them in their own WACC calculations.

The following Table provides a summary of the structure of the WACC parameters Report, BEREC's calculations and (references to) the results derived from it.

Table 0 Summary of the structure of the BEREC WACC parameters Report 2021 with references to result tables

Chapter	**Parameter**	**Results**	**Reference (Table)**
Chapter 1	Introduction WACC formula		
Chapter 2	RFR	RFR for each EU member state	Table 2
Chapter 3	Peer group	BEREC Peer Group 2021 comprising 14 companies	Table 3
Chapter 4	Debt premium, Cost of debt	Debt premium, Cost of debt for each of the 14 companies of the BEREC Peer Group	Table 4
Chapter 5	Equity beta, Gearing, Asset beta	Equity beta, Gearing, Asset beta for each of the 14 companies of the BEREC Peer Group	Table 6
Chapter 6	ERP	EU-wide ERP	Table 10 + 11
Chapter 7	Summary	All WACC parameters as calculated by BEREC	Table 12 + 10

The novelty of the Notice and the WACC parameters Report is the calculation of an EU-wide ERP (equity risk premium). Based on the calculations described in Chapter 6 BEREC considers that the appropriate value of the single EU-wide ERP (without UK) is 5.50% (AM). As the same methodology as last year was used, the increase from 5.31% (AM 2020) to 5.50% in 2021 is mainly attributable to the one-off effect of the UK leaving the EU.

For the first time BEREC estimated additionally a separate EU/EEA-ERP for exclusive use by Nkom (Norway), PFS (Iceland) and AK (Liechtenstein)[2].

BEREC will publish the estimated WACC parameter values and NRAs are assumed to take into account those parameter values when carrying out their own calculations for their national regulatory decisions, but they do have some flexibility within this framework to take account of national specificities. For reference by NRAs the Report is to be published before 1st July 2021 when the Commission starts applying the Notice when reviewing NRA's notifications in the EU electronic communications sector.

BEREC has taken utmost care to develop this Report according to the best knowledge and technical expertise of its members. Nevertheless improvements may be necessary in the future yearly update where deemed appropriate.

1. General introduction

This Report contains the results of the calculations run by BEREC to estimate the parameters of the Weighted Average Cost of Capital (WACC) according to the non-binding Commission Notice on the calculation of the cost of capital for legacy infrastructure in the context of the Commission's review of national notifications in the EU electronic communications sector[3] and the Commission Staff Working Document (SWD)[4] accompanying the WACC Notice which describes the methodologies in more detail. Acc. to para. 6 of the Notice the scope is limited to the WACC calculation for legacy infrastructure.[5]

The following introductory chapter describes the tasks assigned to BEREC by the Notice and the general principles BEREC follows in fulfilling these tasks as assigned acc. to section 7[6] of the Notice.[7] The goal of this Report – according to the tasks – is to enable NRAs to make use of the results of the calculations when setting the WACC in their national regulatory decisions.

For this purpose it is important that the Report is as clear and as detailed as possible in describing each step of the calculation in such a manner that each NRA can replicate the results and thus rely fully on the robustness of BEREC's calculations. The Report therefore explains for each of the parameters estimated:

- the application of the methodologies according to the WACC Notice,
- the assumptions and choices made,

[2] As no data is available for Liechtenstein, the separately estimated EU/EEA-ERP includes only data for Norway and Iceland.
[3] OJ 2019/C 375/01 of 6th Nov. 2019, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52019XC1106(01)&from=EN – the Notice.
[4] SWD(2019) 397_final, https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=62834, the SWD.
[5] Legacy infrastructure means infrastructure of an SMP operator not subject to a Next Generation Access (NGA) premium.
[6] See section 1.1. below.
[7] BEREC is not taking any view regarding the Notice in this Report. BEREC provided input during the Commission's public consultation in 2018, cf. BEREC Position Paper – Input to the Commission's WACC consultation 2018, BoR (18) 67, publ. in Oct. 2018, https://berec.europa.eu/eng/document_register/subject_matter/berec/opinions/8257-berec-position-paper-input-to-the-commission8217s-wacc-consultation-2018.

- the data and data sources used,
- the steps of the calculations,
- the results.

By explaining precisely and transparently how the results were derived NRAs can be confident that they meet state-of-the-art professional standards and that BEREC followed the Notice as closely as possible taking into account also best regulatory practices where the Notice provides for NRAs' flexibility as well as drawing on the explanations of the SWD.

At the end of the introduction the structure of the Report will be outlined for a better understanding and easy reference.

Also, for an easy reference, the standard **WACC formula** as used in the WACC Notice[8] is shown hereafter:

$$WACC = R_E \times \frac{E}{D+E} + R_D \times \frac{D}{D+E}$$

$$R_E = RFR + ß \times ERP$$

$$R_D = RFR + \text{Debt Premium}$$

$$WACC = [(\frac{E}{D+E}) \times (RFR + ß \times ERP)] + [(\frac{D}{D+E}) \times (RFR + \text{Debt Premium})],$$

Where

R_E = the cost of equity (to be estimated using the Capital Asset Pricing Model (CAPM);

ß = beta;

ERP = the equity risk premium;

R_D = the cost of debt;

RFR = the risk-free rate;

Debt Premium = the additional return that lenders require from a company with a given credit risk, over and above the RFR;

E = the value of equity, with $\frac{E}{D+E}$ being the share of equity in the company value (D+E);

D = the value of debt, with $\frac{D}{D+E}$ being the share of debt in the company value (D+E); the share of debt in the company value is also called *gearing (g)*;

V = the value of the company, which is equal to the sum of debt and equity (V = D+E).

[8] As set out in section 2 of the WACC Notice.

This is the second time that this Report is being produced by BEREC. BEREC has taken utmost care to develop this Report according to the best knowledge and technical expertise of its members based on their longstanding experience of applying regulatory principles[9] when setting the WACC in pricing decisions which are reported every year in a specific chapter of the BEREC Regulatory Accounting in practice Report.[10]

As the Commission's Notice has not changed, BEREC is following the same methodology (incl. 'technical choices') as in last year's Report. This implies that changes in the results are due to factual developments, i. e. reflect market and other developments such as the (one-off effect of) UK leaving the Union.

1.1. BEREC's tasks according to the WACC Notice

BEREC's tasks are described in para. 64 – 67 of section 7 of the Notice "Role of BEREC and the Commission in the calculation of WACC parameters". Acc. to section 7 BEREC in close collaboration with the Commission estimates the WACC parameters consistent with the approach described in the Notice. BEREC will estimate and publish the values on an annual basis for the parameters reflecting general economic conditions and the company-specific parameters for the selected peer group.

The parameters reflecting general economic conditions described in section 4 of the Notice consist of the **RFR** which will be estimated for each EU member state and a **single EU-wide ERP**. The single EU-wide ERP follows from the assumption of ultimately reaching a common EU capital market (para 38 Notice).

The company-specific parameters described in section 5 of the Notice consist of the following parameters: **equity beta, gearing, debt premium**, and the **cost of debt** (R_D), the latter being calculated indirectly as the sum of the **domestic RFR** and the **debt premium**. Given that the calculation of the cost of debt includes the *domestic* RFR the debt premium must also be estimated using (besides the relevant corporate bonds) corresponding government bonds of the *home country* of the company as a benchmark in order to avoid inconsistencies. This assumes an investor taking a "home country" approach or, in the context of the Notice, an EU rather than a global investor's perspective. The company-specific parameters will be estimated for each company of the peer group.

BEREC will prepare a list of companies suitable for the **peer group** by following the criteria for selecting the peer group as outlined in para. 44 of the Notice. BEREC will estimate the equity beta, gearing, debt premium and cost of debt for each company included in the list. Acc. to para. 67 BEREC will also describe factors justifying the removal of one or more companies from the "BEREC peer group" to take into account national specificities.

[9] For the regulatory principles see below section 1.2.1.

[10] For an overview of current NRAs' practices when setting the WACC cf. to the latest BEREC Regulatory Accounting in practice Report, WACC chapter (ch. 5), BoR (20) 210, publ. in Dec. 2020, https://berec.europa.eu/eng/document_register/subject_matter/berec/reports/9718-berec-report-on-regulatory-accounting-in-practice-2020.

When estimating the parameters BEREC takes into account the assumptions common to several WACC parameters as described in section 3 of the Notice, namely the length of the averaging period and the averaging method. This ensures "internal consistency" of the estimations. Also to be consistent throughout all parameters the cut-off date is set at 1st April 2021 for this Report.

BEREC will publish the estimated WACC parameter values and NRAs are assumed to take into account those parameter values when carrying out their own calculations for their national regulatory decisions, but they do have some flexibility within this framework to take account of national specificities. The Report is due to be published before 1st July 2021.

1.2. General principles

The work of BEREC is guided by the following three main principles:

- Follow the Notice as closely as possible, which mainly refers to the methodologies to be used for the estimations;
- Be transparent, using publicly available data where possible or using data which is widely used and accepted in the financial markets, which refers to the data sources to be used for the estimations;
- Explain every step of the calculation and proceed in a straightforward manner, which refers to the calculations as such.

The three principles are set out in the following sections. Taken together they serve to ensure a robust result on which NRAs can rely.

1.2.1. Follow the Notice as closely as possible

Following the Notice as closely as possible ensures that BEREC uses the methodologies of the Notice (and detailed in the SWD), i.e. BEREC is doing what it is asked to do. By applying the methodologies foreseen in the Notice BEREC contributes to a consistent application of the regulatory framework thus promoting a competitive internal market for electronic communications networks and services. More specifically, BEREC thus contributes to NRAs using a consistent calculation method for estimating the WACC by NRAs.

In this regard it is important to recall that in line with the objectives of the EU Framework, the Notice is based on four regulatory principles laid down in para. 8: (i) consistency in the methodology; (ii) predictability; (iii) promotion of *efficient* investment taking into account the risk incurred; and (iv) transparency of the method to determine the reasonable rate of return avoiding unnecessary complexity. When calculating the WACC NRAs equally observe these regulatory principles[11].

[11] Cf. also BEREC Position Paper – Input to the Commission's WACC consultation 2018, BoR (18) 67, publ. in Oct. 2018.

With regard to the methodological approach the Notice follows the financial market theory known as the Capital Asset Pricing Model (CAPM)[12]. This methodological approach to estimate the cost of equity is based on a number of assumptions. Generally, the application of any methodology requires making assumptions and choices to reflect the concrete situation and specific purpose of the calculation.[13] In particular this is true for the estimation of WACC parameters, which is a very complex multi-dimensional process that in some instances imply that trade-offs must be solved one way or the other.

Thus, BEREC also had to make some 'technical' choices to be able to apply the methodologies foreseen in the Notice in a meaningful and consistent manner to reach robust results applicable by all NRAs. When making choices BEREC used the margin left in the Notice mindfully to stay in line with the Notice and financial market theory in these cases. Where these choices are made, they are made objectively and the reasons are explained in detail. BEREC followed the best regulatory practice stemming from the application of the CAPM which all NRAs already currently use when calculating the WACC.[14]

1.2.2. Be transparent, using public data where possible

The second principle relates to the ensuring that only reliable data is used for the estimations. The choice of the data sources used must be made transparent and explained explicitly. Whenever possible, preference was given to the use of publicly available data, in particular official EU data sources such as Eurostat and the ECB.

However, the estimation of certain parameters required specific financial market data, namely long term historic data series from Morningstar[15] necessary to estimate the single EU-wide ERP and data derived from the Bloomberg financial system[16] to estimate certain company specific parameters. Both data sources are widely used and accepted by financial market players. Access to this data has to be procured by the BEREC Office to be able to estimate the parameters and publish the results of the calculations based on this specific data. Being proprietary the data as such cannot be published. In order to be able to rely on this type of data BEREC needs to be sure it understands exactly how the data was compiled. BEREC therefore requested and received explanations from the providers on how the data was compiled and aggregated.

[12] Cf. Chapter 5 below for a description.
[13] In this case to estimate WACC parameter values reflecting the cost of capital (SMP) operators face across the EU when investing in telecoms infrastructure for the WACC calculations of NRAs.
[14] Cf. BEREC Regulatory Accounting in practice Report, ch. 5, BoR (20) 210, publ. in Dec. 2020.
[15] Morningstar provides a soft copy of the latest DMS data set (which itself is compiled by Dimson/Marsh/Staunton (DMS) and published yearly in hard copy by Credit Suisse/London Business School as the *Credit Suisse Global Investment Returns Yearbook*). For the calculations in this BEREC Report the 2021 version with data from 1900 through to 2020 was used, i.e. the data source is Dimson/Marsh/Staunton, Global Investment Returns Database 2020 (distributed by Morningstar Inc.). BEREC Office acquired the DMS data distributed by Morningstar Inc. for BEREC.
[16] BEREC Office acquired for BEREC access to the Bloomberg financial system, which is henceforth referred to as Bloomberg. This year BEREC was able to make more extensive use of Bloomberg, therefore the data quality has further improved.

1.2.3. Explain every step of the calculation and proceed in a straightforward manner

The third principle relates to the calculation process as such. To ensure that all NRAs can easily understand and replicate the results of the BEREC calculations, every step of the estimation of each of the parameters is explained in detail and in a straightforward manner. Thus, NRAs will be able to follow the BEREC calculation steps from start to end and to fully understand the logic of the calculation process. This ensures that NRAs are confident that the results are robust and were derived using state of the art professional standards.

All results were cross checked and verified to ensure that no methodological mistakes have been made, no questionable data has been used and no calculation errors have occurred, so that BEREC was able to exclude any systematic bias. Only after these checks were carried out, BEREC was satisfied that the results were correct and NRAs will be confident to use them in their own WACC calculations.

1.3. Structure of the Report: parameter by parameter following the WACC formula

The introduction closes with a short overview of the structure of the report which largely follows the structure of the Notice which itself follows the WACC formula:

$$\text{WACC} = [(\frac{E}{D+E}) \times (\text{RFR} + ß \times \text{ERP})] + [(\frac{D}{D+E}) \times (\text{RFR} + \text{Debt Premium})].$$

Chapter 2 describes the estimation of the RFR.

Chapter 3 sets out the peer group and provides criteria that NRAs can use to remove peer group members to take account of national specificities.

In Chapter 4 the debt premium and the cost of debt is calculated for each member of the peer group.

In Chapter 5 the beta and gearing are estimated for each member of the peer group.

Chapter 6 contains the calculation of the single EU-wide ERP and for the first time also the separate EU/EEA ERP (for exclusive use by Nkom, PFS and AK) which is a key parameter and certainly the most complex to calculate. Therefore it is placed at the end of the Report.

Chapter 7 summarises all results in an overview table for easy reference. Furthermore this chapter also touches upon taxes and inflation (section 6 of the Notice). It also contains a short section comparing the results of the 2021 and the 2020 WACC parameters Report.

2. RFR

2.1. Definition and data source used

The risk-free rate (RFR) is the rate of return an investor would expect to gain from investments in financial instruments that theoretically do not carry any risk of default, such as a government bond. However, even the safest investments may carry some risk of default.

In the CAPM the risk free rate is a parameter used to calculate the cost of equity and the cost of debt:

Cost of equity = Risk Free Rate + ß x Equity Risk Premium

Cost of debt = Risk Free Rate + Debt Premium

The established practice by most NRAs to date has been to calculate the risk free rate by using yields on 10-year domestic government bonds.[17]

BEREC's calculation of the risk free rate is based on data retrieved from Eurostat as the official publicly available source for EU data and referred to in para. 36 of the Notice. The Eurostat dataset is described as follows: "Long term government bond yields are calculated as monthly averages (non-seasonally adjusted data)"[18]. They refer to central government bond yields on the secondary market, gross of tax, with a residual maturity of around 10 years. The bond or the bonds of the basket have to be replaced regularly to avoid any maturity drift. This definition is used in the convergence criteria of the Economic and Monetary Union for long-term interest rates, as required under Article 121 of the Treaty of Amsterdam and the Protocol on the convergence criteria".[19]

2.2. Methodology with reference to Notice

BEREC uses yields on domestic 10-year government bonds for each Member State to calculate the risk free rate. The approach of using long-term bonds, which are less volatile than shorter-term bonds, is in line with the longer-term nature of investments in electronic communications networks. Moreover, it follows the Notice since the Commission underlines that the use of domestic government bonds, together with a consistent methodology, will

[17] BEREC Report, Regulatory Accounting in Practice 2020, Chapter 5.2.1 Risk Free Rate, Figure 9 Methodology used to estimate RFR (fixed market), BoR (20) 210, December 2020.
[18] Online data code: TEIMF050.
[19] See further information on long-term interest rate statistics and convergence criteria for EU Member States: https://www.ecb.europa.eu/stats/financial_markets_and_interest_rates/long_term_interest_rates/html/index.en.html: Annex 1.

ensure that differences in risk free rates capture specific country-risks and reflect differences in financing conditions within the Member States.[20]

Eurostat provides the following description of how it derives this data: yields of long-term government bonds are provided on a monthly basis.[21] Only bonds with an outstanding amount of at least EUR 5 billion are included in the data.[22] The European Central Bank (ECB) provides the underlying data in line with their prescribed methodology.[23] The rates/yields are calculated as monthly arithmetic averages based on daily data provided by National Central Banks' official rates. Daily values are obtained from real trade, in line with the requirements stipulated by the ECB, with the benchmark bond, or imputed values from prior trades when no transactions with the benchmark bond have been made. The monthly values are calculated as an unweighted arithmetic average of daily yields.

Each EU Member State can select between a benchmark bond and a basket of bonds, issued by Central governments. The residual maturity should be as close as possible to 10 years as the recommended residual maturity of bonds should be between 9.5 and 10.5 years. Consequently, the bonds of the basket have to be replaced regularly in order to avoid a maturity drift.[24]

The benchmark bond should be sufficiently liquid and only yields on actively traded government bonds with a maximum bid-ask spread per quote of three basis points are included. The prices and yields are taken at close of market on the trading day.[25] The yield to maturity serves as a nominal long-term interest rate without any adjustments for coupon effects, taxes, or inflation. The rates are not subject to seasonal adjustments.[26] The risk free rates have not been adjusted for any quantitative easing programs in line with the Notice[27].

The averaging period BEREC uses for calculating each country-specific risk free rate is **five-years** and is based on monthly data retrieved from Eurostat. This is in line with the Notice on the calculation of the cost of capital, which highlights that this approach would strike the right balance between predictability and efficiency.[28]

[20] Cf. Notice and SWD.
[21] See https://ec.europa.eu/ eurostat/tgm/table.do?tab=table&plugin=1&language=en&pcode=teimf050. Metadata file on Eurostat: https://ec.europa.eu/eurostat/cache/metadata/en/irt_lt_mcby_esms.htm.
[22] Eurostat metadata, Monetary and financial indicators, 10.6 Documentation on methodology.
[23] See ECB background information on the full monthly time series of long-term interest rate data.
[24] Eurostat, https://ec.europa.eu/eurostat/cache/metadata/en/ei_mf_esms.htm#meta_update1570115961737.
[25] Eurostat metadata, Monetary and financial indicators, 10.6 Documentation on methodology.
[26] European Central Bank, Convergence Report, section 6.5. Link: https://www.ecb.europa.eu/pub/convergence/html/ecb.cr201805.en.html#toc8
[27] Section 4, para. 36.
[28] Notice, para 37.

2.3. Assumptions and choices made

The data used by BEREC has been retrieved from a reliable, publicly available official source (Eurostat, based on ECB statistical data).

The Eurostat reference area for this data are EU member states except Estonia.[29]

Estonia has not issued any 10-year government bonds that comply with the definition of long-term interest rates for convergence purposes. Neither has the ECB been able to identify any suitable proxy indicator that could be used as an alternative. Consequently Eurostat has harmonised the data series for all the Member States apart from Estonia.

To remedy this lack of data for Estonia BEREC has decided to apply to Estonia the same Risk Free Rate as is applied to another EU country with similar country characteristics and credit rating[30].

Eurostat does not collect corresponding data for Iceland and Norway[31]. Therefore, data for Iceland have been retrieved from Bloomberg using the benchmark bond with 10 years residual maturity. Norwegian data have been provided by NKOM based on data by the Central Bank of Norway (Norges Bank).[32] Furthermore, some additional country specific issues have been itemised in the footnote.[33]

[29] See metadata file on Eurostat: https://ec.europa.eu/eurostat/cache/metadata/en/irt_lt_mcby_esms.htm

[30] Estonia has a Credit Rating of A1 for each month in the 5 year time period so BEREC calculates the average RFR for each month of all countries that have a Credit Rating of A1 in that month and when not available the RFR of more closer credit rating countries. Specifically: (i) the monthly RFR of Czechia (A1 Credit rating) from 2016-04 until 2019-09 has been considered; (ii) the monthly average of RFR of countries with credit ratings immediately above and below the one of Estonia (A2 and Aa3 credit rating) from 2019-10 until 2020-05; iii) the monthly Estonia Long term government bond yield itself (available data on Eurostat) from 2020-6 until 2021-03. BEREC has calculated an average on a 5 years period and has applied it to Estonia.

[31] An enquiry to Eurostat was answered by email of the Eurostat User Support on 29.04.2021 with the following information (sic.): “In dataset “EMU convergence criterion series – monthly data”, reference area is: Euro area and EU aggregates, and Member States except Estonia.”

[32] https://www.norges-bank.no/en/topics/Statistics/Interest-rates/Government-bonds-monthly/.

[33] In **Bulgaria** the calculation of the “Long-Term Interest Rate for Convergence Assessment Purposes” (LTIR) has been developed by the Bulgarian National Bank (BNB) in cooperation with the national Ministry of Finance and in compliance with the requirements of the ECB. Bulgaria has selected a benchmark approach, because it is a small market, and the liquidity of different bonds may be very diverse. The calculation of the LTIR is based on a database of the Bulgarian National Bank (BNB). The BNB informs the Ministry of Finance when a replacement of the benchmark bond takes place, i.e. when the benchmark bond no longer meets the requirements for residual maturity and another security. Daily values are taken from real trade, in line with the requirements of the ECB with the benchmark bond or an imputed value from prior trades when no transactions with the benchmark bond have been made. Monthly values are calculated as an unweighted arithmetic average of the daily yields. For **Germany** the Eurostat data is based on a time series provided by Deutsche Bundesbank (BBK01.WT00557) which consists of yields on listed Federal securities. It only includes bonds eligible as underlying instruments for future contracts and calculated as unweighted averages with a mean residual maturity of 9 and up to 10 years, with daily data. Source: www.bundesbank.de/dynamic/action/en/statistics/time-series-databases/time-series. In **Lithuania** - according to the Central Bank of Lithuania - the yields on 10-year government bonds provided by Eurostat may not be representing actual market values correctly. As a basis for the yields on 10-year government bonds Eurostat uses trades on Nasdaq Vilnius, but since there are few trades and the last known rate is used if no further trades are registered, yields reported may be based on outdated statistical data. Source: email of 07.02.2020 by Antanas Bumblauskis, Lietuvos Bankas. In **Slovenia** the Bank of Slovenia does not change the bond underlying LTIR statistics compilation immediately upon the issue of a new 10-year bond in combination with the criteria of volume of market transactions. Source: email of 07.02.2020 by Franc Otoničar, Banka Slovenije.

2.4. Calculation steps – description of how the result is derived

The determination of the Risk Free Rate per country is based on data published by Eurostat[34] and calculating a five-year arithmetic average of data from 1st April 2016 to 31st March 2021.[35]

As mentioned above in section 2.3, due to lack of data, the risk free rate for Estonia has to be determined based on a corresponding EU country with similar country characteristics and credit rating. A country credit rating reflects the interest premium on private loans or government bonds due to the underlying risk associated with the country in question. Thus from the perspective of an investor, it represents a risk premium. The level of the risk premium is dependent e.g. on the general economy, political stability and credit worthiness of the country. These factors are considered by Rating Agencies such as Fitch, Moody's and Standard & Poor's for establishing the country risk rating. The rating usually corresponds with the credit rating for the country's government bonds. The five-year average has been evaluated considering comparable returns in term of credit rating along the time series. The result for Estonia has been derived from the average return of countries with comparable credit rating along a five-year time-window, also taking into account the evolution of the credit rating of Estonia.

Moody's credit rating was used for this purpose.

Table 1 Country Economic Factors (Eurostat)

Country Code	Country	Number of inhabitants[36]	GDP per capita[37]	Unemploy-ment[38]	HICP[39]
AT	Austria	8,858,775	141.9	4.2%	108.47
BE	Belgium	11,455,519	131.9	5.8%	108.23
BG	Bulgaria	7,000,039	29.5	5.3%	106.27
HR	Croatia	4,076,246	41.0	9.2%	103.06
CY	Cyprus	875,899	78.9	8.1%	99.67
CZ	Czechia	10,649,800	67.3	3.0%	111.40
DK	Denmark	5.806.081	180.3	5.8%	102.90
EE	Estonia	1,324,820	68.9	7.4%	109.80

[34] Source Eurostat Long term government bond yields 2016M04 to 2021M03.
[35] Notice, paragraphs 27 and 29.
[36] Source: Eurostat. Total population figure on 1st January 2019. Ireland: estimated. France: provisional https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=demo_gind&lang=en
[37] Source: Eurostat Database: Main Gross Domestic Product (GDP) aggregates per capita 2020. Percentage of EU 27 (=100) from 2020 total per capita (based on million Euro, current prices https://ec.europa.eu/eurostat/databrowser/view/nama_10_pc/default/table?lang=en
[38] Source: Eurostat. Unemployment rate Q4 20. Germany: Q4, 2019 https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=lfsq_urgan&lang=en
[39] Source: Eurostat. Harmonised Index of Consumer Prices (HICP) annual average Index 2020. Index 2015 = 100. Iceland: break in time series https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=prc_hicp_aind&lang=en

FI	Finland	5,517,919	144.8	7.4%	103.98
FR	France	67,012,883	113.6	8.3%	105.50
DE	Germany	83,019,213	135.2	3.1%	105.80
EL	Greece	10,724,599	52.2	16.2%	102.46
HU	Hungary	9,772,756	47.0	4.2%	113.15
IE	Ireland	4,904,240	248.1	5.7%	101.20
IT	Italy	60,359,546	92.7	9.5%	103.00
LV	Latvia	1,919,968	52.0	7.9%	108.62
LT	Lithuania	2,794,184	59.0	9.1%	110.63
LU	Luxemburg	613,894	342.6	6.6%	105.93
MT	Malta	493,559	83.8	4.4%	106.37
NL	Netherlands	17,282,163	154.4	4.0%	106.96
PL	Poland	37,972,812	46.0	3.1%	108.60
PT	Portugal	10,276,617	66.2	7.2%	103.58
RO	Romania	19,414,458	38.0	5.2%	110.67
SK	Slovakia	5,450,421	56.5	7.0%	108.47
SI	Slovenia	2,080,908	74.2	5.1%	104.82
ES	Spain	46,937,060	79.9	16.1%	103.91
SE	Sweden	10,230,185	153.8	7.9%	107.63
IS	Iceland	360,563	175.9	7.5%	103.03
NO	Norway	5,347,896	199.5	4.6%	112.8

2.5. Results

A **Risk Free Rate** based on a five year arithmetic average (April 2016 to March 2021) has thus been determined for each EU member state.

Table 2 BEREC Risk Free Rate EU Member States

Country Code	Country	Country Credit Rating[40]	5 year arithmetic average[41]
AT	Austria	AA1	0.26
BE	Belgium	A3	0.36
BG	Bulgaria	BAA1	0.97
HR	Croatia	BA1	1.95
CY	Cyprus	BA2	1.92
CZ	Czechia	AA3	1.27
DK	Denmark	AAA	0.10
EE	Estonia	A1	0.97
FI	Finland	AA1	0.24
FR	France	AA2	0.37
DE	Germany	AAA	-0.03
EL	Greece	BA3	4.04
HU	Hungary	BAA3	2.73
IE	Ireland	A2	0.50
IT	Italy	BAA3	1.82
LV	Latvia	A3	0.45
LT	Lithuania	A2	0.35
LU	Luxembourg	AA2	0.12
MT	Malta	A2	0.90
NL	Netherlands	AAA	0.15
PL	Poland	A2	2.62
PT	Portugal	BAA3	1.71
RO	Romania	BAA3	4.05
SK	Slovakia	A2	0.47
SI	Slovenia	A3	0.60
ES	Spain	BAA1	1.01
SE	Sweden	AAA	0.34
IS	Iceland	A3	4.39
NO	Norway	AAA	1.38

[40] Source Moody's via Bloomberg (Moody's country credit ratings are comparable to S&P's country credit ratings.)
[41] Source: BEREC average based on Eurostat Long term government bond yields 2016M04 to 2021M03, https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&4.39) pcode=teimf050&language=en. Data for Estonia and Iceland derived by BEREC, data for Norway provided by the Norwegian Central Bank

3. Peer group

3.1. Definition and data source used

The peer group is defined by selecting are companies that fit the Commission criteria – see section 5.3.2.3 of the Staff Working Document.

The data source used to check if a company is listed on a stock exchange is Bloomberg.

3.2. Criteria from the Notice

BEREC has closely followed the criteria in the Notice and the Staff Working Document when deciding on which companies to include in the peer group. Section 5.3.2.3 of the Staff Working Document lists the following criteria for selecting the companies that should be included in the peer group.

The companies in the peer group:

- are listed on a stock exchange and have liquidly traded shares;
- own and invest in electronic communications infrastructure;
- have their main operations located in the Union;
- have an investment grade (credit rating BBB/Baa3 or above); and
- are not, or have not been recently, involved in any substantial mergers and acquisitions.

BEREC has applied these criteria as well as taking into account national specificities in preparing the list of companies included in the peer group of this edition. It has also examined whether or not, based on the five criteria, there are additional companies that should be added to the peer group.

3.3. Assumptions and choices for BEREC peer group

In the Staff Working Document the European Commission presented, by way of illustration, the following companies that it considered to be consistent with the criteria[42]:

[42] Table 25 of the SWD – "Electronic companies from relevant EU Member States with investment grade (2017)".

Figure 1 Illustrative list of peer group companies in the SWD[43]

Company	Country	S&P rating
TDC A/S	DK	BBB-
Elisa Oyj	FI	BBB+
Orange S.A.	FR	BBB+
Koninklijke KPN	NL	BBB-
BT Group plc	UK	BBB+
Telenet	BE	BBB
Tele 2	SE	BBB
Telekom Austria	AT	BBB
Telecom Italia	IT	B+
Vodafone Group plc	UK	BBB+
Telia Company AB	SE	A-
Proximus S.A.	BE	A

Since the publication of the 2020 WACC parameters Report (BoR (20) 116) BEREC, in line with clarifications from the EC, has made two refinements to how it assesses the peer group:

1. Companies that are in the European Economic Area ("EEA") and that meet the criteria are eligible for inclusion in the peer group.

2. Companies are also assessed as to the level of their operations in the EU/EEA before inclusion in the peer group.

EU/EEA

The European Commission (EC) has clarified that it is appropriate that companies (with headquarters) located in the EEA be considered for inclusion in the peer group if they meet the criteria listed in the Staff Working Document.

Criteria and level of activities in the EU/EEA

The EC has also clarified that one of the aims in developing the peer group is that companies that are actively operating in the EU/EEA and meet the criteria are considered for inclusion in the peer group. Companies that possibly meet the criteria but have limited operations in the EU/EEA must be analysed further to see if it is appropriate to include them. A simple application of the criteria could result in companies being added to the peer group from outside the EU/EEA who have limited operations in the EU/EEA, which would not ensure ***consistency*** as set out in the SWD[44]. Therefore and generally, it is important that the criteria are not applied mechanically but with a view to the objective of getting a fair representation of European (SMP) operators with legacy infrastructure when considering whether or not to add companies to the peer group. This will ensure that companies who are outside of the EU/EEA but possibly meet various criteria are not automatically included within the peer group without further analysis.

Consistent with the 2020 WACC parameters Report, where possible, BEREC has followed the list of companies provided by the EC, but uses Table 3 from the 2020 WACC parameters

[43] The illustrative list of the SWD has been used as the starting point, but is subject to adjustments (as explained hereafter).
[44] See section 5.3.2.2 of the SWD.

Report as the starting point for this year's peer group analysis. Consistent with the 2020 WACC parameters Report, BEREC has further assessed the criteria concerning national specificities and maintains its approach that two criteria require further refinement:

Companies have their main operations located in the EU/EEA

A strict application of this criterion without consideration of national specificities could result in the exclusion of companies that generate a substantial proportion of their turnover in the EU/EEA. BEREC considers that, over the five-year period on which the parameters are based, where:

(a) a company's headquarters are located in the Union and therefore major strategic decisions are taken within the EU/EEA; and

(b) a substantial proportion of a company's revenue is generated within the EU/EEA

these companies should be included in the peer group.

In addition, this will allow the home country (domestic) debt premium to be estimated for a wider range of countries. As a result NRAs will have a wider selection of companies/countries that are closer to their national specificities. However, this will also have to be compared to an overall assessment of the criteria when compared to the level of operations in the EU/EEA.

Companies have an investment grade (credit rating BBB/Baa3 or above)

A review of the company credit rating at a particular point in time could result in certain companies being included in one period's peer group and excluded from the next in case they have not at least an investment grade rating. BEREC considers that it is more appropriate to consider the investment grade status of a company over a five-year period and that if a company has had an investment grade rating in four of the five years it would qualify under this criterion. The choice of a five-year averaging period is also consistent with the averaging periods in the Notice[45]. BEREC considers that where the asset beta is to be determined it is important to get a representative sample from across the EU/EEA. Once a company's equity beta is unlevered the underlying asset beta should not be dependent on the gearing of the company but represents how the risk of its assets is assessed relative to the index being used for beta estimation.

As a conclusion from the above considerations it follows that if a company meets four of the five criteria (as modified) it is considered appropriate for inclusion in the peer group. However, a company must meet criterion 1 "*are listed on a stock exchange and have liquidly traded shares*" as a prerequisite for inclusion as otherwise no equity market data is available.

