

RA Report Chapter 5 - WACC

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List of Abbreviations

C

CoD *Cost of Debt*

D

DMS *Dimson, Marsh, Staunton*

E

ERP *Equity Risk Premium*

M

MSCI *Morgan Stanley Capital International*

Q

QE *Quantitative Easing*

R

RFR *Risk Free Rate*

S

S&P *Standard & Poor Credit Rating Agency*

T

TMI *Total Market Index*

TMR *Total Market Return*

5. The Weighted Average Cost of Capital (WACC)

5.1 Introduction and main goals of the section

A specific in-depth focus on WACC in BEREC's Regulatory Accounting reports started with Chapter 5 of the 2017 RA Report (BoR (17) 169), which surveyed legacy WACC values, benchmarking final rates and methodologies for single parameters estimation within the WACC formula computed by NRAs - specifically in market 3a and, more in general, in fixed markets.¹ It also provided information on the evolution of the WACC value over time.

The 2020 RA report (BoR (20) 210) provided an update of the information reported since BoR (17) 169 both for parameter values and methodologies with a cut-off date of 1st April 2020. The current 2021 report presents an up to date version of the WACC benchmark with a cut-off date of 1st April 2021.

Theoretical and practical issues concerning WACC were also covered in the opinion BoR (18) 167² issued by BEREC in response to the public Consultation launched by the European Commission.

During 2019 BEREC also provided further input to the Commission's considerations for the non-binding WACC Notice for legacy infrastructure which was published on 7 Nov. 2019 (hereinafter referred to as WACC Notice). The WACC Notice is an instrument for the review of national notifications in the EU electronic communication sector. In 2020 and 2021 BEREC calculated the main WACC parameters according to the methodology foreseen in the non-binding WACC Notice (BoR (20) 116) and (BoR (21) 86).

In line with the before mentioned BEREC input to the Commission consultation on the non-binding WACC Notice, (BoR (18) 167), it is important to point out that NRAs must retain flexibility within the multidimensional details of their WACC estimation depending on national economic conditions, availability of data, the degree of wholesale and retail competition (which influences the beta), regulatory goals/strategy, judicial reviews, etc., whilst the importance of consistent application of the methodology foreseen in the Notice is acknowledged. NRAs must, of course, be able to substantiate individual approaches to the Commission, the regulated entity, competitors and other market participants, not least to provide legal certainty of their decisions. The Notice aims to ensure a consistent calculation of the WACC by NRAs – which is a core element of any regulatory pricing decision NRAs take - thereby contributing to the development of the internal electronic communications market. The BEREC report on WACC parameter calculations (BoR (20)116, BoR (21) 86) provides a specific guidance on the application of the Notice to NRAs, providing single values for the RFR and ERP and range of values for the beta, gearing and cost of debt.

Compared to the BEREC WACC parameters Reports (BoR (20)116, BoR (21) 86), the present BEREC Regulatory Accounting Report WACC chapter is of a more descriptive nature, aiming at reporting and analysing NRAs WACC calculations "as is" as well at showing the evolution over time, in line with previous versions.

¹ The information collected and presented in the report refers to market 3a. In some cases, due to country specificity issues, data provided can refer to the fixed market (i.e. market 1, market 3b, market 4). Where different data sets have been provided by NRAs this will be highlighted in the text.

² https://BEREC.europa.eu/eng/document_register/subject_matter/BEREC/opinions/8257-BEREC-position-paper-input-to-the-commission8217s-wacc-consultation-2018.

The following analysis is based on an updated questionnaire targeted to collect information on:

- parameter values to evaluate the WACC;
- main methodologies currently used to estimate each parameter (based on predefined options) and adjustments that NRAs may apply to their standard approach in order to take into account country specificity;
- evolution over time of methodologies and parameter values used by NRAs.