Updating the BEREC 2020 peer group (Table 3)

Overall, the BEREC 2021 peer group is almost identical to the 2020 peer group which – as explained above – generally followed the illustrative peer group of the Staff Working

[45] Notice, para. 27.

Document.[46] However, there are a few changes mainly due to taking into account that the UK left the Union and to BEREC now looking at the EU/EEA area.

In the 2020 WACC parameters Report both ***Deutsche Telekom*** (Germany) and ***Telefónica*** (Spain) were added to the SWD's illustrative peer group due to national specificities. While these companies have significant operations outside of the EU/EEA both have their headquarters and boards of directors within the EU/EEA. Therefore, all major strategic decisions are taken and significant proportions of their total revenues are generated within the Union. BEREC considers that this continues to qualify them for inclusion within the peer group.

In the 2020 WACC parameters Report BEREC considered that ***NOS*** (Portugal) should also be included in the peer group as it meets each of the five criteria. BEREC notes ongoing judicial proceedings against significant shareholders in NOS[47] but makes no further comment in this regard[48].

In the 2020 WACC parameters Report ***BT Group plc*** (UK) was part of the peer group as the United Kingdom was still a member of the EU for a significant part of the five year period on which parameters were based and considered to have activities in countries who are members of the European Union. However, since the United Kingdom has left the EU, is not a member of the EEA and the majority of its revenues are earned outside of the EU/EEA, it is no longer considered appropriate to include BT Group plc in the peer group.

In the 2020 WACC parameters Report ***Vodafone Group plc*** (UK) was also included in the peer group. While it is currently headquartered in the United Kingdom it continues to have extensive activities in several EU member states and generates a significant proportion of its revenue from operations in the EU in comparison to its UK operations[49]. It is therefore considered appropriate to continue to include Vodafone Group plc in the peer group.

BEREC also examined other fixed line operators for possible inclusion in the peer group. However, when applying the five criteria above (as modified) none met the minimum requirement of complying with at least four of the five criteria and were therefore not included. While it noted that some companies in Central and Eastern Europe are publicly traded they do not have a five year trading history or have a credit rating and therefore are not included. In particular, the following should be noted:

- ***DIGI Communications N.V***. has been publicly traded since May 2017. BEREC considers that its inclusion may be possible once they have a five-year stock exchange trading history, if they meet the criteria (as modified);

[46] Companies not mentioned explicitly were taken over from the illustrative peer group in the BEREC 2020 peer group and continue to be in the BEREC 2021 peer group.

[47] https://www.bloomberg.com/news/articles/2020-04-05/lisbon-court-seizes-nos-stake-held-by-angola-s-dos-santos

[48] BEREC is aware that the conduct of judicial proceedings may affect the future tradability of NOS shares.

[49] Vodafone Group Plc Annual Report 2021, https://investors.vodafone.com/sites/vodafone-ir/files/2021-05/vodafone-annual-report-2021.pdf

- ***Telekom Slovenije*** is publicly traded and meets certain criteria[50], but the company does not have a credit rating and therefore is not to be included in the peer group.

In order to ensure that the peer group is representative of the entire EU/EEA, BEREC also examined whether or not the members of the peer group had significant investments in fixed line operators in Central and Eastern Europe. In doing so BEREC considered that where this is the case the peer group members' parameters would also incorporate some of the underlying parameters of its investments. Many members of the peer group were found to have made significant investments into Eastern European fixed line operators.[51]

While BEREC notes that it does not offer a one-to-one comparison, it does offer some assurance that telecom assets in Central and Eastern European companies are included in the overall calculations of beta and also debt premiums. BEREC expects that as Central and Eastern European capital markets become more mature over time, more data will be available in the future which will allow the incorporation of companies from this region into the peer group. This will be assessed on an annual basis.

In the 2020 WACC parameters Report only companies in the Union were considered for inclusion in the peer group. As ***Telenor Group*** was within the EEA but outside of the Union it was not included in the peer group of the 2020 WACC parameters Report. As the EC has clarified that companies within the EEA could now be considered BEREC has assessed Telenor Group against the five criteria listed in the Staff Working Document (as modified). BEREC has found that Telenor Group meets the criteria listed and is eligible for inclusion in the peer group.

When assessed against the STOXX Europe Total Market Telecommunications index[52], which lists all possible candidates for a peer group that would be representative of the European Telecommunications Market, the BEREC peer group would represent circa 60% by market capitalisation of the STOXX Europe Total Market Telecommunications index.[53]

3.4. Result: BEREC peer group 2021

Therefore, based on both the criteria and national specificities the **BEREC peer group 2021** is shown in Table 3.

Table 3 BEREC peer group 2021

Company	Country	S&P rating as of April 2021	Rating last reviewed by S&P	Stock Symbol
Deutsche Telekom AG	DE	BBB	01 April 2020	DTE GR
Elisa Oyj	FI	BBB+	01 March 2021	ELISA FH

[50] Listed on a stock exchange; owns/invests in electronic communications infrastructure; main operations in the EU/EEA; not involved in substantial mergers and acquisitions.
[51] Cf. below Chapter 7, Table 13.
[52] https://www.stoxx.com/index-details?symbol=BTEP.
[53] The decrease from 80% in last year's Report to 60% in the 2021 Report is due to the fact that BT is no longer included in the 2021 BEREC peer group.

Koninklijke KPN N.V.	NL	BBB	22 March 2021	KPN NA
NOS	PT	BBB-	29 March 2021	NOS PT
Orange S.A.	FR	BBB+	18 Sept. 2020	ORA FP
Proximus S.A.	BE	A	16 July 2020	PROX BB
Tele 2 AB	SE	BBB	23 Nov. 2020	TEL2B SS
Telecom Italia	IT	BB+	06 Oct. 2020	TIT_MI
Telefónica	ES	BBB-	24 March 2021	TEF SM
Telekom Austria AG	AT	BBB+	10 April 2020	TKA AV
Telenet Group Holding N.V.	BE	BB-	17 July 2020	TNET BB
Telenor	NO	A-	8 June 2020	TEQ
Telia Company AB	SE	BBB+	13 Jan. 2021	TELIA SS
Vodafone Group plc	UK	BBB	29 July 2020	VOD LN

National Specificities

BEREC also considers that NRAs, in order to reflect national specificities should where necessary amend the companies included in the peer group by selecting those that are most reflective of their national specificities. In accordance with paragraph 67 of the Notice this may involve removing companies from the peer group (but not adding any that do not meet the criteria as set out above).

Where possible NRAs should also maintain a peer group that is as wide as possible using the companies in Table 3 being representative of the national specificities.

According to para. 67 and in order to avoid "arbitrary" choices BEREC considers it justified to remove peer group members from the list primarily for the following reasons:

(a) Certain companies in the peer group may not reflect the size of the SMP operator in the particular member state. For example, it may be inappropriate to include a very large company in the peer group if its scale is significantly greater than the SMP operator or the member state itself has a relatively small population[54];

(b) Competition conditions within the electronic communications sector, and in particular infrastructure-based competition, may vary between member states increasing risk for both SMP and OAO operators (access seekers and wholesalers).[55] For example the presence of a significant cable operator could present particular competitive conditions in one member state that may be absent from another;

(c) The share of regulated vs non-regulated revenues of peer group members may vary. Indeed as mentioned by the Brattle report[56], regulated telecommunication activities

[54] The size of an operator could be based on Market Capitalisation. However, the use of a country specific size premium is not considered appropriate.
[55] See Digital agenda Scoreboard "New entrant subscription - using own infrastructure or the incumbent network" indicator, https://ec.europa.eu/digital-single-market/en/desi, Connectivity report slide 22.
[56] See Brattle report (2016), p50: https://op.europa.eu/fr/publication-detail/-/publication/da1cbe44-4a4e-11e6-9c64-01aa75ed71a1/language-en. The Brattle report "Review of approaches to estimate a reasonable rate of return for

could be seen to be less sensitive to changes in the economy than those of an average firm with non-regulated activities;

(d) The scope of segments of activity (i.e. mainly mobile, mainly fixed, mainly TV, combined, etc.) of certain companies in the peer group may differ significantly from the SMP's types of business to an extent of not being representative.

BEREC does not consider it appropriate to exclude companies from the peer group on the basis of the credit rating or risk free rate of the member state. These may not be directly comparable to conditions experienced by the SMP operator in the member state.

4. Debt premium and cost of debt

4.1. Definition and data source used

The cost of debt is defined as the interest or financial cost paid by a company on its debt. It can be expressed as the sum of the risk-free rate and a debt premium:

Cost of debt = Risk Free Rate + Debt Premium

The debt premium is the additional return lenders or investors require for a company above the risk free rate. The level of the debt premium depends to a large degree upon the perceived credit risk and credit rating. The debt premium can be estimated by using the yields on corporate bonds above the interest rate on long-term government bonds. The debt premium is calculated as:

Debt premium = Cost of debt - Risk Free Rate

In order to calculate the debt premium BEREC assesses, in line with established practice, the yield on long-term corporate bonds above the risk free rate. Although BEREC strives to use the same averaging period (five years) and maturity (ten years) as for the calculation of the risk free rate, the secondary market for corporate bonds has different characteristics compared to the market for government bonds. Companies issue corporate bonds in order to raise capital, but given that market conditions vary over time they are not necessarily issued with a regular frequency, they could use different currencies in order to respond to investor interest, and some companies use the bond market to a less extent as they use other sources to obtain capital.

The data source used for the calculation of the debt premium is Bloomberg. Bloomberg is extensively used in the financial and corporate sector.

investments in electronic communications networks in regulatory proceedings and options for EU harmonization" is a study for the Commission.

4.2. Methodology with reference to Notice

Deducting from corporate bond yields the risk free rate with similar maturity and the same currency is the established method to calculate the debt premium. It is in line with the Notice, which states to add the domestic risk free rate to the debt premium.

Moreover, it is also commonly used among NRAs for deriving the debt premium for the WACC applicable for the SMP operator according to the BEREC report on Regulatory Accounting in Practice 2020[57].

Altogether, BEREC estimates the debt premiums for the companies in the peer group from which NRAs can select the appropriate value for their SMP or regulated operator (having regard to its characteristics) and adds this to the estimated domestic RFR to derive the cost of debt.

4.3. Assumptions and choices made

In calculating the debt premium and cost of debt, BEREC has made some assumptions in order to carry out its designated task:

- Considering that the capital market is global, companies use different currencies when they issue corporate bonds according to their needs, market characteristics, and investor interest. However, the calculations of the debt premium is limited to corporate bonds that have been issued in the domestic currency, which primarily is EUR, apart from a few exceptions[58], in order to be able to match domestic long term government bonds. Inflation-linked bonds have been excluded in order to keep consistency in the results.

- The five-year averaging window, where available, will cover the period from April 2016 to March 2021, however the maturity year of the bonds must be within the period from April 2027 - March 2035. BEREC has chosen this maturity period of the bond for the following reasons:

    - Striving to be as close as possible to a 10 year residual maturity.

    - Avoiding excluding too many corporate bonds.

    - Assuming a bias for the longer maturities rather than for the shorter ones in order to balance the fact that the yield curve by maturity period shows an exponentially decreasing rather than a linear form[59].

- The above takes into consideration that companies issue corporate bonds depending upon demand for capital and market conditions, which vary over time. Consequently,

[57] https://berec.europa.eu/eng/document_register/subject_matter/berec/reports/9718-berec-report-on-regulatory-accounting-in-practice-2020

[58] We included bonds issued in GBP for the calculation of the Vodafone debt premium.

[59] https://www.ecb.europa.eu/stats/financial_markets_and_interest_rates/euro_area_yield_curves/html/index.en.html

it is not possible to apply a strict five-year averaging window for all bonds as they have been issued at different times resulting in different periods with a maximum of five years for calculating the average bond yields.

BEREC has, based on the above-mentioned criteria, included as many corporate bonds as possible issued by the peer group companies. However, some companies only have few traded corporate bonds, or only a single one, which means that the underlying data sample varies between the different companies in the peer group[60].

All things considered, BEREC concludes that this approach is in line with the Notice.

4.4. Calculation steps – description of how the result is derived

BEREC has retrieved data for the corporate bonds from Bloomberg. The following steps have been undertaken:

1) Identify corporate bonds that have been issued in the domestic currency by the companies in the peer group that have 7-15 year residual maturity (maturity year within April 2027 - March 2035), and which are traded on the secondary market.

2) Identify government bonds that match each corporate bond, that have been issued by the respective governments, which have 7-15 year residual maturity (maturity within April 2027 - March 2035), and which are traded on the secondary market. This facilitates the establishment of pairs of bonds consisting in a corporate bond compared with a domestic government bond. Additionally, only sovereign bonds with an averaging time window equal or larger than the comparable corporate bond were considered.

3) Provide a description of each bond pair, both the corporate and government bonds, with the following details:

    a. ticker, which is the label and identifier for each bond which is used in the secondary market, including information about when the bond matures,

    b. date when the bond was issued,

    c. currency used for the corporate bond and its nominal value,

    d. coupon, which is the annual interest payment a bond holder receives from the issuer until the bond matures,

[60] In the case of NOS, it has not issued any bond which meets the criteria set in the section 4.3. That is why for that company the only corporate bond included in the calculations matures in 2023, as is shown in Annex 2. At the same time in order to ensure consistency of the debt premium calculation the government bonds used for NOS have a similar maturity to the corporate bonds. In the case of Telekom Austria, its only bond matures in 2026 so it does not meet the criteria, therefore the same exception as for NOS has been applied.

e. ISIN (International Securities Identification Number), which is an identification number for the corporate bonds.

4) Retrieve data from Bloomberg for the maximum period 1st April 2016 up to 31st March 2021 based on weekly data for identified corporate bonds and benchmark government bonds for the following parameter:

- Mid Yield to Maturity (*YLD_YTM_MID* in Bloomberg), which is the yield of a fixed income security that will solve for the mid-price when valuing the security to maturity. It is the total return anticipated on a bond if the bond is held until it matures. Yield to maturity is considered a long-term bond yield and is expressed as annual return, which could be described as the internal rate of return (IRR) of an investment in a bond if the investor holds the bond until maturity, with all payments made as scheduled and reinvested as the same rate.

  Bloomberg provides a weekly value for the mid yield to maturity for each bond, which facilitates for BEREC for each pair to deduct the value of the government bond from the value of the corporate bond on a weekly basis. This gives a debt premium on a weekly basis.

5) Subsequently, BEREC calculates the arithmetic average of the difference between each bond pair for an averaging period up to five years.

6) The debt premium for each company is calculated as an arithmetic average of the difference between all the identified bond pairs, consisting of a corporate bond and a matching domestic government bond. All of this depends on the availability of corporate bonds that fulfill the above listed criteria.

On the whole, this calculation results in the debt premium for each company in the peer group as input for calculating the cost of debt:

Cost of debt = Risk Free Rate + Debt Premium.

In order to make the calculation complete the domestic risk free rate taken from Table 2 is added, which gives the cost of debt for each company.

BEREC now also shows for information purposes averages of the peer group, however there is no obligation for NRAs to use these averages.[61]

4.5. Results

All in all, the results are presented in Table 4.

[61] For calculation details see Chapter 5 and Annex 3.

Table 4 Debt premium and Cost of debt

Company	Debt premium (basis point)	Domestic RFR	Cost of debt
Deutsche Telekom AG	124	-0.03	1.21
Elisa Oyj	73	0.24	0.97
Koninklijke KPN N.V.	116	0.15	1.31
NOS	54	1.71	2.25
Orange S.A.	80	0.37	1.17
Proximus S.A.	92	0.36	1.28
Tele 2 AB	152	0.34	1.86
Telecom Italia	101	1.82	2.83
Telefónica S.A.	44	1.01	1.45
Telekom Austria AG	78	0.25	1.03
Telenet Group Holding N.V.	312	0.36	3.48
Telenor	100	1.38	2.38
Telia Company AB	131	0.34	1.65
Vodafone Group plc	156	0.95	2.51
Weighted Average (information only)[62]	112		
Arithmetic Average (information only)	115		

Remarks on results

The calculations of the debt premium are in line with the Notice and follow the same criteria as those of the 2020 WACC parameters Report.

Given that the mid yield to maturity of the corporate bonds have been compared with the mid yield to maturity of the domestic government bonds, this could not fully reflect the international investor perspective and will be dependent on how the capital market assesses the value of the government bonds. This means that the debt premiums for international companies based on high RFR countries are significantly lower compared with what would have been if the calculations had been based on benchmark bonds regularly used by Bloomberg, this is, German government bonds.

Since the approach excludes corporate bonds issued in non-domestic currencies the results could not exactly show how companies are raising capital on the international market, which could have an effect on the estimated debt premiums. This does not apply for the Swedish companies Tele2 and Telia Company and for the Norwegian Telenor. The three companies

[62] The market cap has been calculated in Euro considering a five year average based on weekly prices of the shares (consistent with BEREC's approach to calculate five year averages). See Annex 3 for details.

have not issued corporate bonds in the domestic currency (SEK or NOK) and this is why these bonds (issued in euros) have been compared with German government bonds.

In addition, some of the peer companies like Elisa, KPN, Proximus, Tele2, Telekom Austria, Telenet and Vodafone have only a very limited number of traded corporate bonds in domestic currencies in combination with the fact that the residual maturity of some of the bonds is short. Altogether, these aspects should be born in mind when evaluating the result presented in the above table.

5. Beta and gearing

5.1. Definition and data sources used

According to Capital Asset Pricing Model (CAPM) the cost of equity considers that a particular relation holds between the level of risk of a company and the level of risk within the whole economy. The level of systematic risk[63] due to macro-economic conditions related to the increment of the interest rates as well as risk related to the demand, affecting all companies in the economy, is described by the relation:

$$\text{Cost of equity } (R_E) = \text{Risk free rate } (RFR) + \text{beta\_Equity} \times \text{Equity risk premium } (ERP) \quad (1)$$

The idea behind the CAPM model is that, in a competitive market, the expected risk premium in an asset varies with respect to the risk free rate in direct proportion to “beta”. The beta is the measure of the risk contribution of an individual security to the risk of a well-diversified portfolio. Stocks with betas between 0 and 1 tend to move in the same direction of the market as a whole, but not as far. Stocks with betas greater than 1.0 tend to amplify the overall movements of the market.[64]

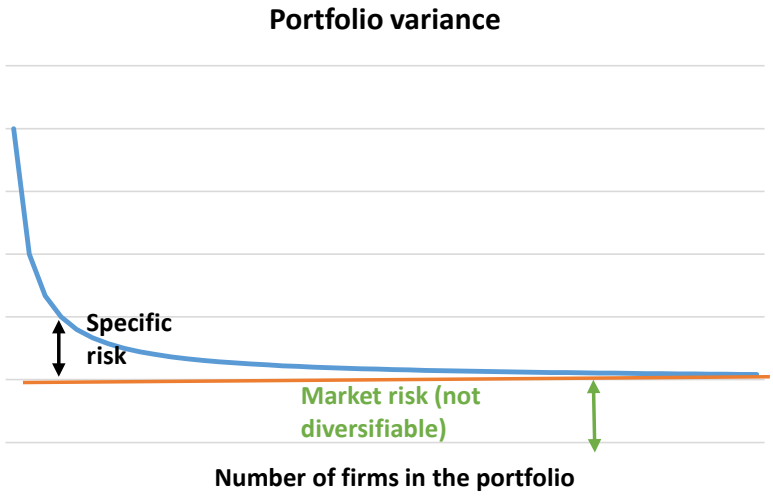
Formally the risk of a portfolio is described by the variance of the return and covariance of the return between each security included. If the number of the stocks (N) included in the portfolio increases with equal proportion of capital invested in each security, the level of the risk of the portfolio measured as the variance of the portfolio itself becomes mainly proportional to the covariance of the stocks between each other and not on the variance of each security included (Figure 2). If ideally the average covariance of a portfolio becomes equal to 0 all risks by holding a sufficient number of securities will be eliminated. Unfortunately, common stocks move together, not independently so a market risk is the one that cannot be diversified. So, the risk of a well-diversified portfolio depends on the market risk of the securities included in the portfolio. The market risk is proportional to the average beta included in the market

[63] Systematic Risks are non-diversifiable market risks in contrast to non-systematic risk relating to the risk associated with individual shares. CAPM serves to measure the systematic risk.
[64] Breadly, Myers, Allen, “Principle of corporate finance”, 11th Edition (2014).

portfolio. Formally this can be understood calculating the variance of the portfolio that is equal formally to:

$$\text{Portfolio variance} = \sum_{i=1}^{N} \sum_{j=1}^{N} x_i x_j \sigma_{ij} \qquad (2)$$

Figure 2 Portfolio variance



Where x_i x_j are the proportions of the resources allocated for each security, and σ_{ij} the covariance between the stocks "i" and "j" included in the portfolio. In other words, the contribution of stock "i" to portfolio risk is equal to the relative size of the holding (x_i) times the average covariance between stock 1 and all the stocks in the portfolio.

To evaluate the relative contribution to the portfolio risk of each security we need to divide the average covariance with the portfolio variance. This ratio formally describes the relative contribution to the risk of the portfolio and it is exactly the beta:

$$\beta_i = \frac{\sigma_{i,m}}{\sigma_m^2} \qquad (3)$$

Where $\sigma_{i,m}$ is the covariance of the stock with respect to the market portfolio and σ_m^2 the variance of the market portfolio itself.

Generally, the higher the value of the beta is, the higher the uncertainty about the returns on a firm's equity with respect to the reference market considered.

Companies with high equity betas tend to have high business risk and/or high financial risk such as:

- Non-diversified businesses with revenues, earnings and cash flows that are highly sensitive to economic factors;
- Highly geared, capital intensive businesses that have a large proportion of fixed operating costs (increasing the volatility of operating and net cash flows);
- Early stage or start-up ventures.

The average beta of the market should be equal to one and this can be effectively addressed considering a portfolio that is the wider as possible approaching the corresponding whole market. From a technical point of view the equity beta of a company/asset is estimated through a regression analysis, i.e. by measuring the relationship between the returns of that company's shares and the returns of a market index, which is meant to approximate the whole economy.[65]

Given the above, the corresponding risk of an asset to the portfolio will depend also on the **financial leverage** or **'gearing'** of the firm.

As the Notice suggests to estimate the equity beta in the CAPM model from a "peer group" of companies it is relevant, in this case, to make reference, for fair comparison of the systematic risk, to an unlevered beta or asset beta from the observed equity beta of each peer. The use of asset beta will ensure that actual differences in underlying business risks (systematic risk) are compared between peers removing from the betas differences in financing decisions.

The main elements to estimate the equity beta are:

i) the methodology (Bottom-up/notional vs SMP operator);
ii) time horizon and sampling period for the estimation of the formula;
iii) market index;
iv) adjustment of the beta;
v) the unlevering formula to get the asset beta.

For beta estimation the return of the security of each company should be calculated with a daily, weekly or monthly sampling period. A corresponding return of a market index in accordance with portfolio theory should be chosen. For the estimation of the asset beta of each peer an unlevering formula should be considered that need also the gearing estimation of each company. So, the gearing is faced in this section of the report due the fact that it is strictly related to the asset beta estimation.

The gearing (g) is a measure of a company's financial leverage. It compares the amount of debt financing to the amount of the value of the company. This parameter is relevant in the WACC formula as it provides the weight for the cost of debt and the complement (1-g) the weight for the cost of equity, but it is also strictly related to the estimation of the final equity beta as it is used in the formula for levering and re-levering the beta as already mentioned.

The "gearing" (g), in accordance with the Notice, is formally considered as the relative weight of debt on the overall firm value, in formula as:

$$g = \frac{D}{D + E}$$

This measures the company's **financial leverage** and shows to what extent its operations are funded by lenders as opposed to shareholders.

The main points for the gearing estimation are the following: i) kind of approach for the estimation of the debt and equity component (market vs book values); ii) kind of debt that can

[65] See Notice, para. 45.

be considered in the debt component; iii) time windows and sampling period of the estimation as for the other main parameters (RFR, beta, cost of debt) of the WACC.

5.2. Methodology with reference to Notice

Following the Notice the approach to estimate the equity beta should be the following:

- Estimate the equity beta for each company in the group of EU companies, which form the peer group;
- Estimate the gearing level for each company in the peer group;
- Derive the asset betas from each company in the peer group, including the SMP operator (using the equity beta and gearing level for each company);
- Relever the asset beta to obtain the final equity beta.

BEREC will provide the data for asset beta and gearing for each company of the peer group, from which the corresponding ranges of values for each parameter can be used for estimating the final equity beta in the WACC formula by each NRA.[66]

The Notice states that the equity beta calculation should use weekly data, a sampling period of, and a time windows of five years, which is in line with the time window used for the calculation of the risk free rate (RFR).

Moreover, the Notice highlights that no adjustments to the equity beta calculation should be done with methods such as Blume,[67] Dimson[68], Vasicek[69]. The Commission doubts that these adjustments would improve the efficiency of the beta estimator and are likely to make the regulator's approach more complex and less transparent.[70]

The Commission, in line with portfolio theory, suggests to use a wide index[71] which in this case is an EU index rather than a domestic market index and favours the STOXX Europe TMI (Europe Total Market Index) also in line with the provision regarding the EU-wide Equity Risk Premium.

Moreover, for the estimation of the beta the levering and unlevering formula is crucial.[72]

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[66] See SWD, page 86.
[67] The adjustment of the Blume formula relies on the idea that over the long term companies should tend towards a beta of 1 (e.g. firms that survive in the market tend to increase in size over time, become more diversified and have more assets in place, which should push betas towards 1) and adjusts the estimated company beta towards 1.
[68] Dimson corrects for distortions in the beta estimation when using daily returns due to the potential for mismatch between the changes in the market index and the reaction of the company's stock to these.
[69] The Vasicek formula is similar to the Blume adjustment, except that it does not assume a tendency of the beta to go to 1, but rather towards an industry average or some other prior expectation of beta, and the extent of the adjustment depends on the standard error of the observed beta.
[70] See SWD, page 80, and BEREC Regulatory accounting in practice 2020, page 29.
[71] In the CAPM framework the market portfolio includes all risky assets, in proportions defined by their relative market values.
[72] Most NRAs unlever and re-lever the beta to take into account financial leverage in the final estimation of the beta, see WACC chapter of the "BEREC regulatory accounting in practice report 2020" (BoR (20) 210), page 29, https://berec.europa.eu/eng/document_register/subject_matter/berec/reports/9718-berec-report-on-regulatory-accounting-in-practice-2020.

A company's financial structure, in fact, has an effect on its equity beta. In particular, financial leverage increases the risk of company's share. For this reason, and in order to be able to compare a company's equity beta to that of other companies, it is common to estimate an asset beta from the company's equity beta. When estimating the equity beta in the WACC formula from the peer group, one must first assess the effect of financial leverage on the observed equity betas (so-called 'levered betas') by calculating the unlevered (or asset) betas.

The Notice suggests to use the formula known as "Miller Formula"[73]:

$$\beta_A = \beta_E \frac{E}{D+E} + \beta_D \frac{D}{D+E}$$

With reference to the beta debt the Notice considers that it entails significant difficulties to be estimated. The reason is the illiquidity of the biggest part of the traded bonds, which means that an estimation of debt betas as the covariance between bond yields and market returns can give incorrect results). For this reason, the Commission suggests to lever and re-lever the beta including a beta debt of 0.1.[74]

With respect to the gearing the Notice provides the following: the Equity component should be measured considering the market value obtained as the product of the price of the share and the number of outstanding shares for each company. The motivation behind this is related to the fact that it is the market value of equity that measures the future earnings potential of firms and their ability to sustain debt.

As the level of liquidity of corporate bonds could be low, the book value of the debt is a good approximation of the market value of the debt. With respect to the kind of debt to be considered to be consistent with a market value evaluation the Notice suggests using only long term debt as all the short term debt are generally netted off by the cash. As long-term debt the Commission considers it relevant to also include capital lease obligation.

5.3. Assumptions and choices made

BEREC estimates the asset beta and corresponding gearing of the 14 peer group companies that fulfill the Commission's selection criteria as reported in chapter 3 above. In this section the equity beta, gearing and asset beta are evaluated from raw data on equity prices of shares obtained on weekly basis of each peer and the corresponding price of the STOXX Europe TMI. The raw data have been obtained from Bloomberg.

The equity beta for each peer of the group is estimated regressing the variation of the shares price on a weekly basis with the corresponding variation of the price of the market index, the beta is obtained using OLS estimator.

[73] The formula proposed is the one used by most NRAs as reported related to beta in op. cit., page 28.
[74] See SWD, page 85.

The asset beta is derived applying the Miller formula including a beta debt of 0.1 as suggested by the Notice. The gearing is derived from the spot gearing evaluated on a weekly basis using a five years' time window.

A standard statistical test has been carried out and liquidity merit figures have been calculated to provide transparency on the data consistency for the equity beta estimation (see Annex 3). Testing for statistical criteria and liquidity in this context is relevant to check the efficient market assumption of CAPM, which is useful for the final quotation of the peer group and asset beta range estimated.

5.4. Calculation steps – description of how the result is derived

For each comparable operator the information on the equity beta, gearing and asset beta has been derived.

The equity beta is calculated regressing the return of each the company with the return of the STOXX Europe TMI.

The STOXX Europe TMI covers approximately 95 percent of the free float European market capitalization (generally more than 1400 peers from different economic sectors) across 17 European countries: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

The calculation is derived on a weekly sampling period, in line with the Notice.

The weekly estimation for the equity beta and the Equity component of the gearing is derived from the daily data selecting the information of the last price of the security and the corresponding price of the market index of one trading day for each week that is included in the time window.[75] For a time window of five years 260 points are collected from 1st April 2016 to 1st April 2021.

The gearing has been evaluated from five year average of the spot gearing taken at weekly frequency. Gearing is evaluated using book value of the net debt, for five years annual data. The net debt is equal to the Short-term Debt plus Long-term Debt minus Cash and Cash Equivalent.[76] The Commission states that "short term loans and liabilities are likely to be offset by short-term assets such as cash and cash equivalents"[77] and that it would seem appropriate to estimate the gearing using the book value of the firm's net debt, including the value of financial leases (capital lease). This is also the approach most frequently used by NRAs[78].

[75] The net return have been evaluated as r_t=P_t/P_(t-1)-1, with P_t the last price of the current trading day of one week and P_(t-1) the last price of the selected trading day of the week before for both the company and the market index (Friday and days before of the week have been considered as the last trading day of the week).
[76] Net Debt = STD+LTD−CCE.
[77] SWD, page 87.
[78] See Regulatory Accounting Report 2020 (BoR (20) 210), WACC chapter.

According to this approach for the book value of the debt component only long term debt[79] and capital lease[80] will be included as proxy of the net debt definition.

Specifically, this assumption on the definition of the net debt is partially fulfilled: in fact the ratio between "Cash" and "Cash Equivalent" with respect to the current liabilities "Notes Payable/Short Term Debt" and "Current Portion of Long Term Debt/Capital Leases" from the balance sheet of each peer is about 0.83 on average excluding some evident outlier observations. At the same time, Bloomberg provides gearing data based on the book value of debt and the market value of equity. Debt also includes finance leases. Cash is not netted off.

With respect to Table 5 of the 2020 WACC parameters Report (BoR (20) 116), the ratio values slightly change due to the availability of one-source data (Bloomberg) subject to the standardization process assuring comparability.

Table 5 Ratio between Cash and Cash Equivalent in relation to current liabilities[81] 5. (a) and raw data from the balance sheets for the ratio calculation in 5. (b)

5. (a)		**Ratio between Cash and Cash Equivalent in relation to current liabilites**					
No.	**Company**	**2016**	**2017**	**2018**	**2019**	**2020**	**Average**
1	Deutsche Telekom AG	58.94%	38.41%	36.45%	37.62%	73.21%	48.93%
2	Elisa Oyj	13.04%	24.92%	28.15%	34.41%	104.21%	40.95%
3	Koninklijke KPN N.V.	160.41%	4755.56%	81.48%	70.79%	72.01%	96.17%
4	NOS	1.02%	3.44%	0.87%	14.50%	152.08%	34.38%
5	Orange S.A.	114.09%	85.65%	69.63%	104.24%	109.42%	96.61%
6	Proximus S.A.	72.97%	58.42%	145.30%	146.15%	134.20%	111.41%
7	Telecom Austria AG	91.48%	33733.33%	25.93%	50.91%	23.35%	47.92%
8	Tele2 AB	8.46%	141.45%	6.29%	9.26%	20.59%	37.21%
9	Telefónica S.A.	26.73%	56.84%	62.29%	59.52%	64.54%	53.98%
10	Telenet Group Holding N.V.	71.18%	10.81%	17.50%	19.25%	16.41%	27.03%
11	Telenor	88.90%	99.28%	117.48%	57.64%	124.00%	97.46%
12	Telia Company AB	130.57%	449.93%	302.81%	47.22%	265.52%	239.21%
13	Telecom Italia	102.21%	78.51%	34.39%	83.48%	113.78%	82.47%
14	Vodafone Group plc	119.09%	63.61%	319.36%	112.33%	-	153.60%
Average							83.38%

[79] Not including pension liabilities.
[80] A capital lease is a contract entitling a lease holder to the temporary use of an asset, and such a lease has the economic characteristics of asset ownership for accounting purposes. In comparison operating leases are recorded only as operating expenses. The capital lease requires a lease holder to book assets and liabilities associated.
[81] "Notes Payable/Short Term Debt" and "Current Portion of Long Term Debt/Capital Leases". Source: Operator's balance sheets retrieved from Bloomberg. Red data are not included in the average calculation.

5. (b)		Cash and cash equivalent (Million of own currency)					Short Term Borrowings/Short Term Lease liabilities/Current Portion of Long Term Debt-Capital Leases (Million of own currency)				
No.	**Company**	**2016**	**2017**	**2018**	**2019**	**2020**	**2016**	**2017**	**2018**	**2019**	**2020**
1	Deutsche Telekom AG	7,747	3,312	3,679	5,393	12,939	13,144	8,623	10,093	14,334	17,675
2	Elisa Oyj	45	44	81	52	220	341	178	287	151	211
3	Koninklijke KPN N.V.	1,179	856	594	766	597	735	18	729	1,082	829
4	NOS	2	3	2	13	153	225	87	254	88	101
5	Orange S.A.	5,429	5,165	5,062	5,487	7,294	4,759	6,030	7,270	5,264	6,666
6	Proximus S.A.	297	333	340	323	310	407	570	234	221	231
7	Telecom Austria AG	458	202	64	140	211	500	1	245	276	903
8	Tele2 AB	257	802	404	448	970	3,037	567	6,427	4,836	4,712
9	Telefónica S.A.	3,736	5,192	5,692	6,042	5,604	13,977	9,134	9,138	10,152	8,683
10	Telenet Group Holding N.V.	99	39	88	101	82	139	362	504	527	500
11	Telenor	23,085	22,546	18,492	13,867	20,577	25,968	22,710	15,740	24,056	16,594
12	Telia Company AB	14,510	15,617	18,765	6,116	8,133	11,113	3,471	6,197	12,951	3,063
13	Telecom Italia	4,064	3,675	1,917	3,138	4,829	3,976	4,681	5,575	3,759	4,244
14	Vodafone Group plc	7,535	4,106	11,777	11,755	-	6,328	6,454	3,688	10,465	-

The equity component of the gearing is evaluated weekly from the number of outstanding shares[82] times the last price value of the share in the relevant trading day. The information is taken from Bloomberg.

5.5. Results

In the following the results for the **equity beta, asset beta and gearing** for each of the peers is shown in Table 6 below. The asset beta is evaluated following the formula provided in the Notice:

$$\beta_A = (1-g)\left(\beta_E + \frac{D}{E}\beta_D\right)$$

The results are given with β_D (beta debt) equal to "0.1".

With reference to the 2020 WACC parameters Report, it is worth to highlight that in the table below also the information about the asset beta estimation is reported, considering also the

[82] The numbers of outstanding shares are those available in the balance sheet for every year, as reported by Bloomberg in the Financial Analysis section of each operator (see Annex 3).

"Pension liabilities"[83] for each operator in the debt component of the gearing, only for sensitivity purposes. In the literature, Pension Liabilities and Pension Assets should be treated in a way to include an adjustment to the asset beta provided in the Miller formula. A theoretical framework for taking into account pension assets and liabilities in the CAPM model has been developed by Jin, Merton and Bodie (JMB framework).[84] This framework sets out the need to estimate separate betas for pension asset (β_PA) and pension liabilities (β_PL) as well as the amount of pension asset (PA) and pension liability (PL), other than the equity beta (β_E), the beta debt (β_D), the Equity (E) and debt (D) components of a firm, as reported in the Miller formula, thus estimating the asset beta correctly.

In this framework the Miller formula for asset beta is only unbiased in case the pension liabilities and the pension assets offset each other and the β_PA and the β_PL are equal. The new asset beta can thus be rewritten in the following way:

$$\beta_A = \beta_E \frac{E}{D+E-S} + \beta_D \frac{D}{D+E-S} + \left(\beta_{PL} \frac{PL}{D+E-S} - \beta_{PA} \frac{PA}{D+E-S}\right)$$

This theoretical framework is hard to be applied in practice due to the fact that pension liabilities are not tradable as such. In general an upward adjustment to the asset beta is needed in case there is a negative balance between pension liabilities and pension assets (S=PA-PL<0) within the hypothesis that the β_PA and beta β_PL are equal.

In any case the pension deficit reported in the balance sheet is generally understood by investors as a source of debt. Therefore equity beta can be affected by a pension deficit as a leverage risk. At the same time the JMB framework states that the systematic "unlevered" risk increases in the presence of a pension deficit. Those two different views are sources of uncertainty about how to treat pension deficit: i) one view treated it to 100% as source of debt; ii) on the other to 100% as a source of systematic risk as in the JMB framework.[85]

Consequentially, the asset beta estimation has been carried out considering a case in which a pension deficit is treated as a full source of debt, in line with the "practitioners'" approach, with the outcome that the pension deficit, independent from the share of input to debt, does not have a material impact on the gearing calculation with an increase of the standard evaluation of about 1% and a decrease of the asset beta on average of about 0.01. The sensitivity analysis on impact of pension found is reported in table A1 in Appendix 3 for each peer.

[83] Amount of pension obligations disclosed on companies' non-current liabilities section. The number may or may not net off with pension assets. It includes both pension and other post-retirement benefit obligations.
[84] L. Jin, R. Merton Z. Bodie: Do a firm's equity returns reflect the risk of its pension plan?. Journal of Financial Economics 2006, Vol 81, Issue 1.
[85] https://www.ofcom.org.uk/__data/assets/pdf_file/0016/111535/Draft-statement-annex-30.pdf.

In the following table the weighted average based on market cap[86] as well as the arithmetic average is provided for the beta and gearing.

Table 6 BEREC peer group 2021 – Equity beta, Gearing, Asset beta

No.	Company	Equity beta	Gearing	Asset beta	Market capitalisation[87] in Billion Euro
1	Deutsche Telekom AG	0.84	48.85%	0.48	70.32
2	Elisa Oyj	0.46	13.61%	0.41	6.45
3	Koninklijke KPN N.V.	0.75	39.12%	0.49	11.28
4	NOS	0.78	31.90%	0.57	2.51
5	Orange S.A.	0.79	50.19%	0.44	35.32
6	Proximus S.A.	0.62	23.02%	0.50	7.90
7	Tele2 AB	0.64	21.32%	0.52	6.70
8	Telecom Italia	1.08	68.24%	0.42	12.59
9	Telefónica S.A.	1.12	55.29%	0.56	37.42
10	Telecom Austria AG	0.69	37.66%	0.47	4.40
11	Telenet Group Holding N.V.	0.70	48.71%	0.41	5.25
12	Telenor	0.42	27.04%	0.33	23.23
13	Telia Company AB	0.68	35.81%	0.48	15.93
14	Vodafone Group plc	0.90	48.26%	0.52	53.31
Weighted Average (information only)		0.82	45.32%	0.48	
Arithmetic Average (information only)		0,75	39.22%	0.47	

[86] The market cap has been calculated in Euro considering a five year average based on weekly prices of the shares (consistent with BEREC's approach to calculate five year averages). See Annex 3 for details.
[87] Weekly average of 5 years in Euro: Number of outstanding shares multiplied by the last share price

6. ERP

6.1. Definition and data sources used

Like the RFR the ERP is a parameter reflecting general economic conditions. The ERP is the expected return on equities over and above the RFR, in other words, the expected additional reward (**premium**) for holding equities that entail a higher risk compared with the interest for holding risk-free assets. It compensates for the added risk of investing in equity rather than in a risk-free asset.[88]

The Commission follows a notional approach and considers it appropriate to calculate **a single EU-wide ERP using historical series** of market premiums in EU member states.[89] According to the Commission, estimating a single EU-wide ERP is consistent with empirical evidence suggesting that financial markets in the EU are increasingly integrated and therefore have convergent ERPs, which also is likely to ensure consistency with the CAPM assumption that investors hold an efficient portfolio and therefore should be rewarded only for non-diversifiable risks.[90]

Furthermore, – upon request and after clarification received from the Commission, BEREC also estimated a separate EU/EEA ERP including data for Norway and Iceland (for exclusive use by Nkom and PFS).

In the following part the data used is described. Given that the calculation of the ERPs is based on the Morningstar data set as updated for 2021[91], and the data derived from Bloomberg using the implied pricing method, the details of both the data used and the calculations based on it are described in this section (6.1). In section 6.3 the construction of the BEREC EU index with the BEREC weighting method based on the results of section 6.1 for each EU member state is explained. Finally, section 6.4 provides the detailed description of the "available years" weighting to "merge" data series of different lengths and its application. Section 6.5 displays and analysis the result.

For the calculation of a single EU-wide ERP and an EU/EEA ERP, BEREC retrieves data from the 2021 Morningstar data set, which contains the so-called DMS Global Returns Data (DMS in the following).[92] This dataset contains historical time series from 1900 – 2020 for the

[88] Cf. Notice, para. 37, SWD, p. 46
[89] Cf. Notice, para. 38, SWD, p. 60 and section 5.2.3.2.
[90] Cf. Notice, para. 38, SWD, pp. 60 and below 6.2.
[91] The database in use by BEREC is the last available through Morningstar: February 2021. This version of DMS data updates the previous version dated February 2020. The estimations available in the 2021 Credit Suisse Yearbook, are based on this new version of the raw data time series since DMS continually updates and improves the series, including revising historical data series. Since the 2020 DMS data series some adjustments, other than the updates to the new year (2020), have been applied to the relevant Bond Total Return time series of the following countries: Belgium (since 1991), Denmark (since 1991), Finland (since 1996), France (since 1985), Germany (1995), Ireland (since 1999), Italy (since 1994), Netherlands (1985), Portugal (1999), Spain (1995) and Sweden (1991).
[92] Dimson/Marsh/Staunton (DMS) data, as published in the *Credit Suisse Global Investment Returns Yearbook 2021* by Credit Suisse/London Business School; a *Summary Edition of the Credit Suisse Global Investment Returns Yearbook 2021* is available here: https://www.credit-suisse.com/about-us-news/en/articles/media-

following 12 EU member states: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Portugal, Spain and Sweden and additionally for the EEA country Norway. For Iceland and other countries not included in the DMS data, the Implied pricing method has been applied with data retrieved from Bloomberg.

The DMS data consists of historical series of market premiums in the EU member states and Norway referred to above.[93] The DMS data is designed to measure the very long-run performance of equity (stocks) and bonds, and on this basis estimates the ERP an investor can expect to earn when investing in equity compared to holding risk-free assets. It is compiled by using best quality stock and bond indices and compiles long-run returns for each national market.[94]

The DMS database comprises annual returns for 32 countries in local currencies and the USD of the following main quantities: i) Nominal Equity Total Return; ii) Nominal Bond Total return; iii) Nominal Bill Total return; iv) Nominal Equity Premium Vs Bond; v) Nominal Equity Premium Vs Bill.[95]

For a better understanding of BEREC's calculation (see 6.3 and 6.4) based on the data series available it is relevant to explain three aspects of the DMS data:

i) General methodologies of the DMS data series;
ii) Equity Risk Premium evaluated for the "Europe Index" as provided in the Yearbook[96];
iii) Equity Risk Premium of the relevant 12 EU member states plus Norway where time series are available.

i) The General methodologies of the DMS data series[97]

The DMS database includes annual returns and is based on the best-quality capital appreciation and income series available for each country, drawing on previous studies and

releases/credit-suisse-global-investment-returns-yearbook-2021-202103.html. The data source is Dimson/Marsh/Staunton, Global Investment Returns Database 2021 (distributed by Morningstar Inc.).

[93] as well as data for other countries namely the UK, USA, Australia, Canada, China, Japan, New Zealand, Russia, South Africa, and Switzerland. Together they represent 98% of world equity market capitalization at the beginning of 1900. In the 2021 update of the DMS database historical series from nine other countries (Brazil, Hong Kong SAR, India, Malaysia, Mexico, Singapore, South Korea, Taiwan, Thailand) have been added with historical series on equity and bond returns with typically more than 50 years of data. Together, these 32 countries cover 98.5% of the investable universe at the beginning of 2021.

[94] For more details on the data sources used and methods applied to construct the historical global investment returns series see Dimson/Marsh/Staunton, Triumph of the Optimists: 101 Years of Global Investment Returns (2002), Dimson/Marsh/Staunton, Equity Premia Around the World, LBS 2011, available here: https://ssrn.com/abstract=1940165. The indices are described in Dimson/Marsh/Staunton, Credit Suisse Global Investments Returns Yearbook 2021 (available from London Business School (LBS)).

[95] The time series also list for each country the Maturity premium, Inflation, Exchange rates with USD and Real evaluation.

[96] The Credit Suisse Yearbook 2021 (which contains the DMS results in hard copy, the underlying DMS data is included in the Morningstar data set 2021 as a soft copy). The data source is Dimson/Marsh/Staunton, Global Investment Returns Database 2021 (distributed by Morningstar Inc.).

[97] The following explanations are mainly based on publicly available descriptions of the compilation of the DMS data, see Elroy Dimson, Paul Marsh, and Mike Staunton, "The Worldwide Equity Premium: A Smaller Puzzle"; Chapter 11 in "Handbook of the equity risk premium", editor Rajnish Mehra 2008, and Dimson/Marsh/Staunton Global Returns Data (DMS Global) Documentation; see also Dimson/Marsh/Staunton, Triumph of the Optimists:

other sources. To span the entire period from 1900, DMS linked multiple index series. The best index is chosen for each period, switching when feasible to better alternatives, as they become available. Other conditions being equal, DMS has chosen equity indexes that provide the broadest possible coverage of market of each country. Virtually all DMS equity indexes are capitalization weighted and are calculated from year-end stock prices, but in the early years, for a few countries, DMS was forced to use equally weighted indexes or indexes based on average- or mid-December prices. All the security returns include reinvested gross (pre-tax) income as well as capital gain.

The guiding principle of the index selection was to avoid survivorship[98], success, look-ahead[99], or any other form of ex post selection bias. The criterion was that each index should follow an investment policy that was specifiable in advance, so that an investor could have replicated the performance of the index (before trading costs) using information that would have been available at the time.[100] The conventional view of the historical equity premium is that, at the start of each period, investors make an unbiased, albeit inaccurate, appraisal of the end-of-period value of the stock market. Consequently, the ex-post premium, averaged over a sufficiently long interval, is expected to be a relatively accurate estimate of investors' expectations. At the same time historical premium may nevertheless be materially biased as a proxy for expectations because the past was in some sense unrepresentative.

The DMS bond indexes are based on government bonds that can be of different maturity, characteristic depending on the emitted product available along the time series for each country. They are usually equally weighted, and chosen to fall within the desired maturity range. Generally long term bonds are targeted, but where these are not available, either perpetual (usually for earlier periods) or shorter maturity bonds are used.

The Equity Risk Premium provided in the year book is estimated from the arithmetic difference between the logarithmic return on equities and the logarithmic return on the riskless asset. Equivalently, DMS defines 1 + Equity Premium to be equal to 1 + Equity Return divided by 1 + Riskless Return. Defined in this way, the Equity Premium is a ratio and therefore has no units of measurement. It is identical if computed from nominal or real returns, or if computed from dollar or euro returns.[101]

Each index starts from 1899 with a base index 1 and comprises data from 1900 – 2020, i.e. 121 years.

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101 Years of Global Investment Returns (2002), Dimson/Marsh/Staunton, Equity Premia Around the World, LBS 2011, available here: https://ssrn.com/abstract=1940165.

[98] Survivorship bias is the logical error of concentrating only on the capital that is related to the present, making it past, and using some selection process and overlooking the capital that didn't have effects on the present. This can lead to false conclusions in several different ways.

[99] Look-ahead bias occurs by using information or data in a study or simulation that would not have been known or available during the period being analysed.

[100] Elroy Dimson, Paul Marsh, and Mike Staunton "The Worldwide Equity Premium: A Smaller Puzzle" Chapter 11 in "Handbook of the equity risk premium" editor Rajnish Mehra 2008.

[101] The time series are provided in each local currency, and in USD.

ii) The Global indexes: "World Index" and "Europe Index" from DMS time series.

In the DMS data base four Global indexes are now included: the "World Index", the "Europe Index", the "Developed Market Index" and the "Emerging Markets Index".

The **"World Index"** comprises 23 countries (including Russia and China) plus nine new countries that have been added in the 2021 Yearbook. It is evaluated in common currency (USD) for both equity and bond. This year, DMS assumes that at the beginning of each year the investor bought a portfolio of the 23+9+58[102] countries weighting each country by its size. The "World equity index" is obtained through a weight based on the market capitalization[103] of each of the 23+9+58 countries. The "World bond market index" is obtained through a weight based on country GDP of each of the 23+9[104] countries. The approach used in order to include a country is to avoid survivorship bias, in the sense that the index also includes this country when it registered a total loss (e.g. 1917 for Russia and 1949 for China), and re-enters the indexes when their market reopened in the early 1990ies.

For the **"Europe Index"** the approach is the same; it includes 16 countries, the equity index and the bond index are evaluated in a common currency (USD), so local currency returns are converted to US dollars. In each period it is assumed that the investor bought a 16 positions portfolio composed of the following 16 countries: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, The Netherlands, Norway, Portugal, Russia, Spain, Sweden, Switzerland and the UK.

The equity risk premium is always evaluated as the ratio of the equity return and bond return, considering a logarithmic difference. In this way the equity risk premium is independent with respect to an evaluation done in nominal or real terms as the adjustment due to inflation to estimate real evaluation of each component, Equity and Bond is netted off. The equity risk premium is independent also with respect to the currency as, also in this case, the adjustment applied through exchange rates to convert the Equity and Bond index to the desired currency is netted off.

Switzerland, Russia and the UK, in the "Europe Index" are not relevant for BEREC's calculation of an EU-wide ERP; moreover Norway is now included in the calculation of an EU/EEA-ERP for EEA notification purposes only. It has to be noted that the updated "Europe Index" is published in the Credit Swiss Global Investment Returns Yearbook 2021, but no longer appears in the free Summary edition.[105]

For the "Developed Market Index" and the "Emerging Market Index" DMS identify whether a market was developing or emerging at each year in the past based on GDP per capita. The "Developed Market Index" at the end of 2020 thus contains the following countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, UK, US, Hong

[102] The equity index includes new countries when the data become available. The 2021 world Equity index includes as well other 58 other countries where data are available.
[103] The market capitalization is included considering a free float adjustment from 2001.
[104] The bond index includes also 9 new countries, but doesn't include the 58 new countries since in this case the data are not available
[105] See below for a comparison of the Credit Suisse "Europe Index" with the BEREC EU27-ERP.

Kong, Singapore, Luxemburg and Israel while the "Emerging Market Index" contains China, South Korea, Taiwan, India, Brazil, South Africa, Russia, Saudi Arabia, Thailand, Mexico, Malaysia, Indonesia as well as 14 smaller markets.

iii) The Equity Risk Premium of the relevant 12 EU member states + Norway from DMS time series.

The DMS Credit Swiss Global Investment Yearbook 2021 reports the following values in terms of arithmetic mean (AM) and geometric mean (GM): nominal annual Equity and Bond returns in local currency.[106]

Table 7 Geometric Mean and Arithmetic Mean 1900-2020 Equity/Bond annual return in nominal terms and Geometric and Arithmetic Average of Equity vs Bond premium[107]

		Mean returns % p.a.					
		Nominal				Premiums	
		Equities		Bonds		Equities vs Bonds	
No.	Country	GM	AM	GM	AM	GM	AM
1	Austria	13.2	28.1	8.5	18.4	2.5	21.1
2	Belgium	7.7	10.2	5.6	6.0	2.0	4.1
3	Denmark	9.6	11.5	6.1	6.6	3.3	5.0
4	Finland	12.7	16.3	7.1	7.3	5.2	8.8
5	France	10.3	12.8	7.1	7.5	2.9	5.2
6	Germany	8.3	13.2	3.3	5.3	4.8	8.1
7	Ireland	8.5	10.9	5.8	6.5	2.6	4.5
8	Italy	10.1	14.0	7.1	7.6	2.7	6.1
9	Netherlands	8.1	10.2	4.7	5.0	3.2	5.4
10	Portugal	11.1	16.1	5.7	6.7	5.1	9.1
11	Spain	9.1	11.2	7.6	8.2	1.3	3.3
12	Sweden	9.5	11.6	6.1	6.6	3.2	5.4
13	Norway	8.1	10.9	5.5	5.8	2.5	5.3

The values reported in the Yearbook refer to the time series from 1899 until 2020 for the index that is equal to 1 in 1899. The corresponding annual return for each year is evaluated from 1900 to 2020 as ((P_t/P_t-1)-1) with P_t the index value of the corresponding year "t" return.

The premium values Equity vs Bond are evaluated as averages (arithmetic/geometric) from the return evaluated as (1+Equity Annual return_t)/(1+Bond Return_t)-1.

[106] The data source of this table is Dimson/Marsh/Staunton, Global Investment Returns Database 2021 (distributed by Morningstar Inc.).
[107] ERPs as notified by the NRAs may differ from the ones provided in the table.

The values reported in Table 7 are rounded from the first decimal place as in the Credit Suisse Yearbook and recalculated from the DMS data distributed by Morningstar Inc. acquired by BEREC Office for BEREC. For all the 12 EU member states + Norway the time series for Equity and Bond annual return are complete from 1900-2020, the only exceptions are Austria and Germany.

For Austria the Equity Risk Premium excludes the averages (AM and GM) for the hyperinflationary years 1921 and 1922, instead the values for the corresponding nominal Equity and Bond index are maintained.

For Germany the nominal return and the corresponding Equity Risk Premium are evaluated excluding hyperinflation years 1922 and 1923.

iv) The Equity Risk Premium of the 15 EU member states plus Iceland not included in the DMS data calculated with the implied pricing method

For Iceland and the 15 EU member states that are not contained in the Morningstar data set, i.e. Bulgaria, Croatia, Cyprus, Czechia, Estonia, Greece, Hungary, Latvia, Lithuania, Luxembourg, Malta, Poland, Romania, Slovakia, and Slovenia relevant data was retrieved from Bloomberg and calculated according to a method applied by the CFA Institute (Charted Financial Analysts, which is an association of investment professional)[108]. The calculation, which could be referred to as an **implied pricing method**, is based on the following three steps. First, the main equity index is identified for each market and with the annual P/E (ratio of the price of a stock and a company's earnings per share) for each index retrieved from Bloomberg it provides a valuation of each equity market.[109] Secondly, the inverse of the P/E ratio (1/(P/E)) is calculated, which is the earnings yield. It is the percentage of how much a company earn per share, which in this case is how much all stocks in the index earns. This reflects the return on investing in equity. The third step is to subtract the risk free rate, annual average on domestic long term government bonds, from the earnings yield, which gives the equity risk premium on an annual basis.

The historical returns series thus assembled cover only a shorter period (see Table 9 below) due to missing long-term (liquid) financial markets because financial markets did not exist in most of the countries prior to joining the EU.[110] This lack of data is a consequence of the planned economy and can therefore not be remedied – where there is no market and consequently no data it cannot be "invented". BEREC therefore had to find a robust, transparent and not overly complicated way to "merge" historical data series with different lengths without however making a methodological mistake resulting in a systematic over- or underestimation of one or the other values, i.e. misrepresenting longer and shorter historic

[108] Comparability and consistency with the Morningstar data has been assured (using the same definition to build the indices etc.). Source: Jason Voss, What the equity risk premium tells us today, Financial Times, FTfm, November 7, 2011.

[109] For the purpose of the Equity index the Adjusted positive Price/Earnings ratio has been considered, calculated as the ratio of the last price divided by the positive Earnings per Share.

[110] This applies to the Central and Eastern European countries. For the smallest EU member state Malta still no data is available for other reasons.

returns series. The solution (the so-called "available years"-weighting) is described in more detail in section 6.4.

In the following part the information about the other EU member states is given separately. In this case the source of data for Equity comes from the implied pricing method time series, about the P/E ratio[111] evaluated in relation to Equity relevant market index of each country. For the bond component a specific index of government bond for each country has been considered as reported in Annex 4. These time series have on average been 15 years long. All the data has been derived from Bloomberg. The result is shown in Table 8.[112]

Table 8 Geometric Mean and Arithmetic Mean 2001-2020 Equity/Bond annual return in nominal terms and Geometric and Arithmetic Average of Equity vs Bond premium.[113]

		Mean returns % p.a.						
		Nominal				Premiums		Time series length
		Equities		Bonds		Equities vs Bonds		
No.	Country	GM	AM	GM	AM	GM	AM	
1	Bulgaria	13.04%	13.29%	4.73%	5.17%	7.94%	8.59%	2006-2020
2	Croatia	8.36%	8.40%	4.59%	5.16%	3.60%	4.29%	2006-2020
3	Cyprus	32.61%	34.50%	4.04%	4.18%	27.45%	29.26%	2015-2020
4	Czechia.	7.60%	7.61%	4.79%	5.22%	2.68%	3.12%	2006-2020
	Estonia	No data available						
5	Greece	11.24%	12.16%	4.52%	5.08%	6.42%	7.82%	2001-2020
6	Hungary	8.79%	8.82%	5.67%	6.50%	2.96%	3.76%	2001-2020
7	Latvia	11.04%	11.11%	2.03%	2.51%	8.83%	9.64%	2005-2020
8	Lithuania	9.40%	9.43%	5.46%	6.09%	3.74%	4.47%	2005-2020
9	Luxemburg	6.20%	6.21%	3.53%	3.77%	2.58%	2.83%	2016-2020

[111] The price-to-earnings ratio or P/E is one of the most widely-used stock analysis tools used by investors and analysts for determining stock valuation. In essence, the price-to-earnings ratio indicates the amount of dollar an investor can expect to invest in a company in order to receive one dollar of that company's earnings. This is why the P/E is sometimes referred to as the price multiple because it shows how much investors are willing to pay per dollar of earnings.

[112] ERPs as notified by the NRAs may differ from the ones provided in the table. Among other things this is due to the fact that BEREC's estimation is based on a bottom-up approach which outcome is affected by the fact that only limited data is available, i.e. the time series are relatively short compared to the long time series with data for 121 years for the 12 EU member states (119 for Germany) included in the DMS data.

[113] Values last checked in Bloomberg in May 2021.

	Malta							No data available
10	Poland	7.89%	7.91%	6.71%	7.25%	1.10%	1.73%	2001-2019
11	Romania	12.93%	13.44%	2.04%	2.73%	10.67%	13.34%	2006-2020
12	Slovakia	7.56%	7.58%	5.08%	5.45%	2.36%	2.65%	2005-2020
13	Slovenia	8.76%	8.81%	4.70%	5.09%	3.88%	4.34%	2005-2020
14	Iceland	7.08%	7.11%	4.31%	4.53%	2.77%	2.99%	2010-2020

6.2. Methodology with reference to Notice

BEREC follows the methodology outlined in section 4.2 of the Notice and described in more detail in section 5.2.3.2 of the SWD[114], i. e. it uses historical returns series of DMS data for 12 EU member states (listed above) + Norway and shorter historical returns series assembled by using the implied pricing method with data from Bloomberg for 13 EU member states + Iceland not included in the Morningstar data set (see above).

Therefore, BEREC cannot simply use an "off-the-shelf" European ERP as e. g. calculated by DMS, as the countries included in their (Old World) "Europe" Index[115] deviate from the EU member states that are relevant for BEREC's calculation of an EU-wide ERP. To our best knowledge, alternative off-the-shelf European ERP estimations are not available. Consequently, BEREC has estimated its own EU-wide ERP by applying a second weighting to reflect the limitation of data availability, which is different for the two groups of EU member states as outlined above. That also explains the difference to the "Europe" ERP shown in Table 21 of the SWD[116] and the result (an EU-wide ERP) estimated by BEREC exhibited in Table 11 in section 6.5.

The Notice provides guidance on how the ERP should be estimated. In line with general portfolio theory which makes the assumption that investors were perfectly diversified over the world, it would make sense to measure a "worldwide" ERP. The Commission's approach of a single EU-wide ERP is based on the idea of a single EU capital market and assumes an investor with an EU perspective holding an efficient portfolio of assets in EU member states. Therefore the single EU-wide ERP is to be estimated based on appropriate data from all EU member states (and from EU/EEA countries for the separate EU/EEA-wide ERP).

[114] SWD, pp. 65.
[115] Which comprises the following 16 countries: Austria, Belgium, Finland, France, Germany, Ireland, Italy, the Netherlands, Portugal, Spain, Denmark, Sweden, Norway, Switzerland, UK and Russia and is therefore not comparable with the EU-wide ERP calculated by BEREC.
[116] SWD, p. 66. Also Table 21 shows values for the period 1900 – 2010, i.e. is outdated. BEREC calculates the EU-wide ERP value using data until 2020.

6.3. Assumptions and choices made

In order to calculate a single EU-wide ERP a sound approach of using longer (for 12 EU member states) + Norway and shorter (for 13 EU member states + Iceland) historical data series in one calculation without a systematic bias needed to be found. The solution is to apply a weighting reflecting the length of the available historical data series – the so-called **"available years"-weighting** as described below in section 6.4.

For 12 EU member states + Norway (listed above in Table 7) the estimation of the EU-wide ERP (and EU/EEA-ERP resp.) is based on the DMS historical returns series acquired by BEREC from Morningstar2021. These series do not cover the remaining 15 EU member states + Iceland (listed above in Table 8). For these member states the estimation has been carried out considering for the equity return time series provided by the implied pricing method using Bloomberg, for the bond market compound index based on long term government bond has been used. In the index selection, inflation index linked bond has been omitted when possible and using local currency indexes composed by long term bonds. The time series of these countries have been included in the estimation from 2001 at the earliest when available.[117] The relative weighting of these time series addresses a selection bias that may happen if countries with shorter data series are included.[118]

Following the Notice BEREC provides an **EU-wide ERP** that is a weighted average of the ERP using DMS historical time series for 12 EU member states + Norway from 1900 and historical time series for 13 EU member states + Iceland, where data are available, not included in the Morningstar data set calculated with the implied pricing method using Bloomberg starting from 2001 at the earliest and 2015 at the latest.[119] The **Equity component** of the new (BEREC) EU index will be derived considering **market capitalization** of each country (market size) in line with the global indexes constructed by DMS and **GDP** weight for the **bond component**.[120]

Using a weight for Equity that takes into account market capitalization is in line with the efficient market hypothesis[121] and with the general assumption that the weighted average market capitalization is the optimal method of asset allocation as it reflects the actual behaviour of markets. In this way, larger Equity markets tend to have a greater influence over the index, just as is the case of modern Index construction. This leads to a natural rebalancing mechanism where a growing Equity market is more influential in the index.

Market capitalization weighted indices reflect the available investment opportunity set in public equity markets. By design, they ignore any unlisted companies, whether privately held or state owned, since these are not accessible to the investing public.[122] However, all companies in a country contribute to the economy whether or not they are listed, available to local or foreign

[117] For more details see above section 6.1.
[118] E. Dimson, P. March, M. Staunton "Survivorship Bias Is Negligible", paragraph 5.4 Chapter 11 Handbook of Equity Risk premium.
[119] For more details see above section 6.1.
[120] The use of Market cap and GDP for the "World Index" and the "Europe Index" have been considered since 2012 by DMS.
[121] The efficient-market hypothesis (EMH) is a hypothesis in financial economics that states that asset prices reflect all available information. A direct implication is that it is impossible to "beat the market" consistently on a risk-adjusted basis since market prices should only react to new information.
[122] GDP Weighting in Asset Allocation 2010 MSCI Research bulletin.

investors, private or public. Since the value of this larger universe of companies is not directly observable, the value of the economy as measured by the GDP is often used as a reference against which a country's current market capitalization is contrasted. This is more effective to catch asset allocation probability in the Bond market portfolio.

BEREC's approach of applying a **5-year averaging window (2016-2020)** when calculating the weights for equity (with market capitalisation) and bonds (with GDP) instead of a "year-by-year" weighting (as done by DMS), leads to "fixed weightings along the years" instead of the rebalancing used by DMS.[123] BEREC's method in this way appears to have an upward bias compared to the estimation followed by DMS for the calculation of a "Europe Index" calculated until 2020. However, the sensitivity analysis run by BEREC shows that the difference is not material.[124]

The annual market capitalisation data has been derived from Bloomberg using all outstanding shares that are only actively traded, the figure does not contain ETF (Exchange trade found) and ADR (America Deposit Receipt) as they do not represent companies directly. It includes only actively traded, primary securities on the countries' exchanges to avoid double counting. It is evaluated in Euro in line with the GDP weight used for the Bond index.[125] The same approach is applied in the DMS Yearbook where the World equity index is weighted using market capitalisation free float adjusted from 2001.

The GDP data has been derived from Eurostat in form of current prices in Euro[126].

Overall these assumptions allow BEREC to calculate a single EU-wide ERP in a robust, transparent and comprehensible way taking into account the limitations as regards to data availability.

6.4. Calculation steps – description of how the result is derived

The first step of the analysis has been carried out considering the following.

As explained in section 6.3 above the weight for the market capitalisation and GDP has been considered as an average with five year time window (2016-2020), in line with the beta and RFR estimation. Using a five-year average window might slightly overestimate the result compared to using a year-by-year weighting which, for practical reasons (time and data constraints), was not possible.[127]

The evaluation of the ERP has been estimated using the following assumption:

For each year of the time series BEREC has obtained annual returns for Equity and Bonds in nominal terms:

[123] i.e. BEREC uses the same weighting *factors* (market capitalisation, GDP), however a different weighting *method* (due to data constraints).
[124] See below section 6.5.
[125] Data are consistent with those publicly available: https://data.worldbank.org/indicator/CM.MKT.LCAP.GD.ZS.
[126] https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nama_10_gdp&lang=en.
[127] See below section 6.5.

Equity_EU_t = (Equity return_t_x* Market Capitalization_x+ Equity return_t_y* Market Capitalization_y+…)/(Sum of market capitalization_t) ;

Bond EU_t = (Average Bond_t_x*GDP_x+ AverageBond_y*GDP y_t+.)/(sum fo GDP_t).