The questionnaire asked NRAs to provide updated information on pre-tax WACC both for fixed and mobile markets and the following main parameters of the WACC formula based on CAPM methodology – in force as at April 2021: i) Risk Free Rate (RFR); ii) Cost of Debt (CoD); iii) Beta; iv) Equity Risk Premium (ERP); v) Gearing; vi) Tax.

In Figure 1 the year of information available for the recorded fixed and mobile market WACC calculation is reported for each country as well as their general frequency of updating (the RA EWG started to collect in-depth information about single parameters and the WACC calculation in 2016).

Figure 1 displays the information collected for each country (the cut-off date is 1st April). The cells marked “X” indicate that in that year single values of each WACC parameter were collected in the RA EWG data base. Colours provide information on the years where NRAs have taken a decision for the fixed market WACC since 2008: green marks decisions, orange public consultations³, grey decisions in force in 2021 but taken after the cut-off date of the 1st April 2021.

For the mobile market information on NRAs that calculate a specific mobile WACC is provided. Column “2019” reports the values in force in 2019 independently from the year of the adoption, while the “2020” and “2021” columns report only the cases where updated values in comparison to the previous year’s report have been provided for the RA report.

WACC methodologies and values for the fixed market are recorded for 32 NRAs⁴. Most of the NRAs (20) update the WACC in line with their market analysis or when pricing decision are taken. In these cases, a market-specific WACC may be in force for 2 or more years. Some NRAs update yearly (10), but in some cases the update only comes into force when new pricing decisions are taken.

The dataset used for the following analysis takes into consideration 117 observations for fixed market of all 6 parameters previously listed and 1 final value based on information collected and related to the period 2008-2021. The collected data refers to information provided by NRAs and is updated for the 2021 report.

All values provided by NRAs are consistent with their final nominal pre-tax WACC calculation meaning that in some cases parameters also contain country specific adjustments applied to the cost of equity - attributed mainly to RFR, ERP or Beta according to the provided information. Technical adjustments are also reported.

The 2021 report, in line with the 2020 version, also provides statistics on WACC values and methodologies for the mobile market.

This year’s report also focusses on the application of the WACC Notice and, for this reason, the current WACC in charge differentiates NRAs that completely apply the WACC Notice, NRAs that partially apply the WACC Notice and NRAs that do not (yet) apply the WACC Notice. Reasons given for non-application of the WACC Notice include: i) the WACC has been evaluated before the WACC

³ In the following analysis the latest available information is displayed in line with each NRA’s information on the appropriate value to be considered for the 2021 report. This approach allows the report to be updated taking into account the information on the current status and time of adoption of the information provided.

⁴ EE states that its final WACC value is obtained using a benchmark among other NRAs, rather than applying a formula.

Notice came into force; ii) NRAs have made use of the transition period specified within the WACC Notice; iii) other reasons.

In line with previous year's report a specific analysis on the dispersion of the values throughout the years is included by using box plot analysis. The main objective is to obtain a more detailed quantitative picture of the convergence path of the values. Taking into account the 25° percentile and 75° percentile of the values of each parameter distribution, with longer time series a general reduction of the dispersion for all values may be observed: mainly for RFR and, to a lesser extent, ERP⁵, CoD, beta and gearing

Appendix II of the current report contains a more in-depth analysis of WACC parameters in terms of causal correlations as a follow-up from last year's report (see appendix 2 of BoR(20) 210). The information is reported for all countries that have provided information and separately for EU member states.⁶