Along the time line the sum of the denominator takes into account the number of countries that are included in recent years. This is effected via applying a second weighting to compensate for incomplete historic values. This is the **"available years"-weighting** according to the length of the time period of data availability. For the 12 EU member states + Norway listed in the Morningstar data set this would be 121 years[128] divided by the maximum time period available (121) and for the remaining 13 EU member states + Iceland not included in the Morningstar data set the weight is the number of years for which data is available (2001 at the earliest – 2020) over the maximum time period available, i.e. 20/121). Thus BEREC is able to incorporate data of different time lengths of all EU member states without over- or understating available data series with different lengths. The formula is shown hereafter:

Equity_EU = (Average Equity_x*Market Capitalization_x*(1)+Average Equity_y*Market Capitalization_y*(y/121)+...)/(market capitalization_x*1+ market capitalization_y*(y/121)+..);

Bond EU = (Average Bond_x*GDP_x*(1) + AverageBond_y*GDPy*(y/121)+...)/(sum for GDP_x*(1)+GDP_y*(y/121)+...).

After obtaining the values of Equity and bond returns in nominal terms BEREC has estimated the equity risk premium in coherence with the approach used in the Yearbook, as the difference of logarithm like (1+ Equity_EU)/(1+ Bond_EU)-1 for each point in time. After that BEREC computed the Arithmetic average and Geometric average of the new time series established. The evaluated equity risk premium is independent from the nominal or real estimation as well as from the currency, due to the fact that BEREC used the ratio of the annual return instead of the difference of the annual return. In this way the adjustment due to nominal or real estimation as well as the currency are not relevant with respect to the final estimation.

Through this approach the time series of the 13 EU member states + Iceland (not contained in the Morningstar data set) are integrated in the final average only where data is available for both the Bond and Equity index.[129] The weights are adjusted year by year taking into account the relevant EU/EEA member states that are included. In the table below the year in which the time series are included is also given. The date of inclusion depends on the availability of both equity and bond data. Data are available for all countries (except Estonia,[130] and Malta), and thus all EU member states (except two) are included.

[128] Or less if individual years are taken out where the value is an outlier (this is the case for Germany for the two years 1922/1923 of hyperinflation, and the Austrian case for 1921/1922 is derived differently (see above). Apart from these two exceptions, BEREC did not make adjustments to the historic returns series of DMS/Morningstar.

[129] The data availability is also a measure of liquidity of the market and so also an indicator of the relevance on representing a likely share in the portfolio.

[130] Estonia has not been included due to the fact that government bond emission started only from June 2020.

Table 9 Year and duration of the time series of the 13 EU member states + Iceland not included in the Morningstar data set

No.	Country	First year of the time series	Time Weight
1	Bulgaria	2006	15/121
2	Croatia	2006	15/121
3	Cyprus	2015	6/121
4	Czechia	2006	15/121
5	Estonia	No data available	
6	Greece	2001	20/121
7	Hungary	2001	20/121
8	Latvia	2005	16/121
9	Lithuania	2005	16/121
10	Luxemburg	2017	5/121
11	Malta	No data available	
12	Poland	2001	20/121
13	Romania	2006	15/121
14	Slovakia	2005	16/121
15	Slovenia	2005	16/121
16	Iceland	2010	11/121

The limitation of the proposed approach is related to the fact that weights are dependent on when data is available for each country. This gives a sort of "look-ahead" bias as the probability of investing along the years, as market capitalization/GDP has changed along the 100 years, but this is a trade-off with respect to the data availability, however, consistently in line with the general framework proposed by the Commission.

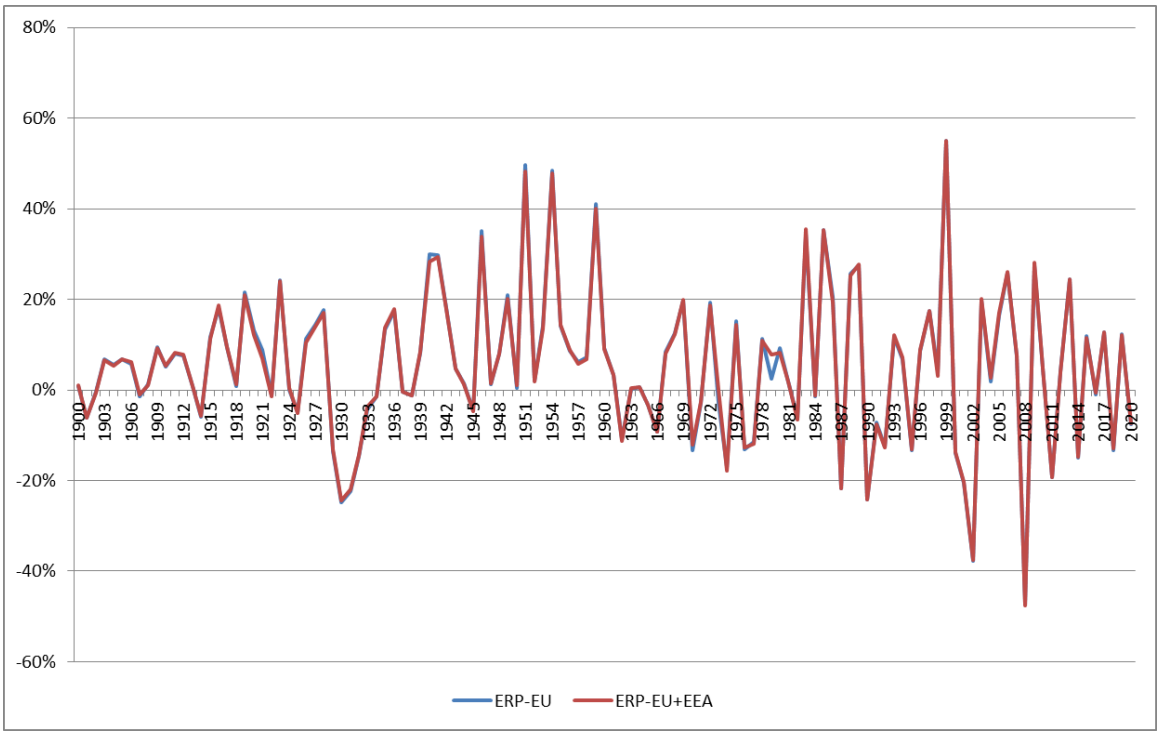
To estimate the single EU-wide ERP BEREC calculated the arithmetic mean (AM) and the geometric mean (GM). BEREC notes that the Notice and the SWD favour for transparency reasons the use of AM. With reference to the other regulatory objectives/principles the SWD is (at best) neutral and rightly points out – in line with financial theory – the drawbacks of an AM (upward bias), in particular with regard to predictability and efficiency.[131] To estimate the ERP on the basis of an arithmetic or geometric means has been subject to unresolved discussions in financial literature. Blume (1974) has shown that for estimating the end value of longer-term capital investments the arithmetic mean is generally an upward-biased estimator, whereas the geometric mean is a downward-biased estimator.[132] It follows that the

[131] SWD, section 5.1.2, pp. 36-38.
[132] See also SWD, p. 37/38. For this reason the Credit Suisse Yearbook publishes both the AM and the GM.

AM usually provides the upper boundary of the value, whereas the GM is the lower boundary. For transparency reasons BEREC provides both the GM and the AM.

In the following Figure 3 the time evolution (1900-2020) of the proposed annual returns of the new EU Equity risk premium is shown, including 12 EU member states with long time series and 13 EU member states with shorter time series as described before. In the figure the evolution over time including Norway and Iceland (EEA) is also given.

Figure 3 Equity Risk Premium 1900-2020 time series



The corresponding ERP averages are shown in Table 10.

Table 10 EU ERP (GM and AM) / EU/EEA-ERP (GM and AM)

	Geometric Mean (GM)	Arithmetic Mean (AM)
EU-ERP	**4.18%**	**5.50%**
EU/EEA-ERP	**4.18%**	**5.48%**

While the effect of the 13 EU member states + Iceland not included in the Morningstar data set is not substantial right now, the significance may increase in the future as markets become more mature.

6.5. Result: EU-ERP and EU/EEA-ERP

The result of the calculation is shown in Table 11. For each EU member state the GM and the AM is provided (unweighted).[133] The line below the last EU member state contains the lower boundary (GM) and the upper boundary (AM) of the single EU-wide ERP as estimated by BEREC with the method described above. BEREC considers that the result is robust based on the data available at this point in time. Only the EU-wide ERP with a value of 5.50% (AM) is relevant for NRAs' own estimations.

In addition, a separate EU/EEA-wide ERP average (GM and AM) is calculated. The EU/EEA-wide ERP with a value of 5.48% (AM) is a relevant reference only for the two EEA countries Norway and Iceland for EEA notification purposes.

[133] Taken from Table 7 and Table 8, ERPs as notified by the NRAs may differ from the ones provided in the table. For the countries not included in the Morningstar data set, the available years-weight is taken from Table 9, the EU-ERP from Table 10.

Table 11 ERP

Country	Geometric Mean in %	Arithmetic Mean in %	Available years weight
Austria	2.5	21.1	100% (121/121)
Belgium	2.0	4.1	100% (121/121)
Bulgaria	7.94	8.59	12.40% (15/121)
Croatia	3.60	4.29	12.40% (15/121)
Cyprus	27.45	29.26	4.96% (6/120)
Czechia	2.68	3.12	12.40% (15/120)
Denmark	3.3	5.0	100% (121/121)
Estonia	not available		
Finland	5.2	8.8	100% (121/121)
France	2.9	5.2	100% (121/121)
Germany	4.8	8.1	98.34% (119/121)
Greece	6.42	7.82	16.53% (20/121)
Hungary	2.96	3.76	16.53% (20/121)
Ireland	2.6	4.5	100% (121/121)
Italy	2.7	6.1	100% (121/121)
Latvia	8.83	9.64	13.22% (16/121)
Lithuania	3.74	4.47	13.22% (16/121)
Luxembourg	2.58	2.83	4.13%(5/121)
Malta	not available		
Netherlands	3.2	5.4	100% (121/121)
Poland	1.10	1.73	16.53% (20/120)
Portugal	5.1	9.1	100% (121/121)
Romania	10.67	13.34	12.40% (15/121)
Slovakia	2.36	2.65	13.22% (16/121)
Slovenia	3.88	4.34	13.22% (16/121)
Spain	1.3	3.3	100% (121/121)
Sweden	3.2	5.4	100% (121/121)
EU-ERP	**4.18**	**5.50**	
Norway	2.5	5.3	100% (121/121)
Iceland	2.78	2.99	9.09%(11/121)
EU/EEA-ERP	**4.18**	**5.48**	

Analysis of results

The result of BEREC's calculation presented in this chapter is broadly in line with likely expected findings. It is plausible that the EU-ERP value is lower than the majority of the national ERP values computed by NRAs (and their average)[134] for two reasons. ERPs

[134] See Regulatory Accounting Report 2020 (BoR (20) 210), WACC chapter, which shows that 17 out of 25 EU NRAs (excluding EE, LV, NL), where data is available, estimate an ERP above 5.53%.

estimated by NRAs may include a "home bias" towards the national market which the EU-wide ERP, calculated by BEREC looking at the single EU capital market, inherently does not have. Also, the larger single EU capital market is pushing down the ERP as more market participants compete with each other, i.e. the decrease is reflecting an efficiency gain.

Bearing in mind that the (inherent) upward bias[135] in the AM is further exacerbated by the BEREC weighting method[136], BEREC does not consider it justified to *solely* show the AM of the EU-wide ERP. Instead of making an arbitrary adjustment or using a combination of AM and GM, BEREC, provides both the AM (the upper boundary) of the EU-wide ERP which is displaying the result of the AM calculation transparently[137] and the GM (the lower boundary). Otherwise, the AM value would be challengeable on the allegation of the (concealed but certain) upward bias.

BEREC considers that the appropriate value of the **single EU-wide ERP** has a value of **5.50%** which is the upper boundary of the margin given by the 4.18% (GM as the lower boundary) and 5.50% (AM). With this BEREC unifies the calculation of the ERP in line with the Notice/SWD thereby eliminating any methodological differences of NRAs' estimations while NRAs need to take into account the existing factual situation in their respective member states adequately in their decisions by setting the (other) parameters based on the BEREC parameter values. In a first step this implies that national ERPs will converge more when NRAs start applying the EU-wide ERP compared to the current situation[138] with the standard deviation expected to go down considerably.[139] In a second step WACC values would also converge.

Overall, the WACC methodology as provided for in the Notice and used in the BEREC WACC parameters Report carefully balance consistency, transparency and continuity, i.e. aiming to reflect market realities of 27 EU Member States as well as the convergence towards an EU-wide capital market not yet fully completed. The application of the historical data series for both Bond and Equity index for the ERP estimation provides the best estimate in the long run

[135] See above section 6.3.

[136] In comparison to the estimation followed by DMS for the "Europe Index" BEREC's weighting method appears to have an upward bias caused by the use of a fixed five year averaging window (2015-2019), which is due to lack of data. The Credit Swiss Yearbook 2021 provides an estimation of 4.0% (AM) for its "Europe Index", which however also includes Switzerland, Norway, Russia and UK. In order to estimate the size of the upward bias BEREC made a sensitivity analysis including also Switzerland, Norway, Russia and UK in a calculation applying its weighting method to be able to compare the AM value published in the Credit Swiss Yearbook 2021 (4.0%) to the EU-ERP AM value estimated by BEREC (5.50%). The result of this estimation is 4.69%, i.e. a difference of +0.69%-points compared to 4.0%. So taking the 4.0% value as the "unbiased" value the difference of 0.69%-points can be considered as an indication of the upward bias. Including this in BEREC's method, this would provide a hypothetical (unbiased) EU-wide ERP of 4.81% (AM). This shows that albeit the bias exists it is relatively small and substantially in line with the upward bias estimated in 2019 (0.46%) in that case not including Russia and the time series slightly different as reported in footnote 91.

[137] Without adjustments, in order to avoid unnecessary complexity.

[138] As shown in the RA Report 2020 (BoR (20) 210), WACC chapter. Since last year's WACC parameters Report only a limited number of NRAs had fully applied the WACC Notice/BEREC's parameters values, many NRAs using the one-year transition period.

[139] The increased value of the AM-ERP in this year's WACC parameters Report is mainly due to the exclusion of the UK ("*Brexit effect*") that has a relevant impact on the weighted average of the EU-ERP. The UK DMS AM ERP is equal to 4.7% in this year's edition from 4.9% ERP in the 2020 Yearbook. The effect of excluding the UK on the AM of the EU-ERP evaluated by BEREC is about -0.34%, in fact the EU-ERP estimated including also the UK about 5.16% with respect to 5.50% excluding it.

perspective based on empirical evidence on the Equity premium over bond compared to other methodologies available.

NRAs not using the AM would need to provide an explanation justifying their result, although within the margin.

7. Summary of Results

7.1. Overview of Results

The following overview table (Table 12) summarizes all results related to company specific parameters for the BEREC peer group. It has been compiled using the results of Chapters 2 to 5.

Table 12 BEREC peer group 2021 – Overview of results for company specific parameters

Peer Group Company	SMP (legacy infra-structure)	Company Credit Rating (S&P)	Country	Country Credit Rating (Moody's)	Debt Premium	RFR (domestic = national) of home country	Cost of Debt (=Debt Premium + RFR)	Equity beta	Gearing	Asset beta
Deutsche Telekom AG	Yes	BBB	DE	AAA	124	-0.03	1.21	0.84	48.85%	0.48
Elisa Oyj	Yes	BBB+	FI	AA1	73	0.24	0.97	0.46	13.61%	0.41
Koninklijke KPN N.V.	Yes	BBB	NL	AAA	116	0.15	1.31	0.75	39.12%	0.49
NOS	No	BBB-	PT	BAA3	54	1.71	2.25	0.78	31.90%	0.57
Orange S.A.	Yes	BBB+	FR	AA2	80	0.37	1.17	0.79	50.19%	0.44
Proximus S.A.	Yes	A	BE	A3	92	0.36	1.28	0.62	23.02%	0.50
Tele 2 AB	No	BBB	SE	AAA	152	0.34	1.86	0.64	21.32%	0.52
Telecom Italia	Yes	BB+	IT	BAA3	101	1.82	2.83	1.08	68.24%	0.42
Telefónica S.A.	Yes	BBB-	ES	BAA1	44	1.01	1.45	1.12	55.29%	0.56
Telekom Austria AG	Yes	BBB+	AT	AA1	78	0.25	1.03	0.69	37.66%	0.47
Telenet Group Holding N.V.	No	BB-	BE	A3	312	0.36	3.48	0.70	48.71%	0.41
Telenor	Yes	A-	NO	AAA	100	1.38	2.38	0.42	27.04%	0.33
Telia Company AB	Yes	BBB+	SE	AAA	131	0.34	1.65	0.68	35.81%	0.48
Vodafone Group plc	No	BBB	UK	(Aa3)	156	0.95	2.51	0.90	48.26%	0.52

Table 13 Major EU/Peer Group Operators' Ownership[140]

Country	SMP/Other Operator	Included in Peer Group (directly or indirectly)	Publicly Traded (directly or indirectly	Comment: Major Owner
AT	Telekom Austria	Yes	Yes	America Movil 51%, Oesterreichische Beteiligungs AG 28.42%
BE	Proximus	Yes	Yes	Kingdom of Belgium 53.51%
BG	Vivacom prev Bulgarian Telecommunications Company (BTC)	No	No	No longer SMP operators. Owned by American International Group
HR	T-Hrvatski (T-HT)	Yes	Yes	Deutsche Telekom 51%
CY	CYTA	No	No	Semi-government organisation
CZ	CETIN a.s.	No	No	PPF Group
DK	TDC	No	No	Pension funds: ATP, PFA and PKA, infrastructure fund MIRA.
EE	Telia Eesti	Yes	Yes	Telia Company
FI	DNA, Elisa, Telia Finland	Yes	Yes	DNA is owned by Telenor. Elisa is owned by institutional owners. The Finnish state owns 10%. Telia Finland is owned by Telia Company.
FR	Orange	Yes	Yes	French Republic 13.39%
DE	Deutsche Telekom	Yes	Yes	Federal Republic of Germany 14.50%
EL	Hellenic Telecommunications Organization (OTE)	Yes	Yes	Deutsche Telekom 46.9%, Hellenic Republic 5.6%
HU	Magyar Telekom	Yes	Yes	Deutsche Telekom 59,21%
IE	Eircom	No	No	Private consortium controlled by Xavier Niel
IT	Telecom Italia	Yes	Yes	Vivendi 23.75%, Cassa Depositi e Prestiti SpA 9.81%
LV	Lattelekom	Yes	Yes	Latvian Government 51% and Telia Company 49%
LT	Teo LT	Yes	Yes	Telia Company 88.15%
LU	Entreprise des Postes et Télécommunications (Post Luxembourg)	No	No	Luxembourg state
MT	Go	No	Yes	Institutional owners
NL	Koninklijke KPN	Yes	Yes	America Movil 20.02%, Capital Group Cos 11.91%
NO	Telenor	Yes	Yes	Norway Ministry of Trade Industry & Fisheries 53.97%
PL	Orange Polska/Telekomunika	Yes	Yes	Orange SA 50.67%

[140] Source: Bloomberg and BEREC survey.

	cja Polska/Polish Telekom (TPSA)			
PT	MEO, NOS	Yes	Yes	MEO is SMP. It is not listed owned by Altice which is privately owned. NOS is not SMP, owned by Zopt SGPS SA 52.15%, Sonae SGPS SA 7.38%
RO	Telekom Romania	Yes	Yes	OTE International 54.01%, Information Society Ministry 45.99%. OTE has entered an agreement with Orange Romania to sell its holding in Telekom Romania, it is subject to regulatory approval, expected to be completed during H2 2021.
SK	Slovak Telekom	Yes	Yes	Deutsche Telekom 100%
SI	Telekom Slovenije	No	Yes	Republic of Slovenia 72.38% (also SDH d.d and Kapitalska družba d.d are 100% owned by the Republic of Slovenia)
ES	Telefonica	Yes	Yes	Institutional owners
SE	Telia	Yes	Yes	Kingdom of Sweden 39.50%

The result for the ERP is as follows. Based on the calculations described in Chapter 6 (and shown in Table 10) above BEREC considers that the appropriate value of the single EU-wide ERP is 5.50% (AM) and the single EU/EEA-wide ERP relevant only for the EEA countries Norway and Iceland is 5.48% (AM).

7.2. Taxes and inflation

Section 6 of the Notice describes the taxes and inflation. Acc. to para. 60 it is appropriate to use the relevant domestic corporate tax rate.

Acc. to para 63 a Eurozone-wide inflation rate is appropriate for Eurozone Member States, for non-Eurozone Member States national inflation estimates may be justified. As a forecast the 5 year-ahead inflation forecast of the ECB is considered appropriate.

The latest available 5-year-ahead inflation forecast of the ECB is 1.7 % (as of Q2/2021).[141]

[141]The ECB inflation forecast is based on a survey of professional forecasters (SPF), which began in 1999, collects information on the expected rates of inflation, real GDP growth and unemployment in the euro area at several horizons, ranging from the current year to the longer term. Expectations are reported not only as point forecasts, but also as probability distributions, providing a quantitative assessment of risk and uncertainty. The aggregate results and microdata are published four times a year. The next update will be on 23rd July 2021 (provisionally),
https://www.ecb.europa.eu/stats/ecb_surveys/survey_of_professional_forecasters/html/index.en.html.

7.3. Comparison to last year's Report

The 2021 WACC parameters Report is the second BEREC Report and so some preliminary comparisons can be made between the 2021 and the 2020 Reports.

First, this year's Report uses the same methodology as last year's Report, so any difference is attributable to factual developments. One major one-off effect impacting in particular on the EU-wide ERP which now excludes the UK, is Brexit. As shown above the increase from 5.31% (AM last year) to 5.50% this year can largely be explained with Brexit given the weight the UK had in the EU28-Index last year.[142] Brexit also led to a change of the peer group as BT no longer qualified for the BEREC peer group. However, as for the BEREC peer group the EU/EEA area is considered as a whole, no distinction needed to be made when the eligibility criteria are fulfilled, thus Telenor is now eligible as a peer.

Another important point to highlight is the effort undertaken by BEREC to incorporate the longer time series available for non-DMS countries for the calculation of the EU-wide ERP and the fact that with Bloomberg a single data source could be used which improves the robustness of the results. Generally, relying on long(er) time series of historical returns (such as the DMS data) is evidence based and contributes to the reliability of the results as short term volatilities are reduced. The application of the historical data series for both Bond and Equity index for the ERP estimation provides the best estimate in the long run perspective based on empirical evidence on the Equity premium over bond compared to other methodologies available.

This approach is in line with the objectives of the WACC Commission Notice: i) to improve consistency in the methodology; ii) to enhance regulatory predictability by limiting unexpected variations in the methodology and the value over time; iii) to promote efficient investment and innovation by setting rates reflecting the appropriate level of risk; iv) to provide more transparency to all stakeholders on the way the calculations are done.

[142] See footnote 139.

Annex

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Abbreviations

A

AM	Arithmetic mean

B

BEREC	Body of European Regulators for Electronic Communications
Bloomberg	Bloomberg financial system

C

CAPM	Capital Asset Pricing Model
CFA	Charted Financial Analysts Institute
Covid-19	Coronavirus disease 2019
Credit Suisse Yearbook	Credit Suisse Global Investment Returns Yearbook 2021

D

DMS	Dimson/Marsh/Staunton dataset (distributed by Morningstar)

E

ECB	European Central Bank
ERP	Equity Risk Premium
EUR	Euro
Eurostat	European Statistical Office

G

GM	Geometric mean

N

NGA	Next Generation Access network
Notice	Commission Notice on the calculation of t. cost of capital of 7th Nov. 19
NRA	National Regulatory Authority

O

OAO	Other Authorised Operator
OLS	Ordinary least square

P

P/E ratio	Price-to-earnings ratio

R

RA Report	BEREC Regulatory Accounting in Practice Report
RFR	Risk-free rate

S

S&P	Standard & Poor's
SEK	Swedish crowns
SMP	Significant Market Power
STOXX Europe TMI	STOXX Europe Total Market Index
SWD	European Commission Staff Working Document

W

WACC	Weighted Average Cost of Capital

Annex 1: RFR

EMU convergence criterion series - monthly data[143] (Source: Eurostat)[144]

TIME	2016-04	2016-05	2016-06	2016-07	2016-08	2016-09	2016-10	2016-11	2016-12	2017-01	2017-02	2017-03	2017-04	2017-05	2017-06
Austria	0,38	0,37	0,33	0,16	0,11	0,15	0,24	0,49	0,53	0,57	0,59	0,59	0,49	0,65	0,55
Belgium	0,55	0,55	0,43	0,2	0,15	0,18	0,27	0,57	0,61	0,7	0,87	0,87	0,78	0,77	0,62
Bulgaria	2,44	2,37	2,4	2,39	2,28	2,15	1,84	1,82	1,8	1,77	1,75	1,73	1,78	1,74	1,7
Croatia	3,62	3,52	3,81	3,75	3,58	3,34	3,07	3,01	2,95	2,8	2,71	2,74	2,98	3,01	2,83
Cyprus	3,99	3,89	3,82	3,87	3,84	3,62	3,39	3,47	3,55	3,45	3,37	3,34	3,23	3,03	2,84
Czechia	0,43	0,46	0,45	0,37	0,29	0,25	0,37	0,55	0,53	0,47	0,63	0,87	0,96	0,74	0,77
Denmark	0,4	0,41	0,23	0,07	0,04	0,01	0,13	0,32	0,39	0,37	0,33	0,19	0,55	0,64	0,53
Estonia	0,215	0,23	0,225	0,185	0,145	0,125	0,185	0,275	0,265	0,235	0,315	0,435	0,48	0,37	0,385
Finland	0,46	0,45	0,33	0,12	0,06	0,08	0,17	0,41	0,46	0,5	0,52	0,51	0,38	0,49	0,56
France	0,51	0,51	0,39	0,17	0,15	0,18	0,33	0,67	0,75	0,86	1,03	1,02	0,88	0,81	0,66
Germany	0,13	0,13	-0,02	-0,15	-0,13	-0,09	0,	0,19	0,25	0,25	0,26	0,35	0,22	0,34	0,25
Greece	9,03	7,64	7,92	7,99	8,19	8,34	8,33	7,33	6,94	7,04	7,52	7,17	6,7	5,86	5,76
Hungary	3,02	3,35	3,31	2,88	2,83	2,88	2,93	3,36	3,31	3,4	3,52	3,48	3,28	3,1	2,99
Ireland	0,86	0,84	0,76	0,47	0,4	0,42	0,5	0,85	0,84	0,99	1,06	1,05	0,91	0,83	0,7
Italy	1,44	1,53	1,45	1,23	1,18	1,27	1,45	1,94	1,89	1,99	2,35	2,4	2,26	2,19	2,05
Latvia	0,61	0,51	0,48	0,3	0,12	0,1	0,19	0,56	0,9	0,89	0,99	0,94	0,92	0,88	0,85
Lithuania	1,31	0,86	0,86	0,86	0,86	0,79	0,31	0,31	0,31	0,31	0,31	0,31	0,31	0,31	0,31
Luxembourg	0,34	0,33	0,17	0,	-0,05	-0,03	0,07	0,28	0,39	0,43	0,55	0,6	0,49	0,57	0,52
Malta	1,	1,02	0,95	0,76	0,61	0,6	0,59	0,84	0,82	1,17	1,32	1,55	1,43	1,37	1,25
Netherlands	0,4	0,38	0,25	0,06	0,03	0,06	0,16	0,39	0,44	0,48	0,49	0,49	0,5	0,59	0,5
Poland	2,95	3,04	3,11	2,89	2,71	2,85	3,01	3,41	3,54	3,68	3,81	3,66	3,42	3,35	3,19
Portugal	3,13	3,15	3,2	3,06	2,91	3,26	3,33	3,51	3,74	3,95	4,04	3,99	3,77	3,29	2,97
Romania	3,43	3,43	3,48	3,14	2,93	2,92	2,94	3,56	3,73	3,75	3,96	3,99	3,79	3,75	3,67
Slovenia	1,37	1,41	1,36	0,95	0,8	0,75	0,62	0,89	0,96	0,99	1,01	0,99	1,	0,98	0,86
Slovakia	0,38	0,41	0,77	0,49	0,3	0,32	0,42	0,72	1,01	1,03	1,09	1,09	1,06	1,03	0,86
Spain	1,53	1,57	1,48	1,17	1,01	1,04	1,07	1,43	1,44	1,46	1,7	1,72	1,61	1,57	1,45
Sweden	0,81	0,77	0,52	0,17	0,1	0,22	0,24	0,43	0,61	0,65	0,66	0,69	0,57	0,56	0,46
Iceland	5,97	5,96	5,96	5,25	5,29	5,28	5,15	4,98	5,21	4,93	4,92	4,86	4,65	4,59	4,73
Norway	1,3	1,4	1,17	0,96	1,07	1,23	1,34	1,58	1,76	1,69	1,74	1,77	1,61	1,59	1,53
UK	1,48	1,43	1,18	0,79	0,6	0,77	1,04	1,34	1,39	1,38	1,24	1,13	1,	1,03	0,98

[143] Maastricht criterion bond yields (mcby) are long-term interest rates, used as a convergence criterion for the European Monetary Union, based on the Maastricht Treaty.

[144] Estonia and Iceland derived by BEREC. Norway provided by NKOM (Source: Central Bank of Norway). UK only included for the purpose of determining the RFR for Vodafone in the CoD calculation.

EMU convergence criterion series - monthly data (Continued)

TIME	2017-07	2017-08	2017-09	2017-10	2017-11	2017-12	2018-01	2018-02	2018-03	2018-04	2018-05	2018-06	2018-07	2018-08	2018-09
Austria	0,73	0,61	0,59	0,61	0,51	0,5	0,67	0,84	0,81	0,76	0,76	0,71	0,6	0,6	0,67
Belgium	0,83	0,73	0,7	0,69	0,58	0,53	0,7	0,97	0,87	0,81	0,83	0,79	0,68	0,71	0,77
Bulgaria	1,65	1,7	1,66	1,4	1,33	1,02	0,9	0,98	1,05	1,02	1,05	0,99	0,92	0,81	0,78
Croatia	2,78	2,87	2,71	2,66	2,65	2,47	2,35	2,27	2,19	2,12	2,16	2,2	2,26	2,18	2,14
Cyprus	2,57	2,49	2,2	1,84	1,54	1,58	1,68	1,93	1,83	2,12	2,52	2,61	2,08	2,22	2,01
Czechia	0,9	0,83	0,97	1,45	1,68	1,5	1,77	1,82	1,81	1,74	1,89	2,14	2,11	2,14	2,14
Denmark	0,67	0,55	0,51	0,53	0,44	0,41	0,57	0,77	0,64	0,55	0,52	0,41	0,32	0,33	0,37
Estonia	0,45	0,415	0,485	0,725	0,84	0,75	0,885	0,91	0,905	0,87	0,945	1,07	1,055	1,07	1,07
Finland	0,76	0,65	0,58	0,6	0,52	0,51	0,68	0,84	0,72	0,69	0,7	0,63	0,53	0,56	0,66
France	0,84	0,71	0,7	0,81	0,72	0,67	0,86	0,98	0,84	0,78	0,78	0,75	0,67	0,7	0,77
Germany	0,46	0,35	0,35	0,37	0,31	0,3	0,47	0,66	0,53	0,48	0,45	0,33	0,28	0,29	0,37
Greece	5,33	5,55	5,56	5,59	5,22	4,44	3,79	4,14	4,27	4,04	4,29	4,39	3,88	4,18	4,17
Hungary	3,1	3,05	2,76	2,57	2,23	2,07	2,06	2,55	2,6	2,47	2,92	3,37	3,39	3,41	3,57
Ireland	0,87	0,73	0,7	0,66	0,58	0,54	0,91	1,13	1,01	0,94	0,98	0,92	0,83	0,86	0,93
Italy	2,23	2,11	2,11	2,07	1,79	1,8	1,98	2,08	1,97	1,77	2,18	2,74	2,64	3,16	2,96
Latvia	0,98	0,85	0,72	0,71	0,69	0,59	0,6	0,75	0,83	0,8	0,86	0,93	1,06	0,95	0,94
Lithuania	0,31	0,31	0,31	0,31	0,31	0,31	0,31	0,31	0,31	0,31	0,31	0,31	0,31	0,31	0,31
Luxembourg	0,69	0,57	0,55	0,57	0,5	0,49	0,63	0,78	0,68	0,62	0,61	0,54	0,47	0,47	0,51
Malta	1,36	1,23	1,26	1,24	1,13	1,07	1,29	1,38	1,23	1,24	1,32	1,37	1,34	1,46	1,52
Netherlands	0,69	0,54	0,53	0,54	0,47	0,45	0,61	0,76	0,63	0,69	0,67	0,57	0,47	0,47	0,55
Poland	3,3	3,33	3,26	3,38	3,39	3,27	3,32	3,39	3,27	3,06	3,23	3,21	3,17	3,14	3,24
Portugal	3,03	2,83	2,63	2,32	1,98	1,83	1,85	2,03	1,79	1,66	1,84	1,87	1,76	1,82	1,88
Romania	3,84	3,86	3,89	4,17	4,43	4,4	4,24	4,49	4,53	4,46	4,69	4,95	5,05	4,8	4,75
Slovenia	1,15	1,09	0,98	0,97	0,81	0,69	0,88	1,14	1,11	0,89	0,96	0,99	0,79	0,77	0,75
Slovakia	0,93	0,83	0,82	0,83	0,76	0,67	0,69	0,77	0,8	0,75	0,75	1,01	0,94	0,92	0,98
Spain	1,6	1,48	1,54	1,61	1,49	1,44	1,47	1,51	1,33	1,21	1,39	1,37	1,33	1,4	1,46
Sweden	0,66	0,63	0,62	0,83	0,76	0,72	0,85	0,91	0,77	0,71	0,66	0,55	0,51	0,52	0,6
Iceland	5,05	5,19	4,95	4,83	4,97	5,18	5,16	5,25	5,23	5,24	5,26	4,89	4,89	5,84	6,12
Norway	1,69	1,62	1,59	1,66	1,59	1,57	1,74	1,98	1,99	1,93	1,89	1,82	1,76	1,77	1,9
UK	1,25	1,1	1,21	1,35	1,28	1,22	1,33	1,57	1,45	1,44	1,42	1,32	1,27	1,31	1,52

EMU convergence criterion series - monthly data (Continued)

TIME	2018-10	2018-11	2018-12	2019-01	2019-02	2019-03	2019-04	2019-05	2019-06	2019-07	2019-08	2019-09	2019-10	2019-11	2019-12
Austria	0,69	0,62	0,52	0,45	0,45	0,38	0,31	0,24	0,03	-0,1	-0,37	-0,3	-0,2	-0,09	-0,04
Belgium	0,85	0,81	0,75	0,77	0,69	0,54	0,47	0,41	0,15	0,	-0,28	-0,24	-0,16	-0,04	0,01
Bulgaria	0,74	0,75	0,72	0,72	0,68	0,67	0,5	0,48	0,32	0,43	0,35	0,35	0,25	0,22	0,18
Croatia	2,09	2,07	2,04	2,23	2,31	2,07	1,82	1,69	1,36	1,06	0,83	0,49	0,47	0,53	0,59
Cyprus	2,35	2,41	2,34	2,22	2,	1,74	1,49	1,34	0,82	0,66	0,44	0,48	0,51	0,58	0,57
Czechia	2,14	2,07	2,01	1,85	1,76	1,82	1,82	1,86	1,58	1,36	0,99	1,24	1,32	1,47	1,51
Denmark	0,42	0,34	0,23	0,15	0,05	0,16	0,08	0,04	-0,22	-0,31	-0,58	-0,59	-0,43	-0,31	-0,26
Estonia	1,07	1,035	1,005	0,925	0,88	0,91	0,91	0,93	0,79	0,68	0,495	0,62	0,	0,	0,
Finland	0,73	0,66	0,55	0,49	0,39	0,35	0,34	0,25	0,05	-0,09	-0,35	-0,3	-0,21	-0,08	-0,04
France	0,82	0,76	0,7	0,65	0,55	0,44	0,37	0,3	0,08	-0,07	-0,34	-0,28	-0,16	-0,02	0,04
Germany	0,4	0,31	0,19	0,13	0,06	0,01	-0,04	-0,13	-0,31	-0,39	-0,65	-0,59	-0,47	-0,35	-0,3
Greece	4,37	4,42	4,28	4,21	3,84	3,76	3,42	3,37	2,67	2,16	1,98	1,5	1,34	1,36	1,42
Hungary	3,74	3,47	3,15	2,85	2,68	3,03	3,14	3,19	2,74	2,33	1,83	2,02	1,94	1,95	1,88
Ireland	1,01	0,98	0,91	0,94	0,86	0,67	0,56	0,5	0,27	0,13	-0,05	-0,01	0,02	0,07	0,04
Italy	3,47	3,39	2,98	2,77	2,81	2,69	2,62	2,64	2,28	1,65	1,4	0,9	1,	1,27	1,37
Latvia	1,01	1,05	1,05	0,95	0,81	0,7	0,58	0,51	0,33	0,15	-0,07	-0,11	0,	0,1	0,16
Lithuania	0,31	0,31	0,31	0,31	0,31	0,31	0,31	0,31	0,31	0,31	0,31	0,31	0,31	0,31	0,31
Luxembourg	0,56	0,5	0,42	0,37	0,26	0,17	0,11	0,02	-0,16	-0,28	-0,54	-0,5	-0,4	-0,27	-0,23
Malta	1,56	1,54	1,39	1,25	1,17	1,03	1,	0,95	0,73	0,52	0,21	0,19	0,26	0,37	0,4
Netherlands	0,58	0,52	0,4	0,33	0,24	0,15	0,2	0,11	-0,09	-0,21	-0,5	-0,43	-0,31	-0,19	-0,14
Poland	3,22	3,19	2,94	2,78	2,69	2,75	2,76	2,72	2,35	2,13	1,93	2,02	1,96	2,05	2,03
Portugal	1,96	1,91	1,71	1,67	1,55	1,32	1,18	1,02	0,59	0,44	0,17	0,2	0,19	0,35	0,41
Romania	4,9	4,78	4,6	4,69	4,79	4,8	4,91	4,93	4,59	4,51	4,12	4,12	4,12	4,32	4,57
Slovenia	0,92	1,01	0,96	0,98	0,87	0,67	0,52	0,38	0,19	-0,01	-0,06	-0,16	-0,09	-0,01	0,02
Slovakia	1,07	1,01	0,94	0,88	0,78	0,68	0,57	0,45	0,25	0,02	-0,34	-0,34	-0,2	0,09	0,13
Spain	1,6	1,59	1,42	1,38	1,31	1,13	1,05	0,87	0,5	0,35	0,14	0,18	0,2	0,39	0,44
Sweden	0,67	0,6	0,47	0,43	0,36	0,29	0,23	0,07	-0,09	-0,12	-0,36	-0,23	-0,16	0,	0,07
Iceland	5,9	5,47	5,18	5,31	4,66	4,14	4,21	3,9	3,82	3,61	3,51	3,37	3,69	3,44	3,18
Norway	2,	1,94	1,83	1,78	1,71	1,66	1,71	1,66	1,43	1,44	1,15	1,21	1,26	1,45	1,47
UK	1,56	1,44	1,27	1,28	1,2	1,14	1,15	1,06	0,84	0,73	0,49	0,58	0,61	0,73	0,78

EMU convergence criterion series - monthly data (Continued)

TIME	2020-01	2020-02	2020-03	2020-04	2020-05	2020-06	2020-07	2020-08	2020-09	2020-10	2020-11	2020-12	2021-01	2021-02	2021-03	5 Y Avg.
Austria	-0,09	-0,26	-0,09	0,05	-0,1	-0,13	-0,25	-0,28	-0,32	-0,4	-0,41	-0,42	-0,4	-0,2	-0,09	0,26
Belgium	-0,03	-0,13	-0,02	0,14	0,04	-0,04	-0,17	-0,21	-0,25	-0,34	-0,38	-0,39	-0,36	-0,21	-0,04	0,36
Bulgaria	0,15	0,12	0,15	0,2	0,2	0,68	0,5	0,26	0,2	0,2	0,2	0,19	0,19	0,15	0,14	0,97
Croatia	0,61	0,57	0,96	1,24	0,91	0,96	0,97	0,85	0,79	0,78	0,73	0,63	0,59	0,52	0,51	1,95
Cyprus	0,61	0,56	1,26	1,87	1,69	1,05	0,95	0,89	0,72	0,44	0,29	0,19	0,21	0,3	0,39	1,92
Czechia	1,62	1,47	1,28	1,28	0,92	0,86	0,86	0,95	0,98	0,94	1,12	1,26	1,28	1,49	1,87	1,27
Denmark	-0,26	-0,41	-0,41	-0,21	-0,29	-0,26	-0,34	-0,36	-0,39	-0,46	-0,46	-0,47	-0,44	-0,28	-0,03	0,10
Estonia	0,	0,	0,	0,	0,	0,14	0,05	0,	0,01	-0,08	-0,14	-0,18	-0,19	-0,11	0,05	0,44
Finland	-0,07	-0,24	-0,12	0,03	-0,12	-0,18	-0,21	-0,25	-0,3	-0,38	-0,4	-0,41	-0,38	-0,22	-0,13	0,24
France	-0,01	-0,18	-0,06	0,06	-0,03	-0,04	-0,15	-0,17	-0,21	-0,3	-0,33	-0,34	-0,31	-0,15	-0,07	0,37
Germany	-0,31	-0,47	-0,54	-0,45	-0,52	-0,43	-0,52	-0,52	-0,52	-0,61	-0,61	-0,62	-0,58	-0,45	-0,36	-0,03
Greece	1,34	1,07	1,97	2,05	1,93	1,32	1,14	1,08	1,08	0,9	0,75	0,63	0,65	0,81	0,91	4,04
Hungary	2,08	2,15	2,43	2,49	1,99	2,18	2,23	2,18	2,39	2,27	2,15	2,15	2,22	2,43	2,68	2,73
Ireland	0,	-0,13	0,07	0,2	0,11	0,08	-0,05	-0,12	-0,13	-0,22	-0,25	-0,29	-0,24	-0,06	0,03	0,50
Italy	1,28	0,96	1,55	1,8	1,76	1,46	1,2	1,03	0,98	0,77	0,66	0,58	0,62	0,59	0,7	1,82
Latvia	0,11	-0,04	-0,06	0,3	0,26	0,01	-0,17	-0,19	-0,2	-0,23	-0,25	-0,29	-0,29	-0,25	-0,2	0,45
Lithuania	0,31	0,31	0,31	0,31	0,31	0,17	0,16	0,16	0,16	0,16	0,16	0,16	0,16	0,16	0,16	0,35
Luxembourg	-0,25	-0,43	-0,36	-0,25	-0,32	-0,34	-0,43	-0,45	-0,5	-0,54	-0,54	-0,55	-0,54	-0,45	-0,4	0,12
Malta	0,38	0,26	0,4	0,57	0,7	0,76	0,64	0,54	0,51	0,38	0,37	0,27	0,32	0,41	0,4	0,90
Netherlands	-0,17	-0,34	-0,33	-0,22	-0,31	-0,29	-0,39	-0,41	-0,44	-0,53	-0,54	-0,55	-0,53	-0,39	-0,33	0,15
Poland	2,23	2,07	1,8	1,46	1,35	1,31	1,33	1,32	1,35	1,26	1,2	1,29	1,19	1,31	1,53	2,62
Portugal	0,37	0,25	0,71	0,97	0,81	0,53	0,4	0,36	0,32	0,18	0,07	0,03	0,03	0,16	0,23	1,71
Romania	4,28	4,04	4,56	4,83	4,54	3,89	3,94	3,88	3,49	3,29	3,04	2,94	2,72	2,65	2,96	4,05
Slovenia	0,09	0,04	0,02	0,27	0,74	0,42	0,09	-0,1	-0,08	-0,13	-0,18	-0,23	-0,17	0,02	0,03	0,60
Slovakia	0,13	0,	0,04	0,69	0,56	0,04	-0,16	-0,22	-0,27	-0,35	-0,39	-0,52	-0,43	-0,18	-0,05	0,47
Spain	0,42	0,27	0,52	0,82	0,74	0,51	0,37	0,29	0,27	0,17	0,09	0,04	0,08	0,23	0,31	1,01
Sweden	0,11	-0,05	-0,17	-0,07	-0,06	0,01	-0,07	-0,04	-0,08	-0,03	0,	0,01	0,07	0,25	0,4	0,34
Iceland	2,88	2,6	2,35	2,25	2,53	2,53	2,61	2,69	3,01	3,12	3,18	3,4	3,61	3,49	3,76	4,39
Norway	1,39	1,35	0,93	0,7	0,47	0,65	0,61	0,69	0,65	0,67	0,79	0,91	1,01	1,28	1,46	1,43
UK	0,67	0,57	0,41	0,31	0,22	0,23	0,15	0,21	0,21	0,24	0,31	0,26	0,28	0,56	0,78	0,95

Annex 2: Debt premium and cost of debt

Government bonds

- Austria: RAGB, Republic of Austria Government Bond
- Belgium: BGB, Kingdom of Belgium Government Bond
- Finland: RFGB, Finland Government Bond
- France: FRTR, French Republic Government Bond
- Germany: DBR, Bundesrepublik Deutschland Bundesanleihe (German Government bond)
- Italy: Italy, Republic of Italy Government International Bond
- The Netherlands: NETHER, Netherlands Government Bond
- Portugal: PGB, Portugal Government Bond
- Spain: SPGB, Spain Government Bond
- United Kingdom: UKT, United Kingdom Treasury

Table Corporate bonds

Deutsche Telekom	Issued	Currency	Government bond	Issued	Currency	Spread
DT 0 1/2 07/05/27	05/07/2019	EUR	DBR 6 1/2 07/04/27	04/07/1997	EUR	0,915
DT 3 1/4 01/17/28	17/01/2013	EUR	DBR 5 5/8 01/04/28	23/01/1998	EUR	1,035
DT 1 1/2 04/03/28	23/03/2016	EUR	DBR 5 5/8 01/04/28	23/01/1998	EUR	1,076
DT 2 12/01/29	01/06/2018	EUR	DBR 6 1/4 01/04/30	21/01/2000	EUR	1,204
DT 4 1/2 10/28/30	28/10/2010	EUR	DBR 5 1/2 01/04/31	27/10/2000	EUR	1,183
DT 1 3/4 03/25/31	25/03/2019	EUR	DBR 5 1/2 01/04/31	27/10/2000	EUR	1,219
DT 7 1/2 01/24/33	24/01/2003	EUR	DBR 4 3/4 07/04/34	31/01/2003	EUR	1,284
DT 3.55 02/11/33	11/02/2013	EUR	DBR 4 3/4 07/04/34	31/01/2003	EUR	1,409
DT 2.2 07/25/33	25/07/2018	EUR	DBR 4 3/4 07/04/34	31/01/2003	EUR	1,756
DT 1 3/8 07/05/34	05/07/2019	EUR	DBR 4 3/4 07/04/34	31/01/2003	EUR	1,330
					Average	1,241
Elisa	**Issued**	**Currency**	**Government bond**	**Issued**	**Currency**	**Spread**
ELIAV 0 1/4 09/15/27	15/09/2020	EUR	RFGB 0 1/2 09/15/27	06/09/2017	EUR	0,731
					Average	0,731
KPN	**Issued**	**Currency**	**Government bond**	**Issued**	**Currency**	**Spread**
KPN 1 1/8 09/11/28	09/09/2016	EUR	NETHER 5 1/2 01/15/28	15/01/1998	EUR	1,196

KPN 0 7/8 12/14/32	14/09/2020	EUR	NETHER 2 1/2 01/15/33	09/03/2012	EUR	1,120
					Average	1,158
NOS	**Issued**	**Currency**	**Government bond**	**Issued**	**Currency**	**Spread**
NOSPL 1 1/8 05/02/23	02/05/2018	EUR	PGB Float 12/05/22	05/12/2017	EUR	0,542
					Average	0,542
Orange	**Issued**	**Currency**	**Government bond**	**Issued**	**Currency**	**Spread**
ORAFP 1 1/4 07/07/27	07/04/2020	EUR	FRTR 1 05/25/27	10/04/2017	EUR	0,664
ORAFP 1 1/2 09/09/27	09/03/2017	EUR	FRTR 2 3/4 10/25/27	11/09/2012	EUR	0,605
ORAFP 1 3/8 03/20/28	20/03/2018	EUR	FRTR 0 3/4 05/25/28	09/10/2017	EUR	0,701
ORAFP 3.22 04/11/28	11/04/2013	EUR	FRTR 2 3/4 10/25/27	11/09/2012	EUR	0,874
ORAFP 2 01/15/29	15/01/2019	EUR	FRTR 0 3/4 11/25/28	11/06/2018	EUR	0,722
ORAFP 3.3 04/11/29	11/04/2013	EUR	FRTR 5 1/2 04/25/29	12/03/1998	EUR	1,070
ORAFP 0 1/8 09/16/29	16/09/2020	EUR	FRTR 0 11/25/29	07/10/2019	EUR	0,438
ORAFP 1 3/8 01/16/30	16/01/2018	EUR	FRTR 2 1/2 05/25/30	06/05/2014	EUR	0,693
ORAFP 1 7/8 09/12/30	12/09/2018	EUR	FRTR 2 1/2 05/25/30	06/05/2014	EUR	0,776
ORAFP 2.6 09/17/30	17/09/2015	EUR	FRTR 2 1/2 05/25/30	06/05/2014	EUR	0,932
ORAFP 1.342 05/29/31	29/05/2019	EUR	FRTR 1 1/2 05/25/31	05/10/2015	EUR	0,926
ORAFP 1 5/8 04/07/32	07/04/2020	EUR	FRTR 5 3/4 10/25/32	12/06/2001	EUR	0,700
ORAFP 0 1/2 09/04/32	04/09/2019	EUR	FRTR 5 3/4 10/25/32	12/06/2001	EUR	0,747
ORAFP 8 1/8 01/28/33	28/01/2003	EUR	FRTR 5 3/4 10/25/32	12/06/2001	EUR	0,901
ORAFP 3 3/4 09/30/33	30/09/2013	EUR	FRTR 5 3/4 10/25/32	12/06/2001	EUR	1,106
ORAFP 1.2 07/11/34	11/07/2019	EUR	FRTR 1 1/4 05/25/34	05/02/2018	EUR	0,917
					Average	0,798
Proximus	**Issued**	**Currency**	**Government bond**	**Issued**	**Currency**	**Spread**
PROXBB 3.19 03/20/28	20/03/2013	EUR	BGB 5 1/2 03/28/28	26/02/1998	EUR	0,848
PROXBB 1 3/4 09/08/31	08/03/2019	EUR	BGB 1 06/22/31	17/02/2015	EUR	0,996
					Average	0,922
Tele2	**Issued**	**Currency**	**Government bond**	**Issued**	**Currency**	**Spread**
TELBSS 2 1/8 05/15/28	15/11/2018	EUR	DBR 4 3/4 07/04/28	09/10/1998	EUR	1,524
					Average	1,524
Telecom Italia	**Issued**	**Currency**	**Government bond**	**Issued**	**Currency**	**Spread**
TITIM 2 3/8 10/12/27	12/10/2017	EUR	ITALY 1.862 02/02/28	02/02/2015	EUR	0,638

TITIM 1 5/8 01/18/29	18/01/2021	EUR	ITALY 1.771 03/05/29	05/03/2015	EUR	0,926
TITIM 7 3/4 01/24/33	24/01/2003	EUR	ITALY 2 09/05/32	05/03/2015	EUR	1,461
					Average	1,008
Telefonica	**Issued**	**Currency**	**Government bond**	**Issued**	**Currency**	**Spread**
TELEFO 1.201 08/21/27	21/05/2020	EUR	SPGB 0.8 07/30/27	31/03/2020	EUR	0,426
TELEFO 1.715 01/12/28	12/09/2017	EUR	SPGB 1.45 10/31/27	04/07/2017	EUR	0,433
TELEFO 2.318 10/17/28	17/01/2017	EUR	SPGB 5.15 10/31/28	16/07/2013	EUR	0,370
TELEFO 1.788 03/12/29	12/03/2019	EUR	SPGB 6 01/31/29	15/01/1998	EUR	0,506
TELEFO 2.932 10/17/29	17/10/2014	EUR	SPGB 1.95 07/30/30	04/03/2015	EUR	0,281
TELEFO 0.664 02/03/30	03/02/2020	EUR	SPGB 0 1/2 04/30/30	21/01/2020	EUR	0,458
TELEFO 1.93 10/17/31	17/10/2016	EUR	SPGB 5 3/4 07/30/32	23/01/2001	EUR	0,413
TELEFO 1.807 05/21/32	21/05/2020	EUR	SPGB 5 3/4 07/30/32	23/01/2001	EUR	0,585
TELEFO 5 7/8 02/14/33	14/02/2003	EUR	SPGB 5 3/4 07/30/32	23/01/2001	EUR	0,510
					Average	0,443
Telekom Austria	**Issued**	**Currency**	**Government bond**	**Issued**	**Currency**	**Spread**
TKAAV 1 1/2 12/07/26	07/12/2016	EUR	RAGB 0 3/4 10/20/26	23/02/2016	EUR	0,780
					Average	0,780
Telenet	**Issued**	**Currency**	**Government bond**	**Issued**	**Currency**	**Spread**
TNETBB 3 1/2 03/01/28	13/12/2017	EUR	BGB 5 1/2 03/28/28	26/02/1998	EUR	3,125
TNETBB 3 1/2 03/01/28	13/12/2017	EUR	BGB 5 1/2 03/28/28	26/02/1998	EUR	3,124
					Average	3,124
Telenor	**Issued**	**Currency**	**Government bond**	**Issued**	**Currency**	**Spread**
TELNO 0 1/4 09/25/27	25/09/2019	EUR	DBR 0 1/2 08/15/27	14/07/2017	EUR	0,811
TELNO 0 1/4 02/14/28	14/02/2020	EUR	DBR 0 1/2 02/15/28	12/01/2018	EUR	0,906
TELNO 1 1/8 05/31/29	31/05/2019	EUR	DBR 0 08/15/29	12/07/2019	EUR	0,895
TELNO 0 5/8 09/25/31	25/09/2019	EUR	DBR 5 1/2 01/04/31	27/10/2000	EUR	0,989
TELNO 1 3/4 05/31/34	31/05/2019	EUR	DBR 4 3/4 07/04/34	31/01/2003	EUR	1,153
TELNO 0 7/8 02/14/35	14/02/2020	EUR	DBR 0 05/15/35	13/05/2020	EUR	1,238
					Average	0,999
Telia	**Issued**	**Currency**	**Government bond**	**Issued**	**Currency**	**Spread**
TELIAS 3 09/07/27	07/09/2012	EUR	DBR 6 1/2 07/04/27	04/07/1997	EUR	1,096
TELIAS 0 1/8 11/27/30	27/11/2020	EUR	DBR 5 1/2 01/04/31	27/10/2000	EUR	0,751

TELIAS 5.135 04/01/31	01/04/2011	EUR	DBR 5 1/2 01/04/31	27/10/2000	EUR	1,498
TELIAS 5.03 07/01/31	01/07/2011	EUR	DBR 5 1/2 01/04/31	27/10/2000	EUR	1,533
TELIAS 3 1/2 09/05/33	05/09/2013	EUR	DBR 4 3/4 07/04/34	31/01/2003	EUR	1,335
TELIAS 2 1/8 02/20/34	20/02/2019	EUR	DBR 4 3/4 07/04/34	31/01/2003	EUR	1,451
TELIAS 1 5/8 02/23/35	23/02/2015	EUR	DBR 4 3/4 07/04/34	31/01/2003	EUR	1,490
					Average	1,308
Vodafone	**Issued**	**Currency**	**Government bond**	**Issued**	**Currency**	**Spread**
VOD 5.9 11/26/32	26/11/2002	GBP	UKT 4 1/4 06/07/32	25/05/2000	GBP	1,563
					Average	1,563

Annex 3: Beta and Gearing

In this annex the process and the results of the estimation for the 14 peers analyzed will be reported.

The information for each peer about the estimation of the equity beta, the spot gearing and its components (Equity and Debt) are provided. For each comparable a statistic analysis is also reported to get information on the consistency, in term of bias and efficiency of the estimation.

In the table below we report some information about the 14 peer-operators. Specifically, information about where i) the shares have been traded; ii) the revenues have been achieved since last financial, reports public available, in the EU countries; iii) the free float percentage of the traded share (spot value);[145] iv) the sensitivity analysis as reported in chapter 5 considering an estimation of the gearing including pension liabilities in the debt component and the corresponding asset beta evaluated with this new gearing.

Table A1 Peer group companies

No.	Peer Group Operator	Country	Fitch	Moody's	S&P	Free Float	Market Cap. (5 Y time window weekly sampling period in Euro)	Weight (Market Cap.)	Equity beta	Gearing	Asset beta	Gearing Including pension fund	Asset beta with gearing including pension fund	Debt Premium
1	Deutsche Telekom AG	Germany	BBB+	Baa1	BBB	68,10%	70,32	24,03%	0,84	48,85%	48,34%	51,66%	0,46	1,24
2	Elisa OYJ	Finland	N/A	Baa2	BBB+	85,09%	6,45	2,20%	0,46	13,61%	40,84%	13,79%	0,41	0,73
3	KPN NV	Netherlands	BBB	Baa3	BBB	78,03%	11,28	3,85%	0,75	39,12%	49,42%	39,76%	0,49	1,16
4	NOS	Portugal	BBB	N/A	BBB-	39,68%	2,51	0,86%	0,78	31,90%	56,51%	31,90%	0,57	0,54
5	Orange	France	BBB+	Baa1	BBB+	74,96%	35,32	12,07%	0,79	50,19%	44,35%	51,97%	0,43	0,80
6	Proximus	Belgium	N/A	A1	A	42,02%	7,9	2,70%	0,62	23,02%	49,98%	27,06%	0,48	0,92
7	Telecom Austria	Austria	N/A	Baa1	BBB+	20,50%	4,4	1,50%	0,69	37,66%	46,54%	39,50%	0,45	0,78
8	Tele2 AB	Sweden	N/A	N/A	BBB	67,02%	6,7	2,29%	0,64	21,32%	52,44%	21,32%	0,52	1,52
9	Telefonica	Spain	BBB	Baa3	BBB-	88,42%	37,42	12,79%	1,12	55,29%	55,86%	55,65%	0,55	0,44
10	Telnet Group	Belgium	BB-	WR	BB-	37,51%	5,25	1,79%	0,70	48,71%	40,90%	48,83%	0,41	3,12
12	Telenor	Norway	NR	A3	A-	45,62%	23,23	7,94%	0,42	27,04%	33,17%	27,67%	0,33	1,00
11	Telia	Sweden	WD	Baa1	BBB+	53,96%	15,93	5,44%	0,68	35,81%	47,52%	38,84%	0,46	1,31
13	TIM	Italy	BB+	Ba2	BB+	65,10%	12,59	4,30%	1,08	68,24%	41,62%	69,28%	0,41	1,01
14	Vodafone	United Kingdom	BBB	Baa2	BBB	99,00%	53,31	18,22%	0,90	48,26%	52,26%	48,52%	0,52	1,56
Weighted average based on market cap. (information only)									0,82	45,32%	47,91%	46,73%	0,47	1,12
Arithmetic average (information only)									0,75	39,22%	47,12%	40,41%	0,46	1,15

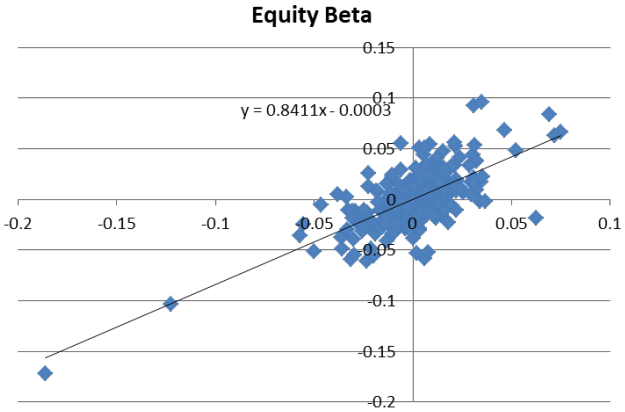
[145] March 2021

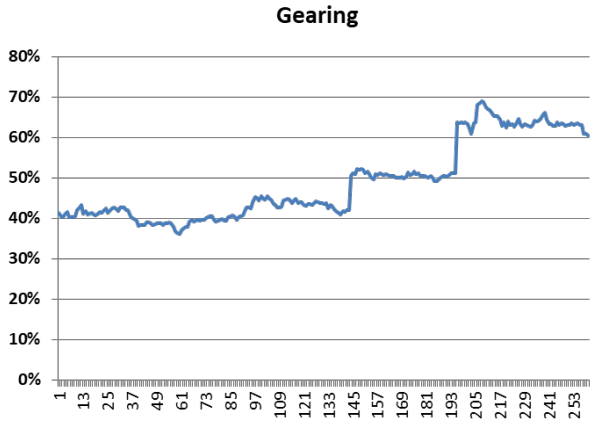
More detailed information for the selected parameters for each company are reported in the following.

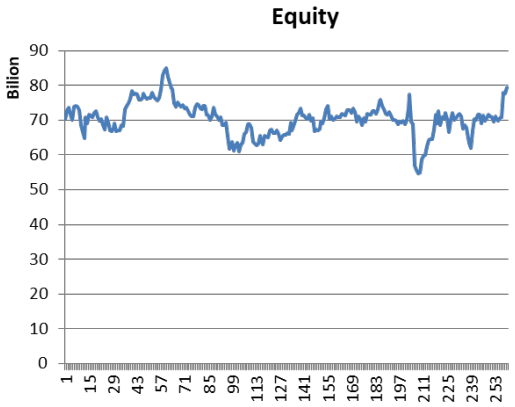
Deutsche Telekom Group

Balance sheet (milion Own currency)

	2020	2019	2018	2017	2016	2015
Long term debt	93678	57327	49485	46436	47810	45575
Capital leases	27607	15848	1622	1884	1962	1616
Cash and Cash Equivalent	12939	5393	3679	3312	7747	6897
Pension liability	7684	5831	6307	9211	9734	8028
Short debt/Current portion of long term debt-capital lease	17675	14334	10093	8623	13144	14255
Outstanding share (Absolute number)	4.72E+09	4.74E+09	4.74E+09	4.74E+09	4.66E+09	4.61E+09





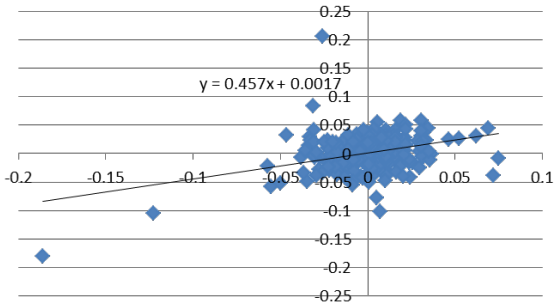


Elisa

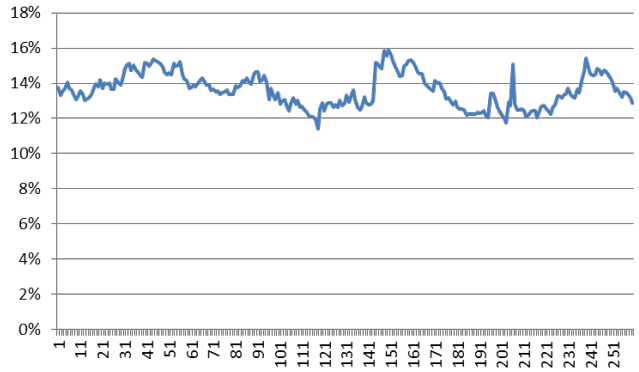
Balance sheet (milion Own currency)

	2020	2019	2018	2017	2016	2015
Long term debt	1136.8	1007.5	839.5	917.4	804.8	662.1
Capital leases	96.5	77.6	21.8	22.2	22.5	23.9
Cash and Cash Equivalent	220.1	52	80.9	44.3	44.5	29.1
Pension liability	11	16.7	15.2	16	16.6	15.6
Short debt/Current portion of long term debt-capital lease	211.2	151.1	287.4	177.8	341.3	305.2
Out standing shares (Absolute number)	1.6E+08	1.6E+08	1.6E+08	1.67E+08	1.6E+08	1.6E+08

Equity Beta



Gearing



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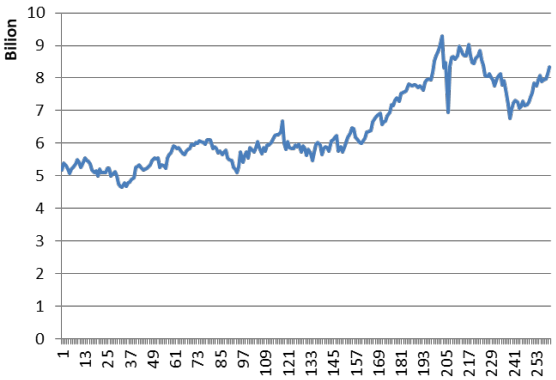
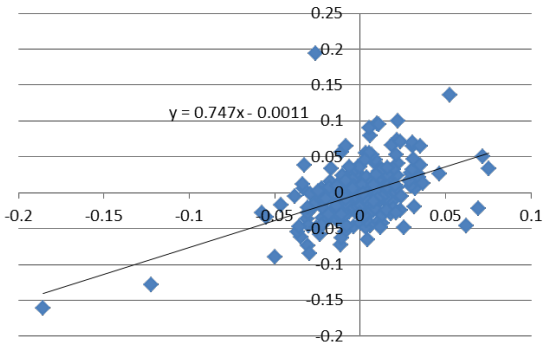


KPN

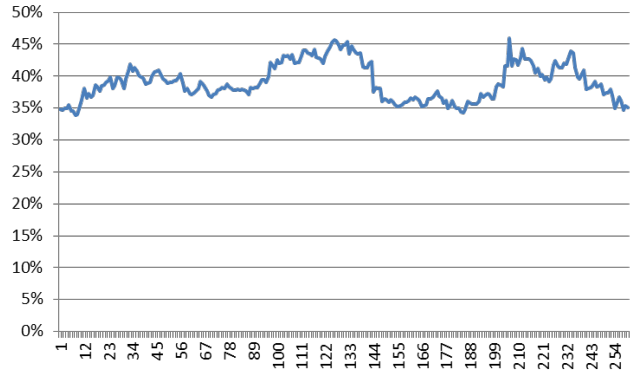
Balance sheet (milion Own currency)

	2020	2019	2018	2017	2016	2015
Long term debt	5821	5722	6939	7579	7897	8853
Capital leases	787	785	827			
Cash and Cash Equivalent	597	766	594	856	1179	1446
Pension liability	152	188	206	218	262	259
Short debt/Current portion of long term debt-capital lease	829	1082	729	18	735	847
Out standing shares (Absolute number)	4.2E+09	4.2E+09	4.2E+09	4.2E+09	4.27E+09	4.27E+09