Figure 1 - WACC database and frequency of update/calculation⁷

		Fixed Market (Year of adoption)														Mobile Market			Frequency
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2019	2020	2021	
EU member state	AT		X			X			X							X			MA/RP
	BE	X		X				X				X				X	X		MA/RP
	BG						X		X							X			MA/RP
	CY				X			X		X	X	X	X	X	X	X	X	X	MA/RP
	CZ								X			X				X			MA/RP
	DE				X						X	X	X	X	X	X			YEARLY
	DK							X	X	X	X	X	X	X	X	X			YEARLY
	EE																		
	EL						X		X		X	X		X		X			MA/RP
	ES		X				X			X	X	X	X	X	X	X		X	YEARLY
	FI		X				X				X					X			MA/RP
	FR					X	X			X		X				X		X	MA/RP
	HR						X			X					X		X	X	MA/RP
	HU							X	X	X	X	X	X	X	X	X	X	X	YEARLY
	IE		X						X						X		X		MA/RP
	IT			X					X					X		X			MA/RP
	LT								X			X	X	X					YEARLY
	LU									X							X		MA/RP
	LV															X		X	
	MT					X								X		X	X		MA/RP
NL					X			X							X			MA/RP	
PL										X	X	X	X	X	X			YEARLY	
PT								X	X	X		X	X	X	X		X	YEARLY	
RO						X								X				MA/RP	
SE											X	X				X	X	MA/RP	
SI							X					X						MA/RP	
SK					X			X		X	X	X			X	X		YEARLY	
NO EU member	CH	X				X				X	X	X						YEARLY	
	IS										X								
	LI						X											MA/RP	
	MK		X													X			
	ME														X			X	
	NO					X				X	X				X			MA/RP	
	RS						X	X	X	X	X	X	X	X	X	X	X	YEARLY	
	UK			X				X				X	X			X			MA/RP
XX																	X		
Number of	2	5	3	2	4	10	4	11	12	12	16	18	13	5	24	10	6		

X	New data reported with respect to 2020 RA report
x	Available in the RA database
	Adopted decision
	Public consultation
	In charge for the year report, but adopted after the cut off date of 1 April

⁵ For ERP a reduction of "outlier" values is more evident in this year's report.

⁶ The table (Figure 1) reports the year of adoption [April N-1 to April N], or, when different, of application.

⁷ BNetzA WACC decisions are taken on the 30.06. of each year, therefore values stated are in use and valid for Q1/Q2 of the current year only. CH have provided updated information for 2017 (2018 RA report), 2018 (2019 RA report), and for 2019; in those cases WACC has been updated by the SMP operator even if no specific decision has been taken into account by the NRA: for this reason in figure 1 the corresponding cell is white (figures on WACC in the following refer to the last WACC figure provided for 2019). For SE the last current fixed market WACC was adopted on 1 October 2018, but according to the cut-off date, has been classified for 2019. For FI due to supreme court decision (11/2020) price caps are no longer valid and WACC in force in fixed network is therefore no longer in charge from the year 2017.

Source: BEREC RA database 2021

Focus on the application of the WACC Notice

This year's report provides also information about the application of the WACC Notice and of the BEREC WACC Parameters Report 2020 (BoR(20)116).

The WACC Notice has been adopted on 19th November 2019. Therefore most NRAs, that have updated their WACC since 2020 have fully or to partially taken into account the methodology proposed in the WACC Notice, even if making use of the transition period starting from the 1 July 2020⁸.

The following table briefly reports the main methodology for legacy WACC estimation available in the WACC Notice and the corresponding relevant values included in the BEREC WACC report BoR(20)116.

Figure 1b - WACC Notice approach and WACC BEREC report BoR(20)116 main values

	Commission Notice methodology (by points)	BEREC WACC BoR(20)116 (values)
RFR	-Own country bond; -10 Year bond, -weekly sampling period; -five years time windows for the average.	Eurostat based calculation on monthly data for each country
Debt premium	Peer group of companies usually including national SMP: -maturities closer to 10 years, -weekly sampling period, -five years time windows for the average	14 comparable companies: 1.30% (arithmetic average); 3.02%(max); 0.42% (min)
ERP	Single European Equity risk premium based on historical data (arithmetic average of historical equity premium)	Single EU ERP: 5.31%
Equity Beta	Peer group of companies usually including national SMP -estimation starting from unlevered beta; - weekly sampling period, - five years time windows - European market index for regression estimation and - Miller formula including 0,1 for beta debt for beta levered and unlevered estimation	14 comparable companies: 0.52 (arithmetic average) asset beta; 0.69 (max) asset beta; 0.38 (min) asset beta; 0.79 (arithmetic average) equity beta; 1.12 (maximum) equity beta; 0.59 (minimum) equity beta.
Gearing	- Peer group of companies usually including national SMP Debt component from Book value (only long term debt); - Equity component through market value; - five years time windows; - weekly sampling period	14 comparable companies: 36.95% (arithmetic average); 63.8% (max); 13.51% (min).