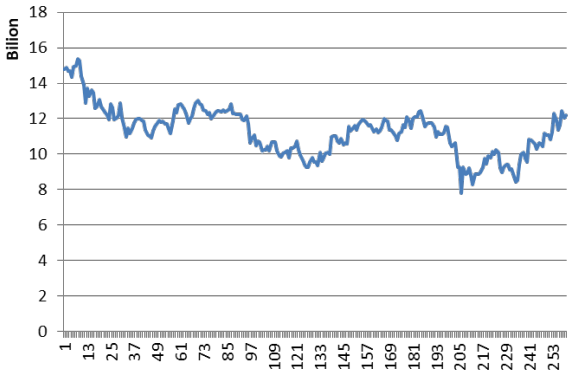
Equity Beta



Gearing



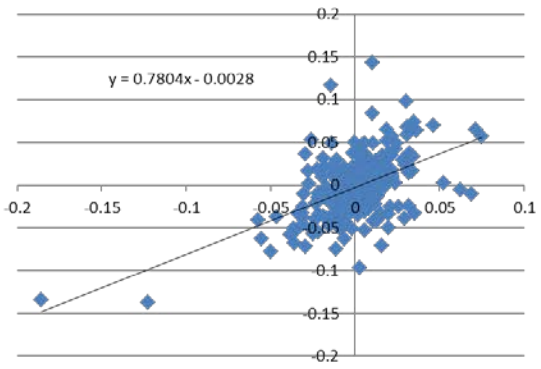
Equity

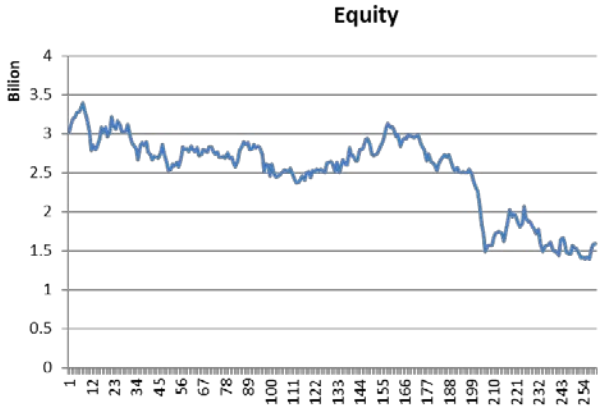


NOS

Balance sheet (milion Own currency)

	2020	2019	2018	2017	2016	2015
Long term debt	854.5	1021.8	825.4	870.34	871.78	862.56
Capital leases	575.3	195	188.97	84.32	100.23	116.86
Cash and Cash Equivalent	153.3	12.8	2.2	3	2.3	9.9
Pension liability						
Short debt/Current portion of long term debt-capital lease	100.8	88.3	253.6	87.2	224.7	178
Outstanding shares (absolute number)	5.13E+08	5.13E+08	5.13E+08	5.12E+08	5.14E+08	5.13E+08



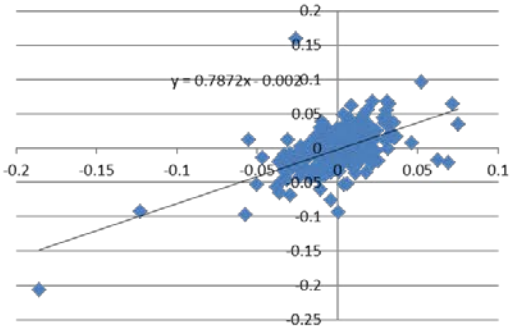


Orange

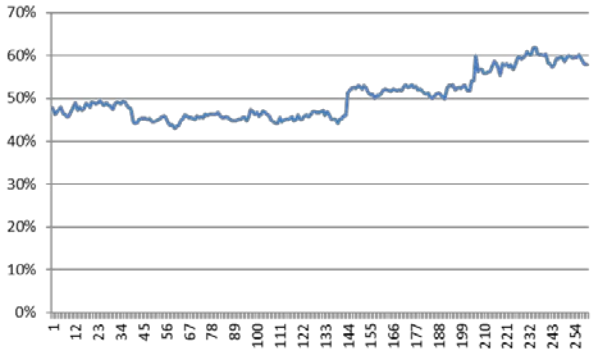
Balance sheet (milion Own currency)

	2020	2019	2018	2017	2016	2015
Long term debt	30089	33148	26323	25839	28404	29028
Capital leases	8145	6481	5634	5810	6355	4469
Cash and Cash Equivalent	7294.2	5487.1	5062	5164.7	5429.4	3295.8
Pension liability	2202	2554	2823	2674	3029	3142
Short debt/Current portion of long term debt-capital lease	6666	5264	7270	6030	4759	4536
Out standing shares (absolute number)	2.66E+09	2.65E+09	2.65E+09	2.66E+09	2.66E+09	2.65E+09

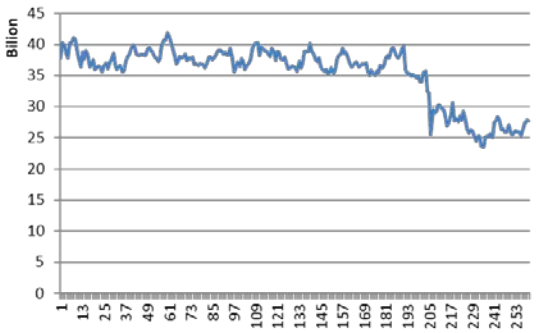
Equity beta



Gearing



Equity

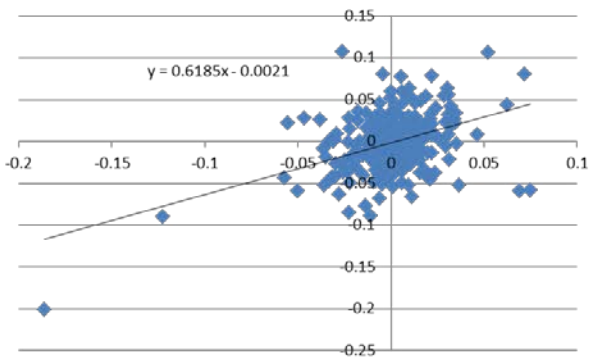


Proximus

Balance sheet (milion Own currency)

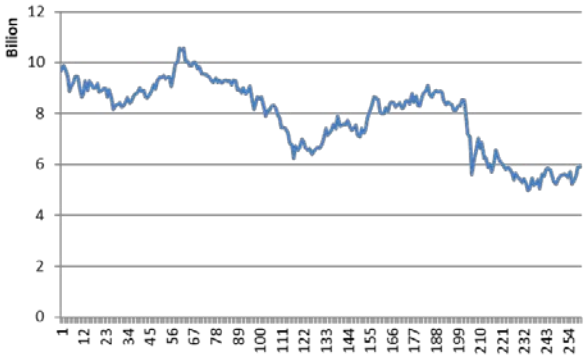
	2020	2019	2018	2017	2016	2015
Long term debt	2506	2355	2255	1850	1755	1753
Capital leases	216	243	4	6	2	3
Cash and Cash Equivalent	310	323	340	333	297	502
Pension liability	559	639	553	515	544	464
Short debt/Current portion of long term debt-capital lease	231	221	234	570	407	673
Outstanding shares (absolute value)	3.23E+08	3.23E+08	3.23E+08	3.23E+08	3.23E+08	3.22E+08

Equity beta



Gearing

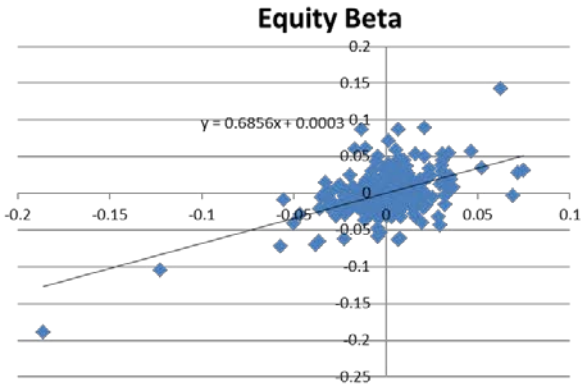
Equity

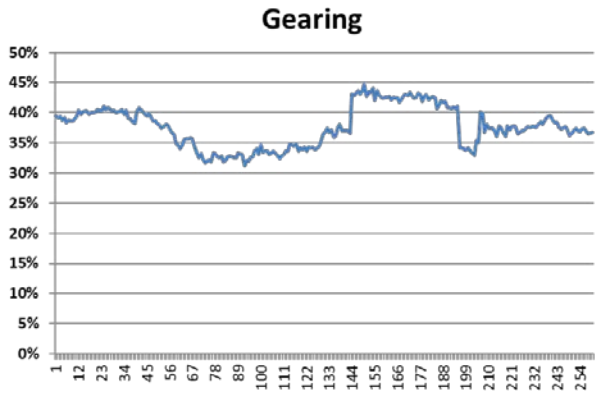


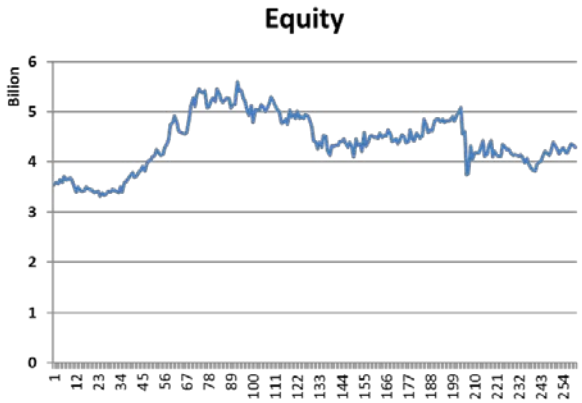
TA

Balance sheet (milion Own currency)

	2020	2019	2018	2017	2016	2015
Long term debt	1793.7	2539.6	2536.4	2533.26	2303.43	2584.82
Capital leases	700	788.22	0.4	0.35	0.1	0.15
Cash and Cash Equivalent	210.9	140.3	63.6	202.4	457.5	909.2
Pension liability	231.5	220.1	203.7	196.8	206.3	196.5
Short debt/Current portion of long term debt-capital lease	903.4	275.6	245.3	0.6	500.1	810.4
Out standingshares (absolute values)	6.64E+08	6.64E+08	6.64E+08	6.64E+08	6.64E+08	6.64E+08



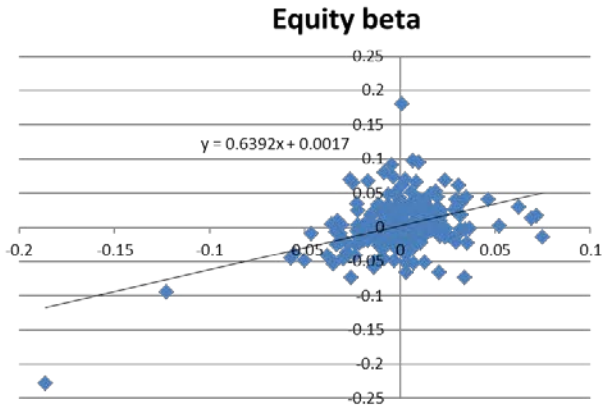


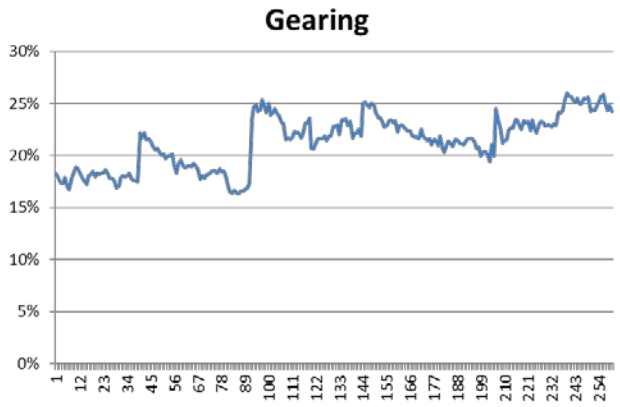


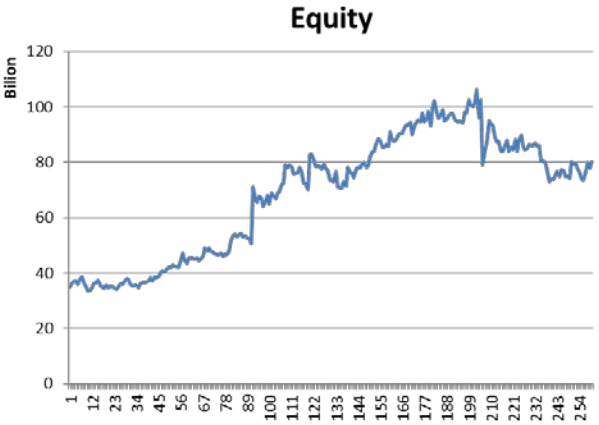
Tele 2

Balance sheet (milion Own currency)

	2020	2019	2018	2017	2016	2015
Long term debt	21406	21572	21664	10567	7746	4284
Capital leases	4209	4501	15	15	32	45
Cash and Cash Equivalent	970	448	404	802	257	107
Pension liability						
Short debt/Current portion of long term debt-capital lease	4712	4836	6427	567	3037	4964
Outstanding shares (absolute number)	6.9E+08	6.9E+08	6.87E+08	5.03E+08	5.02E+08	4.63E+08



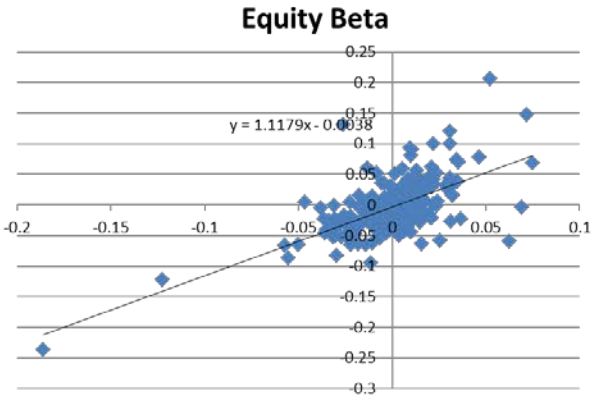


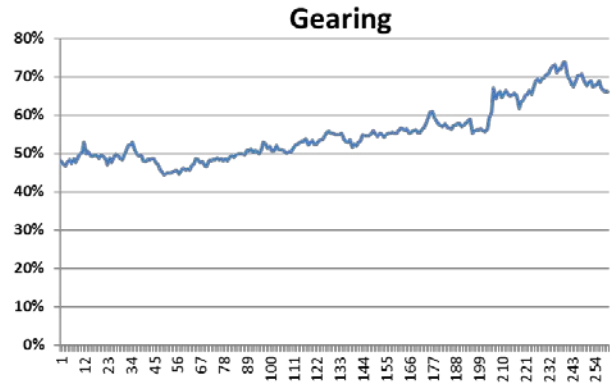


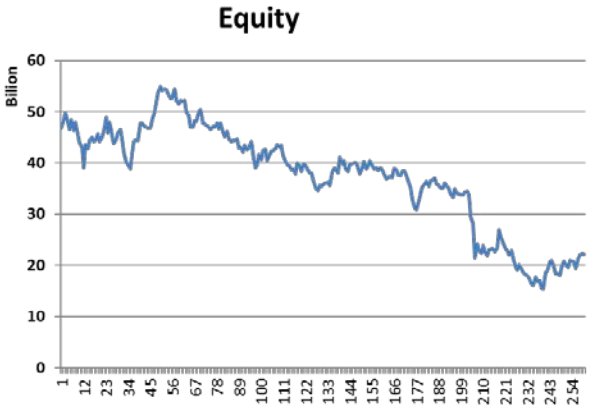
Telefonica

Balance sheet (milion Own currency)

	2020	2019	2018	2017	2016	2015
Long term debt	39425	42378	43805	44120	43562	45134
Capital leases	4039	5626				
Cash and Cash Equivalent	5604	6042	5692	5192	3736	2615
Pension liability	484	565	389	1030	935	689
Short debt/Current portion of long term debt-capital lease	8683	10152	9138	9134	13977	12625
Outstanding shares	5.53E+09	5.19E+09	5.19E+09	5.19E+09	5.04E+09	4.98E+09



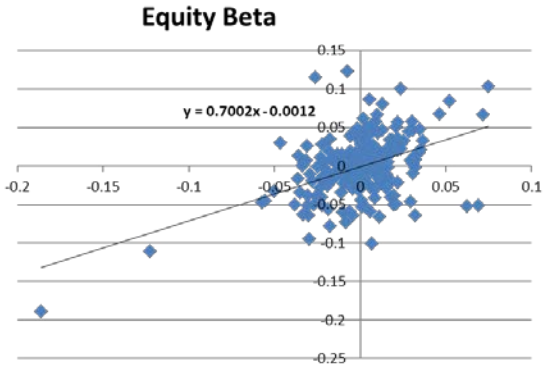


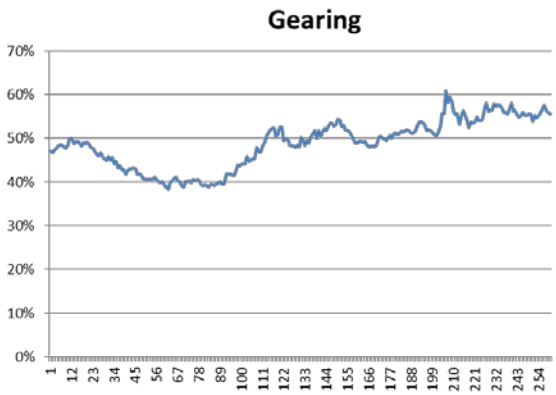


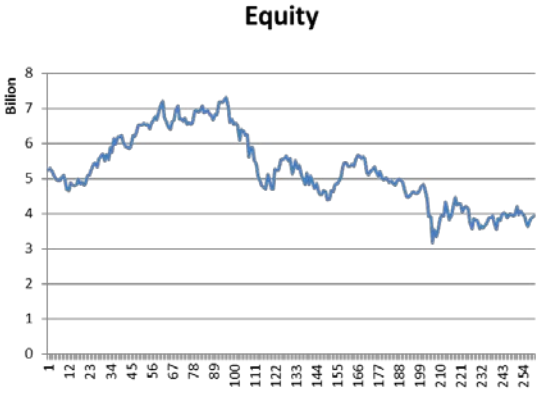
Telenet

Balance sheet (milion Own currency)

	2020	2019	2018	2017	2016	2015
Long term debt	4918.3	4742.3	4798	4128	4328.9	3379.2
Capital leases		463.7	363	334.2	313.6	304.1
Cash and Cash Equivalent	82	101.4	88.2	39.1	99.2	277.3
Pension liability		29.9	25.6	31.1	32.6	24.5
Short debt/Current portion of long term debt-capital lease	499.6	526.8	504.1	361.7	139.37	110.56
Out standing shares (absolute value)	1.14E+08	1.15E+08	1.18E+08	1.18E+08	1.17E+08	1.17E+08



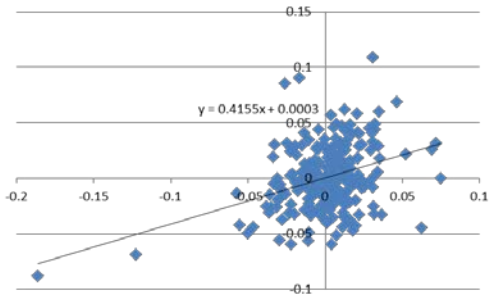




Telenor

Balance sheet (milion Own currency)

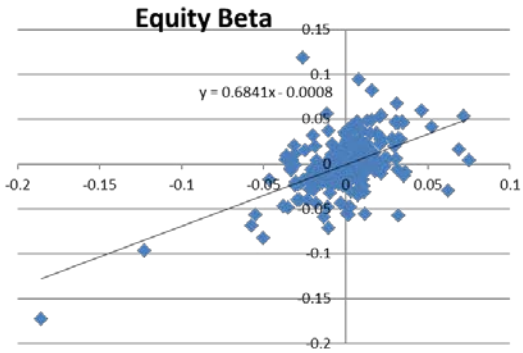
	2020	2019	2018	2017	2016	2015
Long term debt	98627	83987	55120	50745	59467	62784
Capital leases	35584	32002	805	842	924	1018
Cash and Cash Equivalent	20577	13867	18492	22546	23085	13958
Pension liability	2747	2386	2819	2565	2585	2424
Short debt/Current portion of long term debt-capital lease	16594	24056	15740	22710	25968	12626
Out standing shares (absolute value)	1.40E+09	1.42E+09	1.46E+09	1.49E+09	1.50E+09	1.50E+09

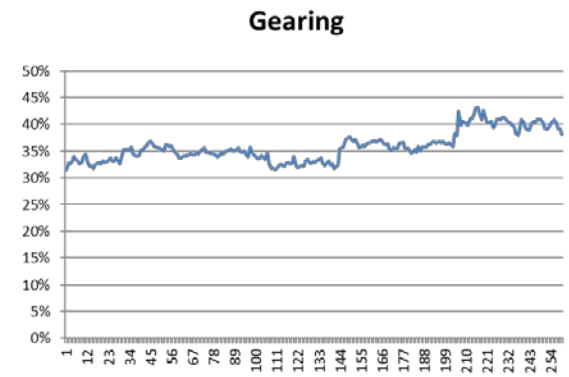


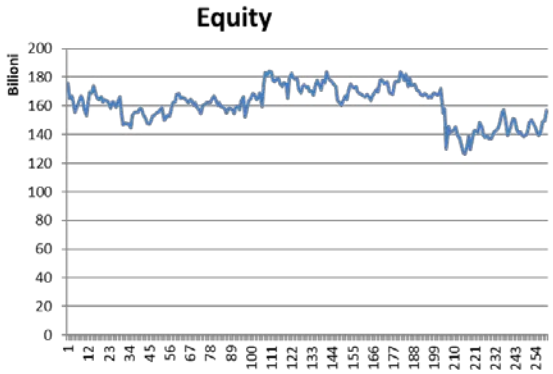
Telia Company

Balance sheet (milion Own currency)

	2020	2019	2018	2017	2016	2015
Long term debt	84014	84929	83673	85375	80256	89279
Capital leases	12183	12046	1363	171	221	46
Cash and Cash Equivalent	8133	6116	18765	15617	14510	14647
Pension liability	7428	3334	2519	2377	2109	1824
Short debt/Current portion of long term debt-capital lease	3063	12951	6197	3471	11113	9266
Outstanding shares (absolute number)	4.09E+09	4.11E+09	4.23E+09	4.23E+09	4.23E+09	4.23E+09



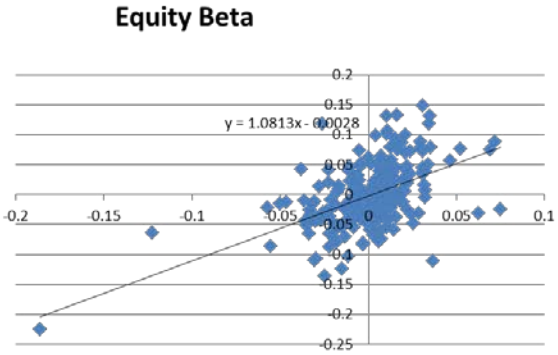


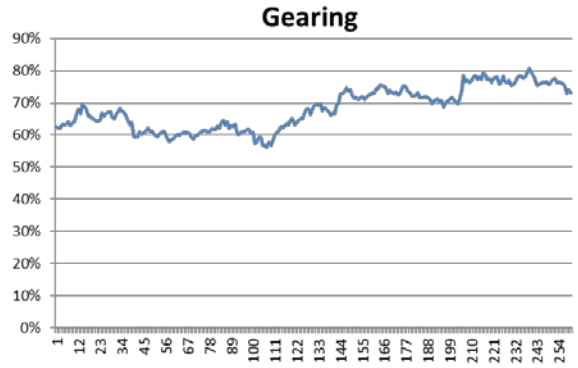


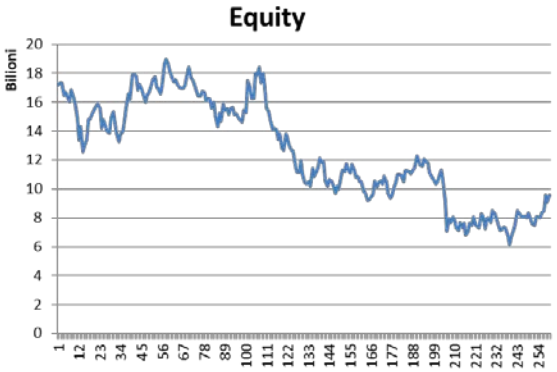
TIM

Balance sheet (milion Own currency)

	2020	2019	2018	2017	2016	2015
Long term debt	21813	23945	21894	23940	26136	26652
Capital leases	4199	4576	1740	2249	2444	2271
Cash and Cash Equivalent	4829	3138	1917	3675	4064	3559
Pension liability	724	1182	1567	1736	1355	1420
Short debt/Current portion of long term debt-capital lease	4244	3759	5575	4681	3976	5549
Out standing shares	21196000000	2.11E+10	2.11E+10	2.11E+10	1.94E+10	2.11E+10



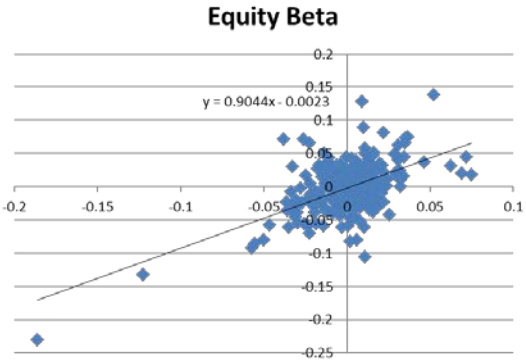


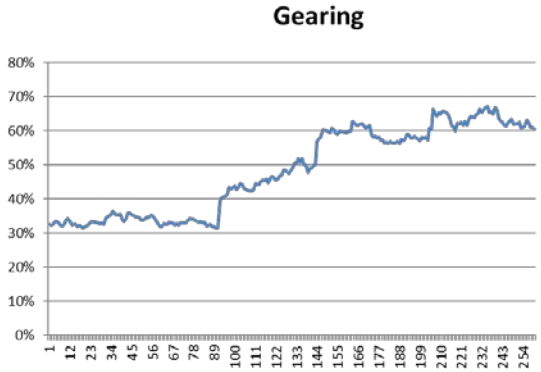


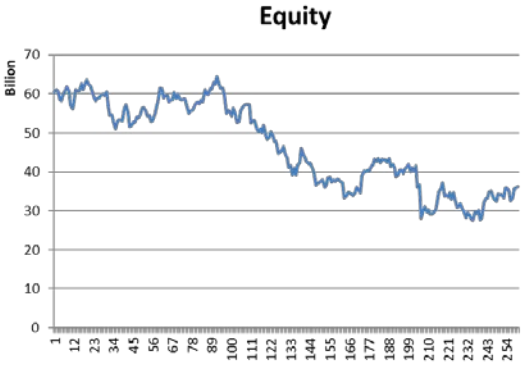
Vodafone

Balance sheet (milion Own currency)

	2019	2018	2017	2016	2015	2014
Long term debt	52424.2	41824.2	28427.5	28981.3	28931	22310
Capital leases	3229	221.1	233.6	203	158.9	125
Cash and Cash Equivalent	11755	11777.2	4105.5	7535.3	10217.1	6882
Pension liability	387.6	475.9	456.8	555.2	446.7	567
Short debt/Current portion of long term debt-capital lease	10464.8	3687.7	6454.2	6327.6	11690.9	12623
Outstanding shares (absolute number of share)	2.68E+10	2.72E+10	2.67E+10	2.66E+10	2.66E+10	2.65E+10







Statistical Analysis

The estimation of the asset betas is subject to the consistency of the OLS (Ordinary Least Square) in term of bias[146] (that affects the beta estimation) and efficiency[147] that affects the significance level of the estimation.

More specifically, the following elements should be taken into account to address the consistency of the OLS estimation:

- The Error terms of the regression are normally distributed around a zero mean;
- The Error terms are homoscedastic that means that the error terms have constant variance across the sample.
- The Error terms are not autocorrelated, i.e. there is no systematic dependence across the error terms.

Specifically, the failure of normality can put a question on the validity on the single factor CAPM method. The presence of heteroscedasticity in the meaning of failing the general hypothesis of constant variance, generally does not bias the beta estimate, but it affects the confidence interval and therefore statistical inferences around those estimates.[148] When error terms are "autocorrelated", this means that the validity of a time independent model can be questionable.[149]

In the following we present visual inspections and statistical tests -where relevant- of the residual component of the regression model presented in the previous section, for each comparable, to test the three main issues (normalilty, heteroscedasticity, autocorrelation9 previously addressed.

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

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

[148] Armitage, S & Brzeszczynsky 2011 "Hetheroscedasticity and interval effects in estimating beta: UK evidence" Applied Financial Economics, Vol. 21, no. 20, pp. 1525-1538.

[149] The presence of autocorrelation in the residual for the beta estimation is generally attributable to significantly variation of the beta in the time windows considered due to the fact that the beta evolution is not a stationary process. The presence of autocorrelation can be more evident when daily observation are used on longer time windows. In this case the beta estimation using the OLS can be biased. When this happens dynamic models for beta estimation, generally, can be taken into account, such as ARCH model (AutoRegressive Conditional Heteroskedasticity) or GARCH (Generalized Autoregressive Conditional Heteroskedasticity). https://www.ofgem.gov.uk/ofgem-publications/145143

Normality

To test the normality only a visual approach[150] through the Box-plot, density plot, and Q-Q plot[151] have been used.

In the following picture, the Box-plot of the residual distribution is provided. The box-plot shows the median as a horizontal line inside the box and the interquartile range (range between the 25th to 75th percentiles) as the length of the box. The whiskers (line extending from the top and bottom of the box) represent the minimum and maximum values when they are within 1.5 times the interquartile range from either end of the box. Scores greater than 1.5 times the interquartile range are out of the boxplot and are considered as outliers, and those greater than 3 times the interquartile range are extreme outliers. A boxplot that is symmetric with the median line at approximately the center of the box and with symmetric whiskers that are slightly longer than the subsections of the center box suggests that the data may have come from a normal distribution.

The Kernel plot of the distribution of the residual is also included in comparison with the corresponding theoretical normal distribution with same mean and standard deviation is provided.

[150] Parametric test for larger samples (i.e. more than one hundred), as in the cases under consideration, are not suitable as the assumption of normality might be rejected too easily due to high sensitivity to outlier. So for large samples Q-Q plot, histogram are the best solution. https://www.sheffield.ac.uk/polopoly_fs/1.579191!/file/stcp-karadimitriou-normalR.pdf. Non parametric test are generally less powerful to test normality of the sample https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3693611/.

[151] In statistics, a Q–Q (quantile-quantile) plot is a probability plot, which is a graphical method for comparing two probability distribution by plotting their quantiles against each other. First, the set of intervals for the quantiles is chosen. A point (x, y) on the plot corresponds to one of the quantiles of the second distribution (y-coordinate) plotted against the same quantile of the first distribution (x-coordinate). Thus, the line is a parametric curve with the parameters which is the number of the interval for the quantile.

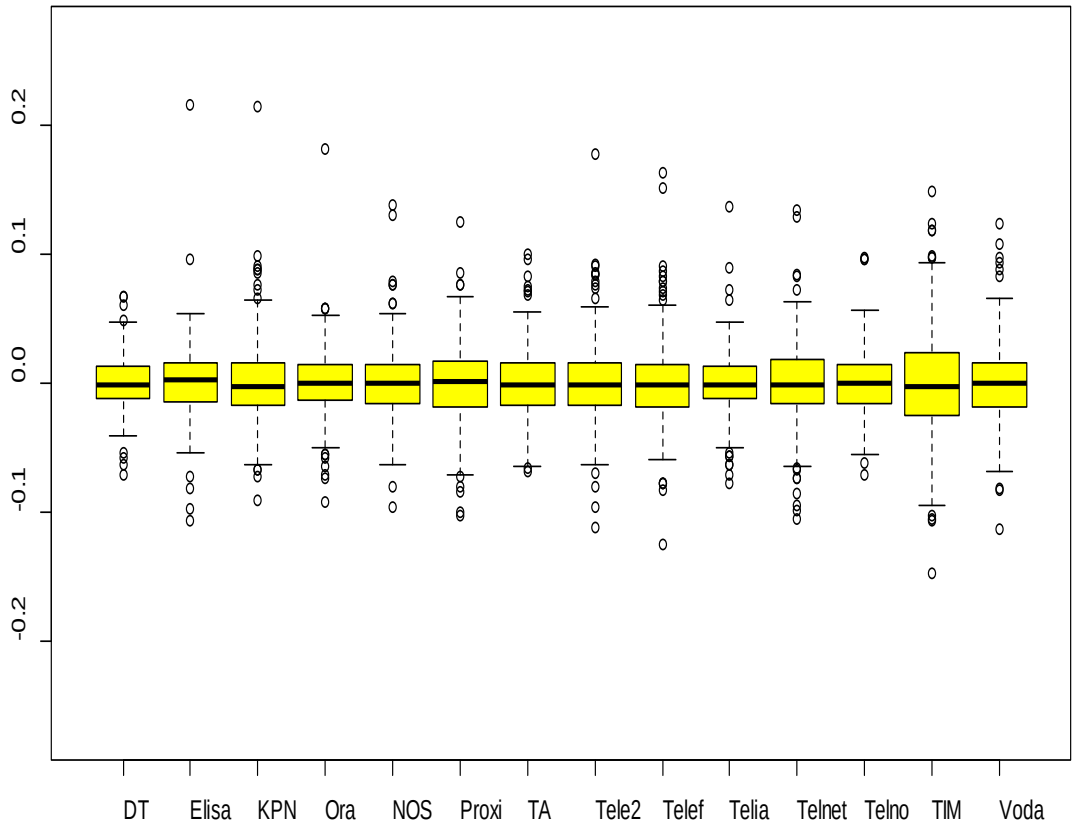
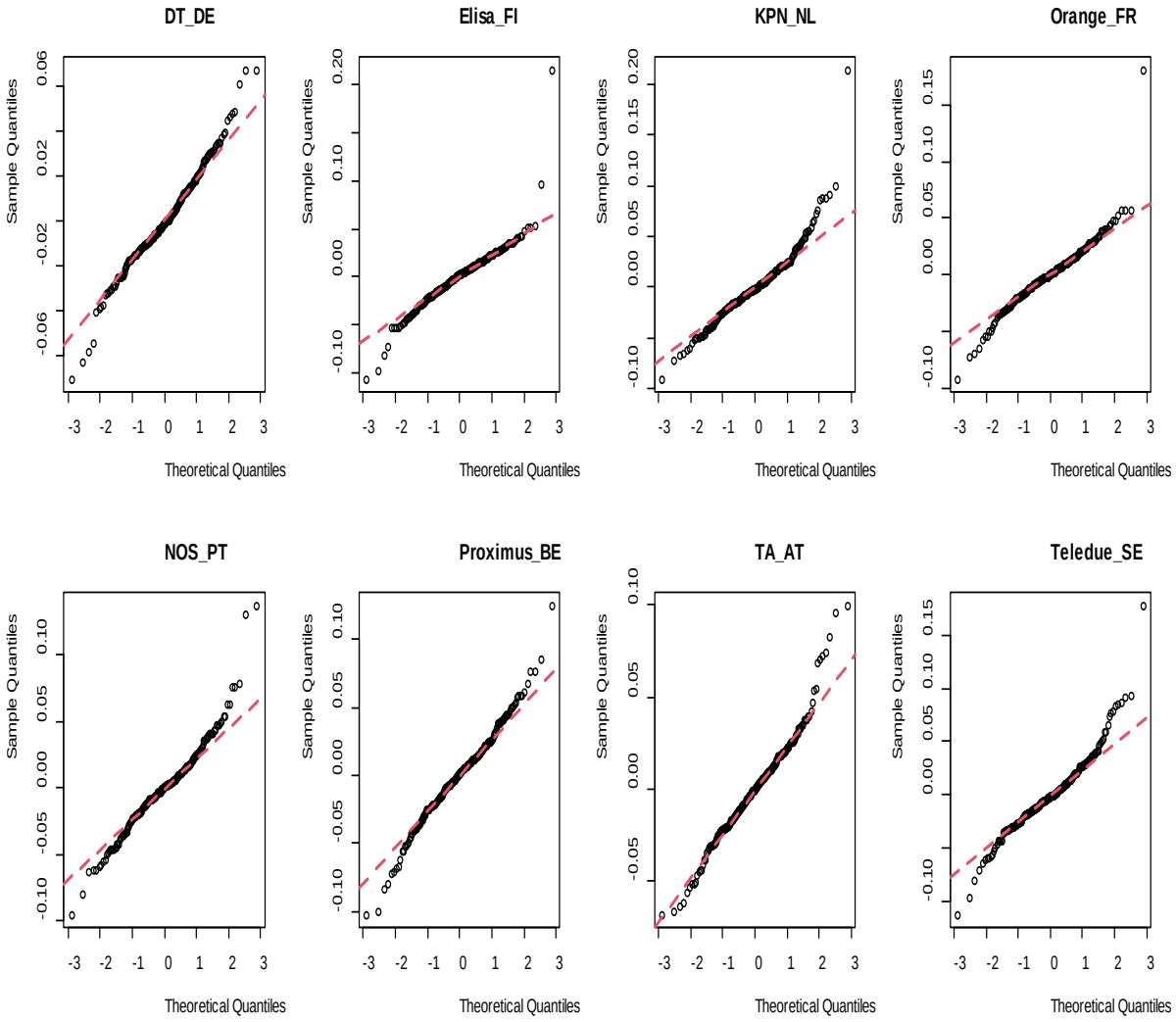


Figure A1 Box plot of residual distribution of the beta equity estimation

A more accurate picture of the distribution of the residual with respect to the theoretical normal distribution is provided in the Q-Q plot below. A Q-Q plot represents the quantiles (values that split a data set into equal portions) of the data on the y-axis with respect to the quantile of the theoretical normal distribution reported on the x-axis; the red line provide the theoretical line if the residual data comes from a normal distribution with same average and standard deviation of the residual data under inspection.


DT_DE
Elisa_FI
KPN_NL
Orange_FR
NOS_PT
Proximus_BE
TA_AT
Teledue_SE
Sample Quantiles
Theoretical Quantiles

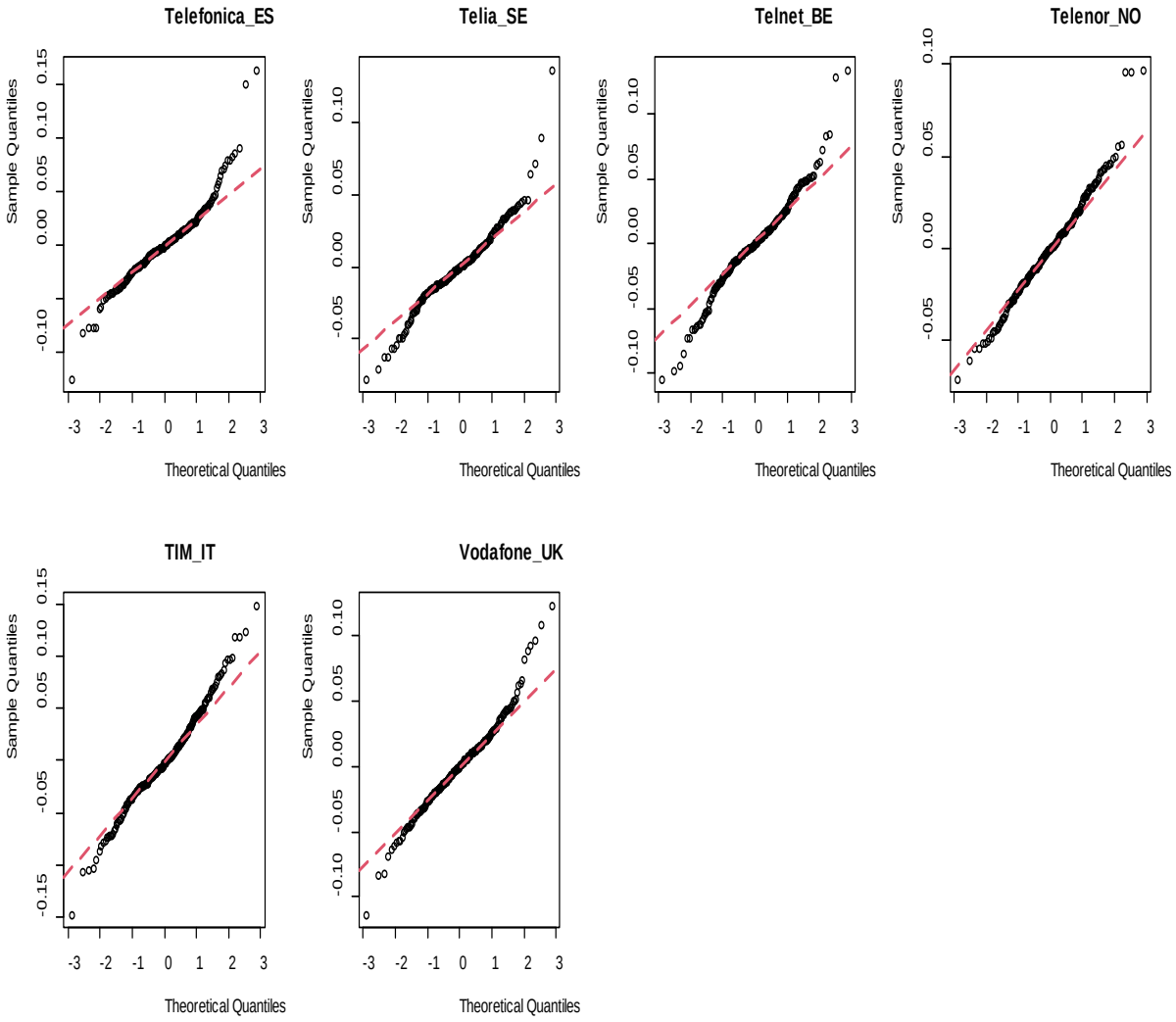
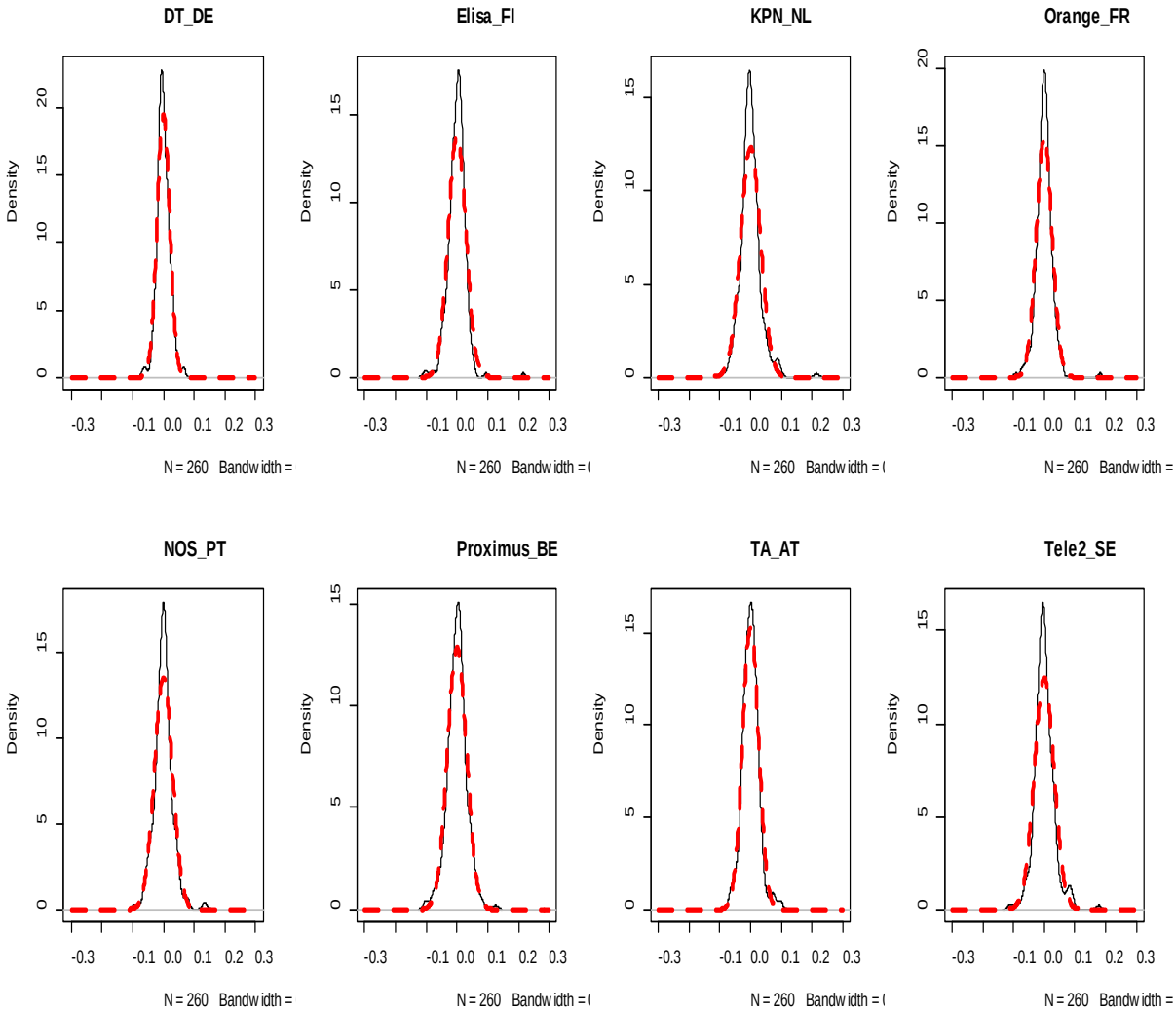


Figure A2 Q-Q plot of residual distribution of the beta equity estimation


DT_DE
Elisa_FI
KPN_NL
Orange_FR
NOS_PT
Proximus_BE
TA_AT
Tele2_SE
Density
-0.3 -0.1 0.0 0.1 0.2 0.3
N = 260 Bandwidth =

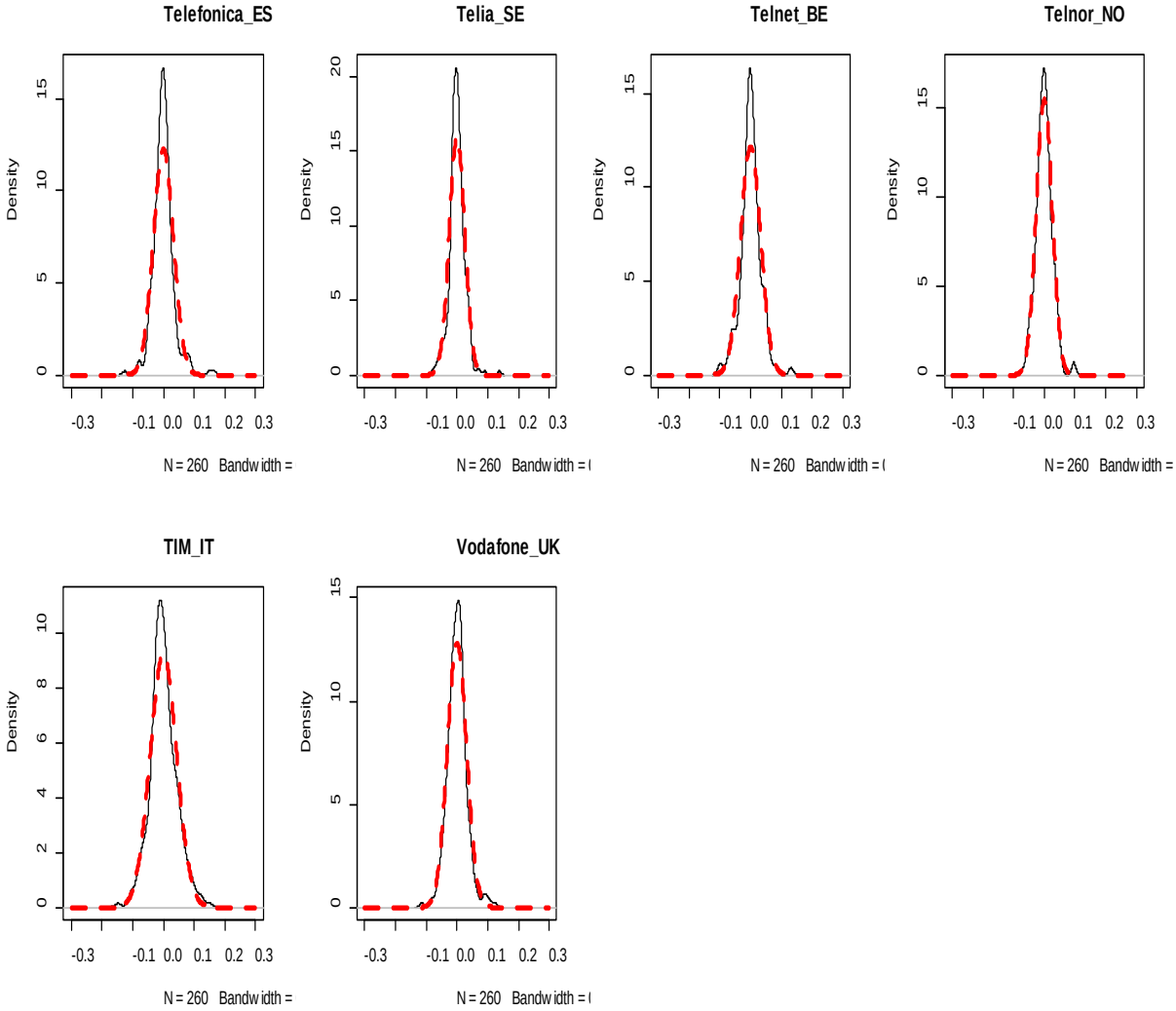


Figure A3 – Density plot of the residual of the distribution

From the graphical analysis of the box plot, density plot and Q-Q plot it can be observed that the normal distribution assumption is generally violated only due to the presence of outliers' values in the residual. In that sense a general approximation of normal distribution can be accepted.

In the following table for each comparable the number of relevant outliers[152] as well as the p-values of the Shapiro-Wilk normality test[153] are provided. This analysis shows that the

[152] The number of outliers has been evaluated considering influential observations in the residual that have combination of high leverage and large error. The leverage coefficient is a measure of the effect of a particular observation on the regression predictions due to the position of that observation in the space of the inputs. A common measure of influence is Cook's Distance. The Cook's distance of each observation has been considered high if it is larger than 4/n with n the number of observations.

[153] The Shapiro-Wilk test is one of the most used normality test generally used for small sample (<50), as all the parametric normality tests. In this case the objective is to find a measure between comparables to detect outliers of the level of "non-normality". Only two operators pass the normality test highlighted in blue. For the others where the alpha level is 0.05 and the p-value is less than 0.05, the null hypothesis that the data are normally distributed is rejected.

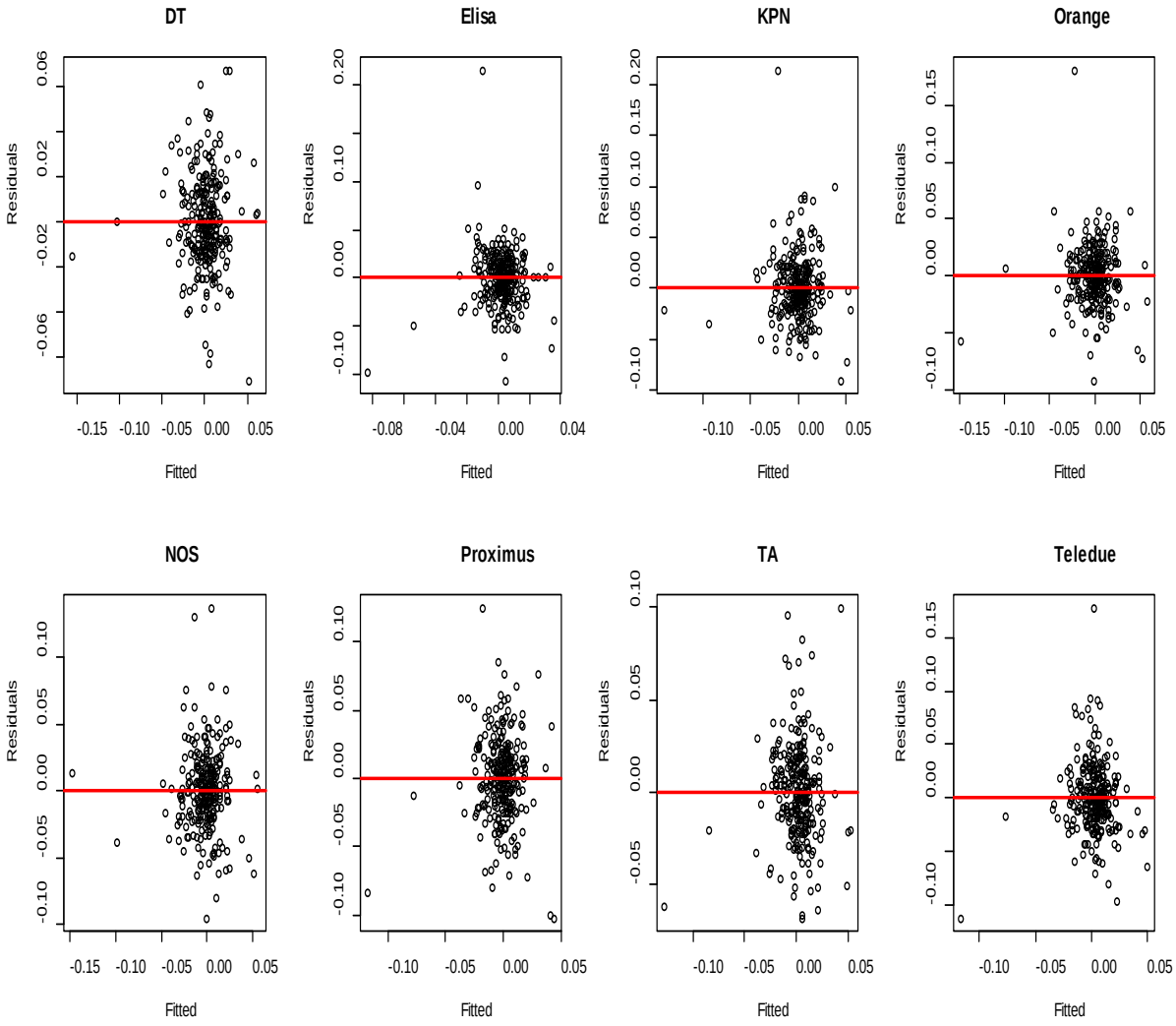
normality assumption can be generally accepted, and the failure of the normality test is not due to systematic failure of the model assumption, but due the presence of some outliers that are between 3-6% of the whole number of observations.

	Number of outlier	p-value Shapiro-Will Normality test
DT	15	0.002818
ELISA	11	6.57E-13
KPN	13	1.49E-10
ORANGE	9	8.15E-11
NOS	17	1.44E-06
PROXIMUS	13	0.005064
TA	15	8.45E-05
TELE2	14	2.19E-08
TELEFONICA	15	1.83E-09
TELIA	15	1.04E-07
TELNET	14	1.60E-05
TELNOR	12	0.001234
TIM	15	0.01136
VODAFONE	13	6.75E-05

Table A2 –Relevant outlier and normality test

Homoscedasticity

In relation with the homoscedastic behavior (constant variance of the residual), a graphical analysis of the distribution of the residual with respect to the corresponding fitted value of the model is provided. If the residuals are distributed around the zero line, and no pattern is observable, then the residuals are homoscedastic at least with respect to the constant variance attribute across the sample.


DT
Elisa
KPN
Orange
NOS
Proximus
TA
Teledue
Residuals
Fitted

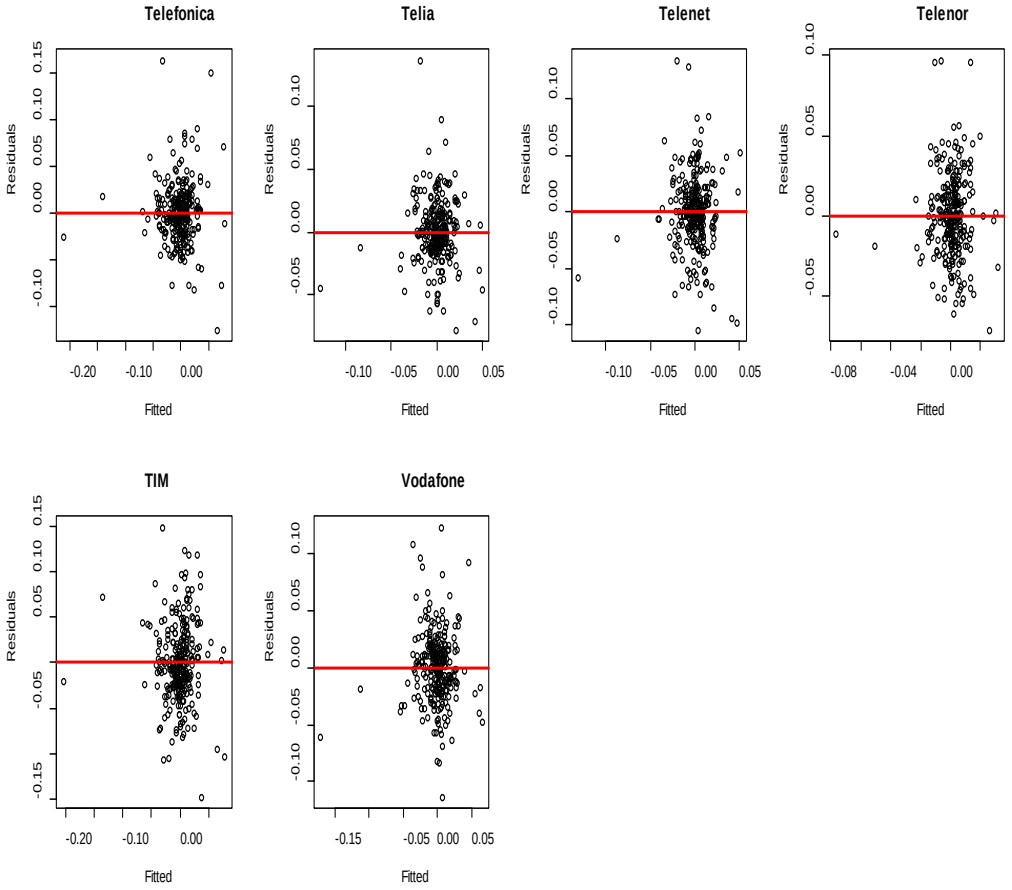


Figure A4 - Residual versus Fitted Values

The general picture of the residuals shows a distribution in line with a homoscedastic property of the residuals. Deviation from a “random noise” of the residual around a zero line is only due to some outliers, and thus not based on a systematic pattern of the residual.

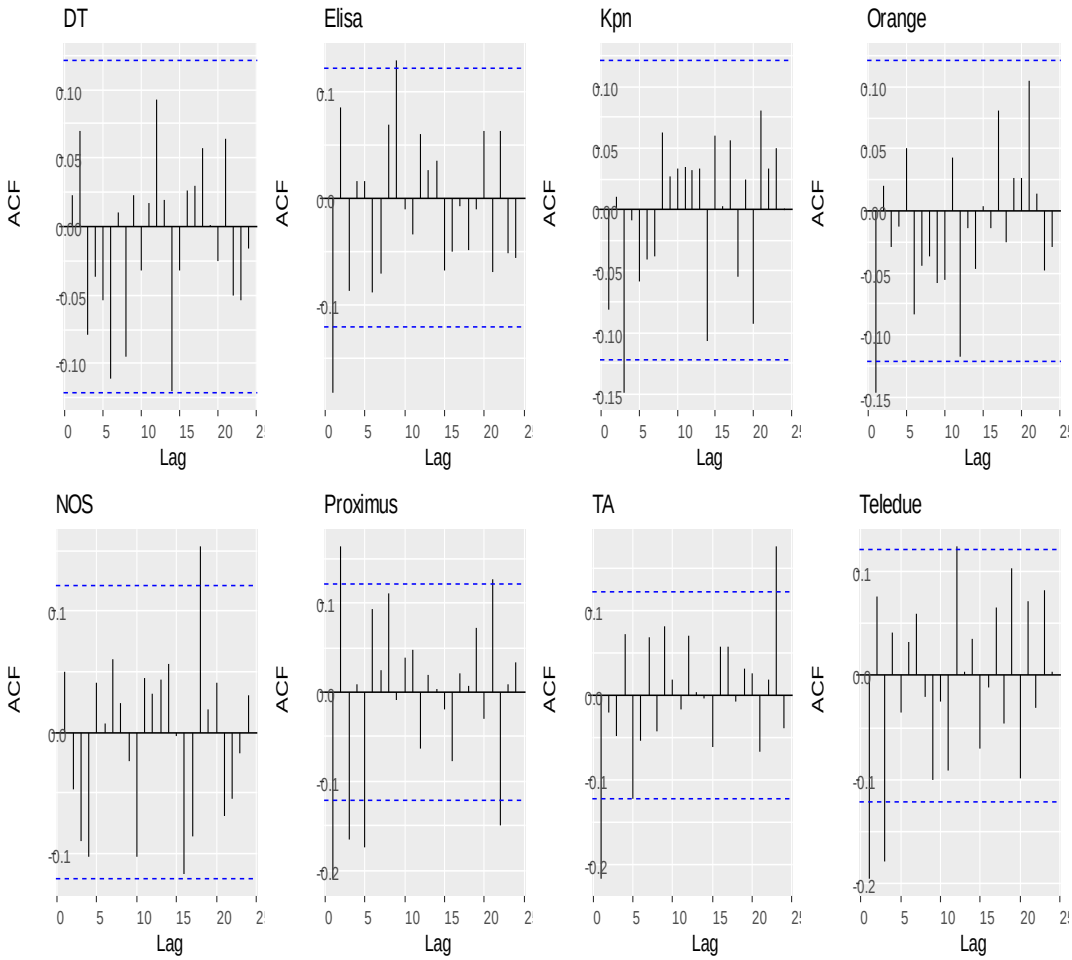
Autocorrelation of the residuals

The graphical analysis reported in the previous section indicates that the presence of strong autocorrelation in the residuals is statistically unlikely. At the same time in this section a deepening on this issue will be given.

In the following the autocorrelation (ACF) of the residual from each comparable is reported.[154]

In the same graph the “test bound” (dashed lines) is also shown. These bounds are used to test the null hypothesis that an autocorrelation coefficient is 0. The null hypothesis is rejected if the sample autocorrelation is outside the bounds. The picture below (Correlogram)[155] shows that the level of autocorrelation of the residual is low or absent for all the comparables considered until the 24 lags of the ACF are taken into account.

[154] The Autocorrelation function is used to assess to what extent a time series is dependent on its past.
[155] The plot of the Autocorrelation sample for different lags is known as an Autocorrelation plot.


DT
Elisa
Kpn
Orange
NOS
Proximus
TA
Teledue
ACF
Lag

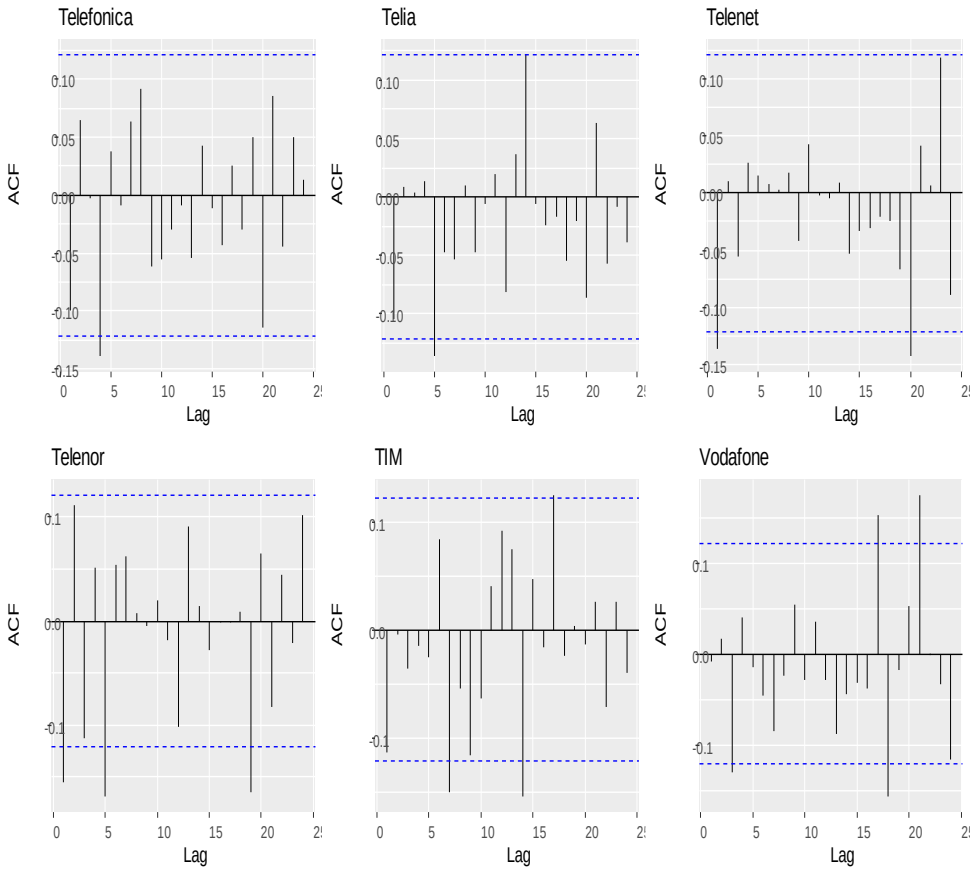


Figure 5 ACF residuals

To obtain a more quantitative picture and comparison between the 14 comparables, the Ljung-Box test and the Breusch-Godfrey test are also considered in the next table.[156]

	Ljung-Box Test p-value	Godfrey test
DT	0.6042	0.4165
ELISA	0.1266	0.09711
KPN	0.5076	0.5706
ORANGE	0.5313	0.3694
NOS	0.2295	0.2685
PROXIMUS	0.000147	0.005983
TA	0.03105	0.009565
TELE2	0.006672	0.07391
TELEFONICA	0.4129	0.3797
TELIA	0.5678	0.4219
TELENET	0.539	0.191

[156] Instread of analying every single lag distinctly, as done by the ACF plot, the Ljung-Box test and the Breusch-Godfrey test instead consist of a verification of absence of global correlation with respect to a certain number of lags.

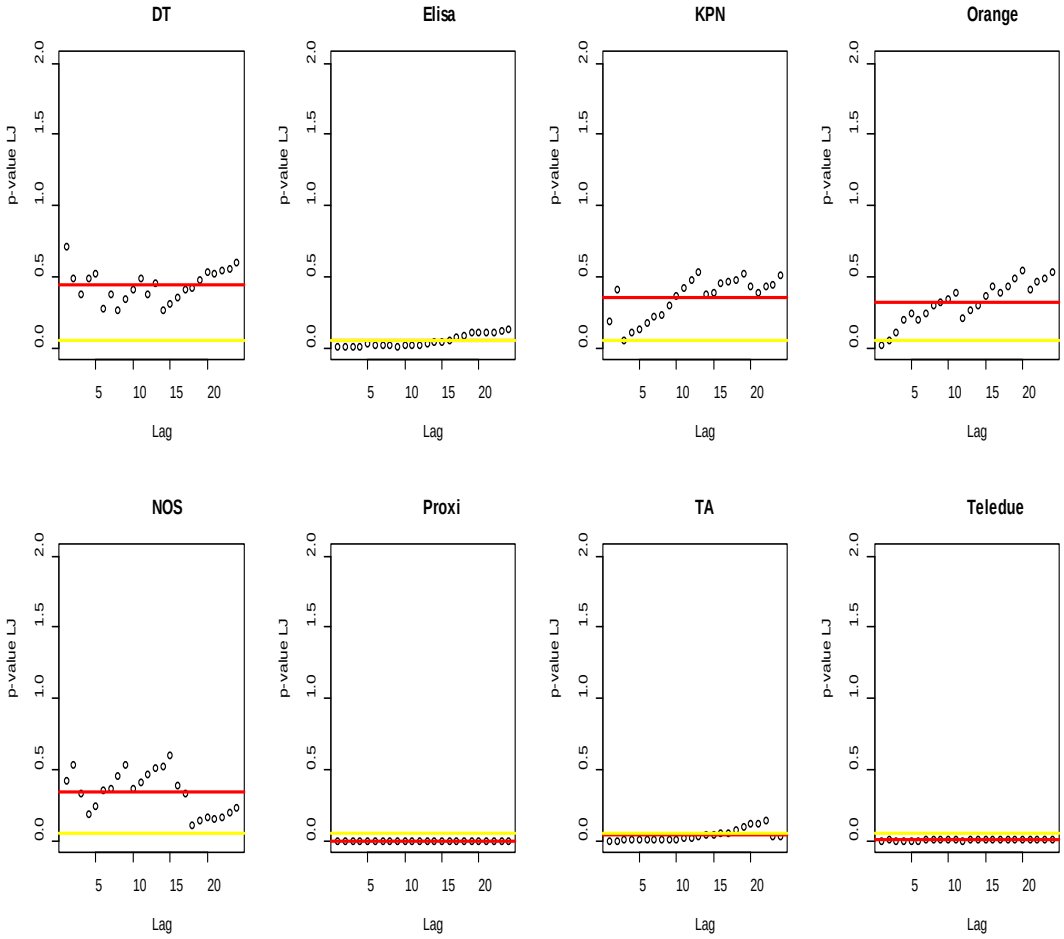
TELENOR	0.008705	0.5468
TIM	0.05395	0.04686
VODAFONE	0.02092	0.04892

Table A3 Statistic test for the Ljung-Box test and the Breusch-Godfrey test for 24 lags

The p-values from the Ljung-Box and Breusch-Godfrey test applied on 24 lags[157] show a small autocorrelation of the residual in Telekom Austria and Proximus that is also detected looking at the corresponding ACF graphs. Tim, Telenor and Tele2 also show a small level of autocorrelation due to their increased volatility during the last year.

In the following picture the test is done considering different lags from 1 to 24. The statistical test fails at 95 % on average only for Telekom Austria, Proximus, Tele2 and Telenor, considering a level of confidence at 99 % also for those operators where the test fails for the most part of the lag. This analysis shows that in every case the level of autocorrelation in the residuals is low so that we can still consider the beta estimation to be reliable and unbiased.

[157] 24 lags are generally accepted as maximum inspection for the test.


DT
Elisa
KPN
Orange
NOS
Proxi
TA
Teledue
p-value LJ
Lag
0.0
0.5
1.0
1.5
2.0
5
10
15
20

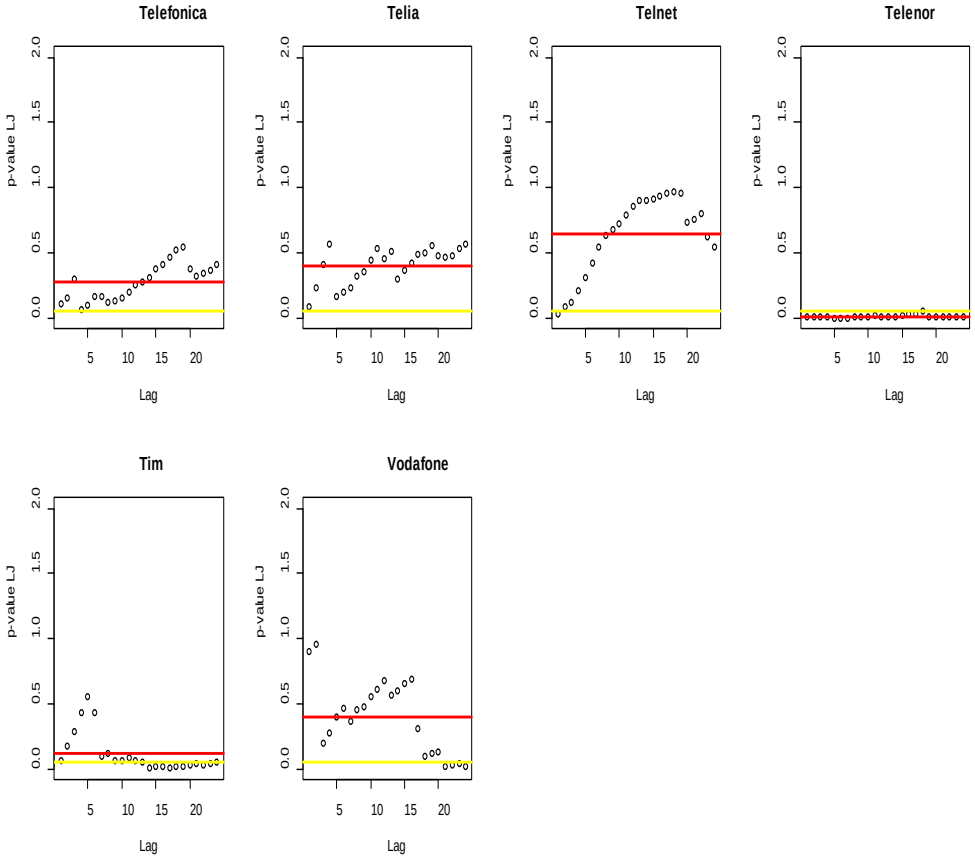
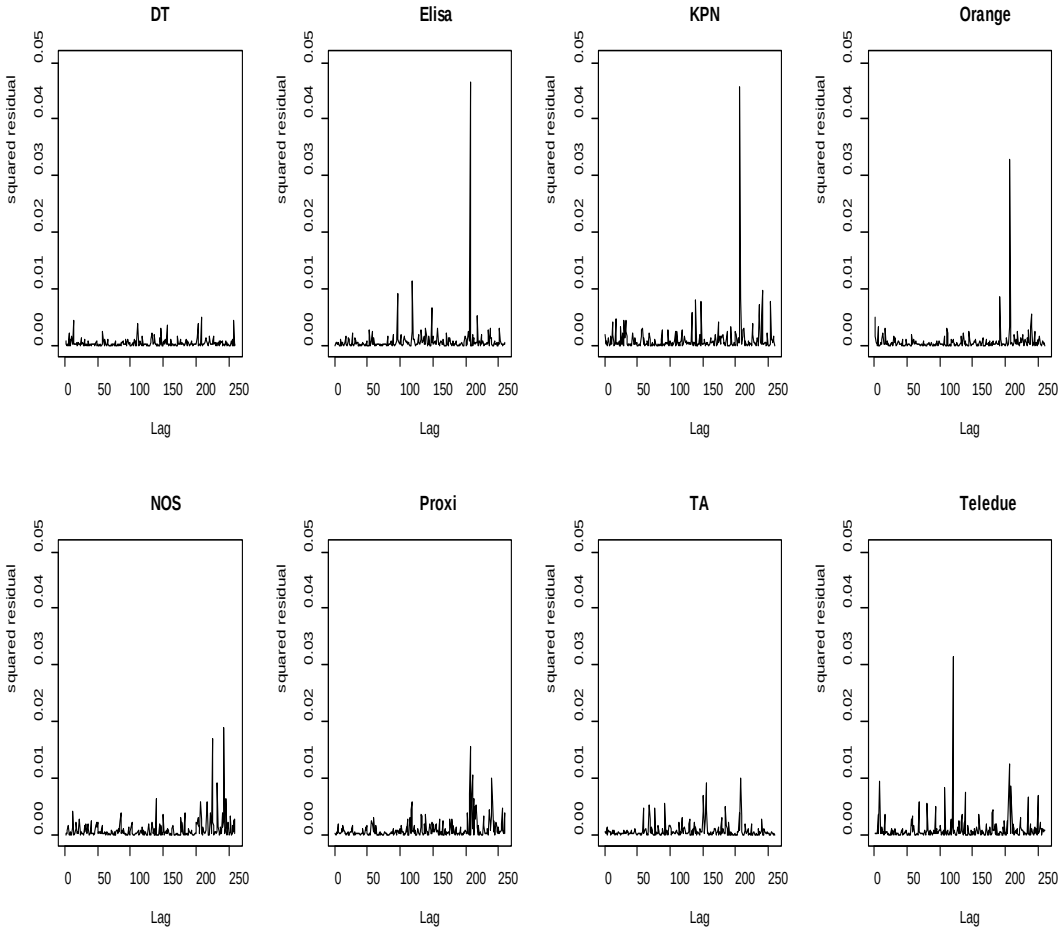


Figure A6: p-vales of Ljung-Box test for lag from 1 to 24 (yellow line: the 0.05 limit for null hypotesis evaluation; red line: average p-value over the 24 lags)

The increased volatility that has caused a reduction in the quality of the OLS estimator in comparison to last year, can be understood looking at the squared residuals in the picture below, specifically after the first pandemia induced lockdown in March 2020, which was applied in many European countries.


DT
Elisa
KPN
Orange
NOS
Proxi
TA
Teledue
squared residual
0.00
0.01
0.02
0.03
0.04
0.05
0
50
100
150
200
250
Lag

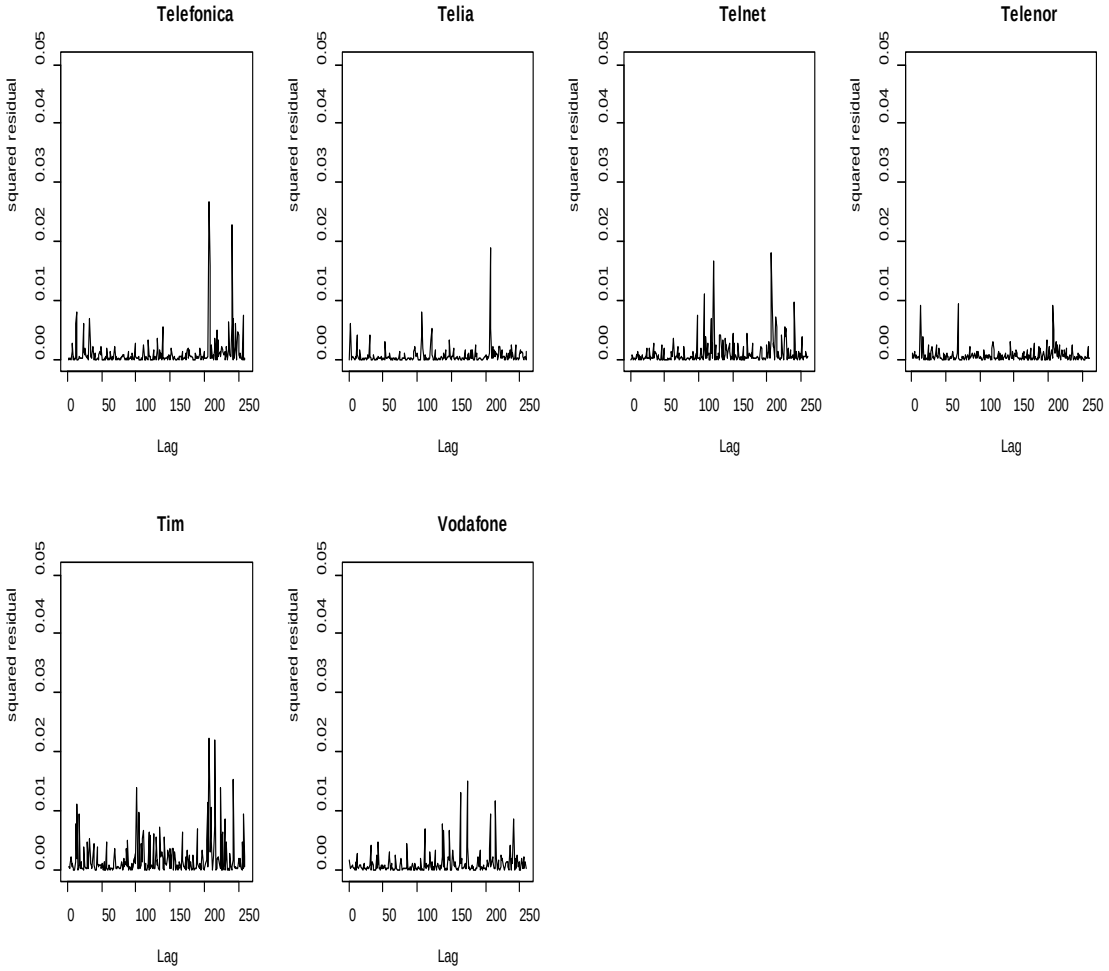


Figure A7: Squared residual representation

Another relevant test is to check if conditional heteroscedasticity in the residual is present. The presence of the Arch effect in the residual when there is no autocorrelation in the residual is an indication that outliers are not independent. In presence of conditional heteroscedasticity, an uncorrelated time series can still be serially dependent due to a dynamic conditional variance process. A time series exhibiting conditional heteroscedasticity—or autocorrelation in the squared series—is said to have autoregressive conditional heteroscedastic (ARCH) effects.

For this reason, the ARCH Engle's test is carried on. The test is the Lagrange Multiplier test which aims to fit a linear regression model for the squared residuals and examines whether the fitted model is significant. So the null hypothesis is that the squared residuals are a sequence of white noise, namely, the residuals are homoscedastic. This means that, under the ARCH framework, large shocks tend to be followed by another large shock. The Arch effect can be detected considering the following model

$$a_t^2 = \alpha_0 + \alpha_1 a_{t-1}^2 + \cdots + \alpha_m a_{t-m}^2 + e_t \qquad t = m+1, \ldots, T$$

Where e_t is the error term m is the lag order of the model and T the sample size with a_t the residual of the model considered. The test wants to verify the $\alpha_i = 0\ (i = 1, \ldots, m)$ in the

previous linear regression.[158] With this analysis an Arch effect in the residual can be detected for the most part of the lags in Proximus, Telecom Austria, Telefonica, and in some way also for NOS and Telia with an increase in the number of operators that "fail" the test of absence of conditional heteroscedasticity in comparison to last year.[159] In every case the level of "arch effect" can be considered low without the need to apply any adjustment to the equity beta estimated by the OLS.

To strengthen the assertion that the beta estimation in every case is not biased in a relevant way, just like last year we have estimated the Beta including in the error term of the regression the "Arch" effect and adjusted the regression estimation by a weighted least-squares, with weights equal to the reciprocals of the conditional variances of the Arch model estimated with respect to the time series of the standard residuals.

The fit of the residual with a suitable Arch model has followed the AIC[160] "Akaike Information Criteria", the best model has been selected choosing the one with the lower Akaike Information Criteria parameter considering different ARCH(p) models with p from 1 to N.

Recalculating the regressions lines through a weighted least square with weights equal to the reciprocal of the conditional variance of the Arch model estimated with relevant order, provides the following results for a beta adjusted for the two peers that main fails the statistical Engle's test.[161] The adjustment calculated with the same procedure for all the other peers provide always an adjustment in absolute term lower than 0.02 as reported in the following.

	EQUITY BETA	EQUITY BETA ADJUSTED	VARIATION	Adjustement in the error term
NOS	0.78	0.76	0.02	Arch(1)
PROXIMUS	0.62	0.61	0.01	Arch(3)
TA	0.69	0.68	0.002	Arch(1)
TELEFONICA	1.11	1.11	0.003	Arch(2)
TELIA	0.68	0.70	0.02	Arch(2)

This is consistent with the literature that shows small adjustments in situations where there is conditional heteroscedasticity in the CAPM beta estimation.[162]

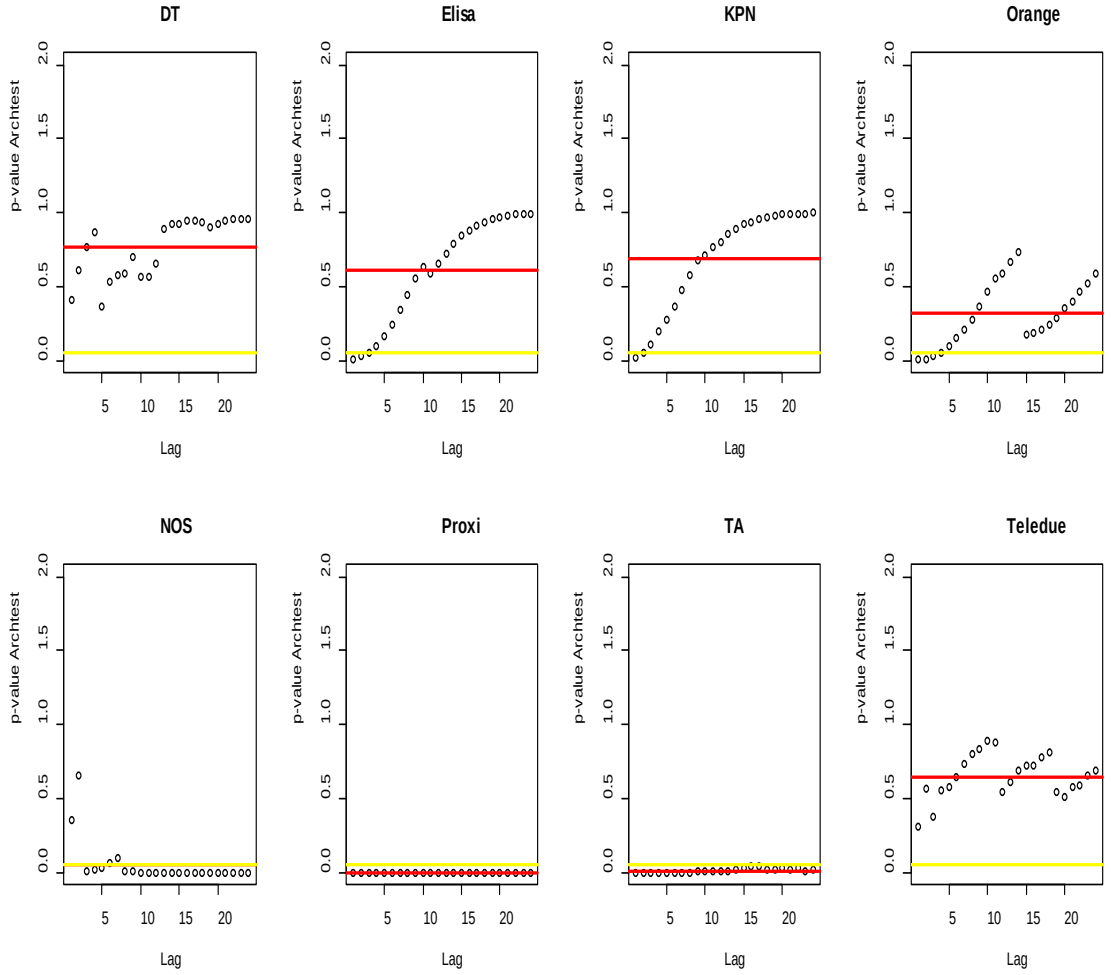
[158] The test evaluates the F statistic as ((SSR_0-SSR1)/m)/(SSR_1/(T-2m-1))) with SSR_0=∑(a_t-omega)^2 and SSR_1=∑e_t^2 with t from m+1 to T and omega is the sample mean a_t^2 which is asymptotically distributed as chi-squared distribution with m degrees of freedom under the null hypothesis. "Analysis of Financial Time Series" Wiley R.S. Tsay (2004)

[159] The considered Operators are those with an Egel test with an average failure of 24 lags.

[160] AIC rewards goodness of fit (as assessed by the likelihood function), but it also includes a penalty that is an increasing function of the number of estimated parameters. The penalty discourages overfitting, because increasing the number of parameters in the model almost always improves the goodness of the fit.

[161] D. Ruppert, "Statistics and Data analysis for financial engineering" Springer 2015.

[162] Armitage, S & Brzeszczynski, J 2011, 'Heteroscedasticity and interval effects in estimating beta: UK evidence', *Applied Financial Economics*, vol. 21, no. 20, pp. 1525-1538.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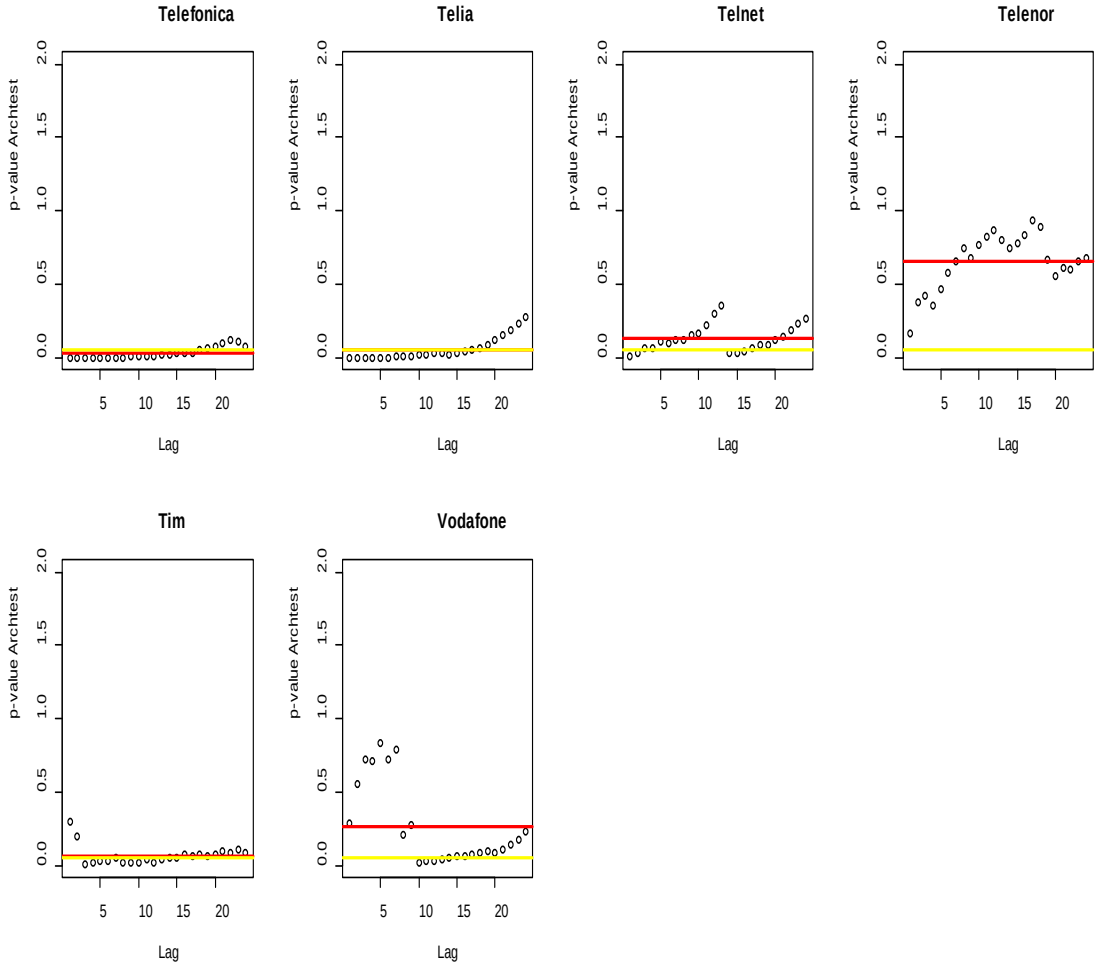

Figure A7 P-values of arch test for different order (lags) in the Egel's test model

To assess the uncertainty around the equity beta estimates presented in the previous sections, we calculate confidence intervals for each of our comparators. These figures show the 95 % confidence intervals of the equity beta estimation.[163]

[163] The confidence level is based on the estimation of the regression based on a generalized least squared error that provide a better estimate of the standard error in case of heteroscedasticity and autocorrelation of the residual.

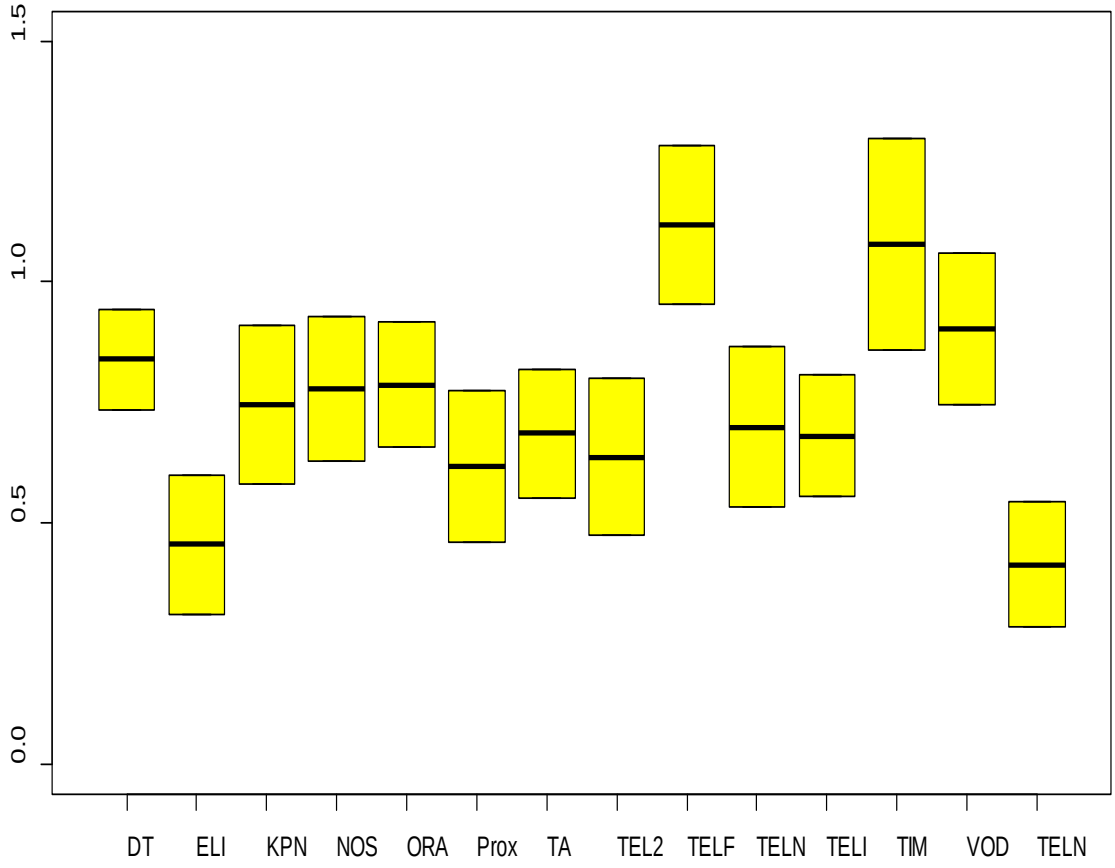

Figure A8 Confidence level of beta equity estimation

The estimated betas for companies with illiquid stocks tend to be unusually low and statistically less reliable. As a result, it is also necessary to assess the liquidity of stocks when selecting comparator companies. Failure in liquidity merit figures is also a reason for the failure of some statistical tests previously carried on. As liquidity is a difficult concept to define and is subject to interpretation, it is useful to look at a wide range of measures. In particular, the following liquidity measures were considered other than considering the free float reported in table A1 for each comparable.

Bid–ask spread as a percentage of closing price. This is the difference between the lowest price at which an asset is offered for sale in a market and the highest price that is offered for purchase of the asset. The lower the bid–ask spread, the more liquid the stock. A relatively narrow bid–ask spread could be a sign that there are a large number of buyers and sellers in the market. The merit figure has been evaluated considering the data, reported by Bloomberg with respect to the maximum and minimum price during the previous 20 days for each new day of evaluation.

Share turnover. This is a measure of stock liquidity calculated by dividing the total value of shares traded over a period of time by the average market capitalisation of the stock for the period. The higher the share turnover, the more liquid a stock is. For example, a high trading volume would indicate that a stock can be bought and sold easily.

In the picture below the five years average of Bid Ask Spread and Share Turnover are provided for the previous set of comparables. Telecom Austria have lower values with respect to the others considering the share turnover, which means a low level of liquidity - this is already seen in the analysis of autocorrelation of residual and free float.

	Bid/Ask spread	Share turn over
DT_DE	13.83%	1.15%
ELI_FI	14.75%	1.27%
KPN_NL	17.78%	1.73%
NOS_PT	19.59%	0.70%
ORA_FR	14.80%	1.31%
PRO_BE	17.87%	1.03%
TA_AT	14.12%	0.11%
T2_SE	16.17%	1.87%
TEL_ES	23.56%	2.25%
TEN_BE	19.44%	0.74%
TIA_SE	13.17%	1.35%
TI_IT	27.98%	2.42%
VO_UK	19.93%	1.14%
TEN_NO	14.07%	0.58%
AV_EU	17.92%	1.31%
AV_EU_EEA	17.65%	1.26%

Table A4

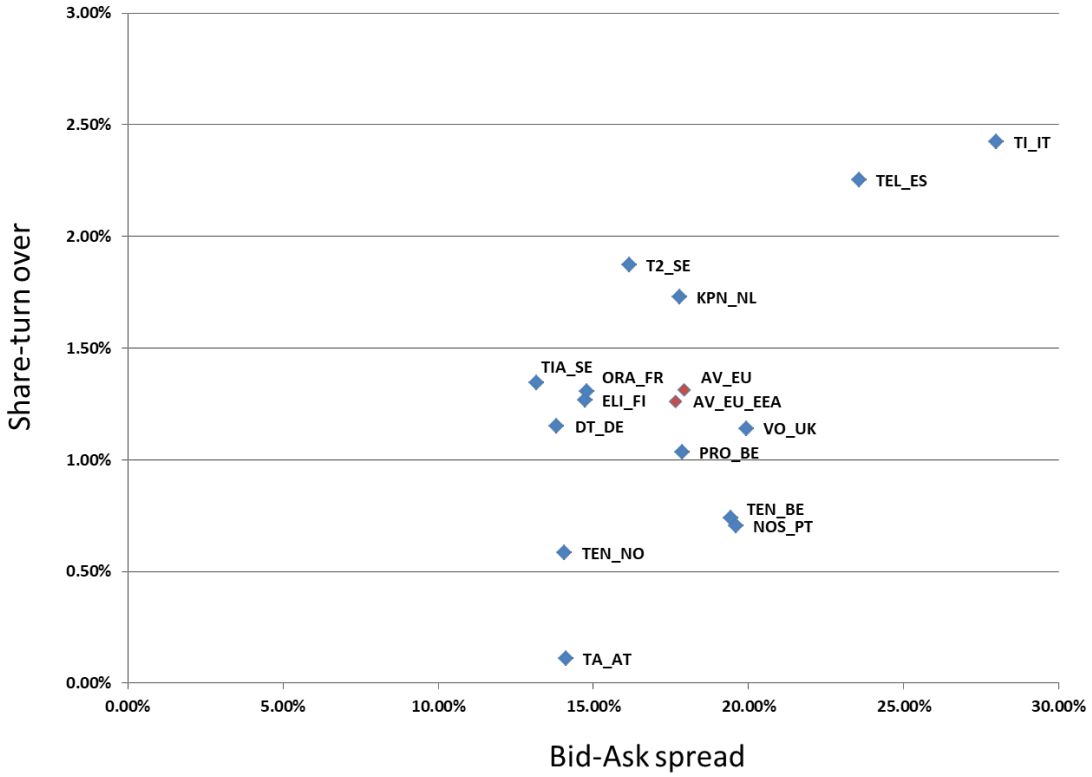

Figure A9 Bid-ask spread and Share turnover

Annex 4: Table of bond indices

Country	Thicker Bloomberg Barclays Index Global index	
Bulgaria	I11095US	Bulgaria Global Aggregate Index
Croatia	I03354US	Croatia Global Aggregate Total return Index Unhedged
Cyprus	I03355US	Cyprus Global Aggregate Total return Index Unhedged
Czech Rep.	I03356US	CzechRep Global Aggregate Return Total return Index
Estonia		
Greece	I03361US	Greece Global Aggregate Total return index Unhedged
Hungary	I03362US	Hungary Global Aggregate Total return index Unhedged
Latvia	I09101US	Latvia Global Aggregate Total return index Unhedged
Lithuania	I06240US	Lithuania Global Aggregate Total return index Unhedged
Luxemburg	I03365US	Luxemburg Global Aggregate Total return index Unhedged
Malta		
Poland	I03368US	Poland Global Aggregate Total return index Unhedged
Romania	I13198US	Romania Global Aggregate
Slovakia	I06239US	Slovakia Global Aggregate Total return index
Slovenia	I03370US	Slovenia Global Aggregate Total return index
Iceland	I11096US	Iceland Global Aggregate

The choice of the index for the bond return evaluation of Eastern European countries, Iceland and Luxemburg has been based on the family of homogeneous Bloomberg Barclays Global Aggregate indexes[164]. This choice is mainly guided by the fact that the Global Bloomberg Barclays index has a longer time series available at country level. The bond index return has

[164] https://data.bloomberglp.com/professional/sites/10/Bloomberg-Barclays-Methodology1.pdf

been evaluated (consistent with last year's report) using, for each country, the time series of the last price with a monthly sampling period, in line with the DMS time series, as P_t/P_(t-1) -1 with P_t the price at Year t and P_(t-1) the price in the Year t-1.

In this year's report the index chosen includes longer data series. The eligibility criteria of bonds' components in the Global aggregate index is mainly based on investment grade. Classes of indexes based on Emerging Market[165] or Inflation linked Indexes were excluded.

[165] Emerging market debts are specific indexes where the members are chosen based on certain rules and reviewed annually.