Source: BEREC RA

29 NRAs have provided information on their final fixed market WACC estimation (30 NRAs including mobile market) in the 2021 survey, of which 13 NRAs have provided updated values, as shown in

⁸ Point 71 of the Notice: “When reviewing notifications under the Article 7 procedure, the Commission will, as a rule, use the methodology described in the present Notice from 1 July 2020. However, in justified cases and at the request of the notifying NRA, the Commission will not base its review of draft measures on this methodology during a transitional period of up to one year (starting from 1 July 2020). For example, this may be justified when the review based on this methodology, if applied by the national regulator, would result in significant changes in the WACC value undermining regulatory stability and predictability. During the transitional period of one year, the Commission will also take into consideration if the full set of WACC parameters to be published by BEREC is available and the possibility for the NRAs to rely on those parameters in their analysis”.

Table 1 (CY, DE, ES, FR, IE, LV, LT, ME, PL, PT, RO, RS, -updated values reported in red) of the that

7 NRAs fully apply the WACC Notice DE, LV, ES, FR, PL, PT, HU; five of them (DE, ES, FR, PL, PT) have notified the WACC values because of an ex art. 7 procedure, as an independent WACC notification or including the WACC estimation within an updated market analysis or price decision.

Two NRAs have fully applied the method outlined in the WACC Notice and the corresponding BEREC Report BoR(20)116 (LU and SE) and notified their decisions, but the new WACC values come into effect only after the cut-off date of 1st April 2021 considered in the present report. Two other NRAs (AT,DK) have updated the WACC for 2021 in line with the WACC Notice and BEREC report, but this value is not yet in charge. The values which have been calculated in line with the Commission notice by AT, DK, LU, SE, are therefore not included in the results of the present survey.

Out of the 7 NRAs that fully apply the WACC notice, two have made use of the transition period in their notification assessment (DE, ES); and two NRAs (LV, HU) have not yet notified the decision. It should be pointed out that 6 of the 7 NRAs, excluding HU, have effectively applied not only the methodology proposed by the WACC Notice, but have also made use of the corresponding BEREC calculations and parameter ranges in BoR (20) 116; HU applied the methodology proposed by the WACC Notice without applying the corresponding BEREC calculations and parameter ranges in BoR (20) 116, because the BEREC Report was not available at the time of their notification. HU has not yet notified a new WACC decision, because there has been no new market decision.

Four NRAs that updated the WACC since 2020 have partially applied the WACC Notice (CY, RO, HR, RS) (figure 1c). Out of the EU NRAs, RO has notified the WACC to the Commission, making use of the transition period due to the fact that during their consultation period the BEREC parameter calculation was not yet available. Four NRAs (ME, DK, EL, LT) have not (yet) applied the WACC Notice even though their decision has been taken during 2020 or 2021 (at a time when the transition period still applied). In EL the fixed WACC has been notified and adopted in 2020, for LT the national law regulates the WACC calculation and DK has not yet notified the 2020 decision.

In all other case the WACC was adopted before the WACC Notice came into force. In one case (IE) the WACC has been notified before 1st July 2020 and the consultation parameters have been evaluated before the WACC Notice and the BEREC Report were available.

In the present survey the six NRAs that estimated the WACC following both the Commission WACC Notice and the BEREC WACC parameters report have done it for all the five parameters (RFR, ERP, Beta, gearing and debt premium).and thus are considered to apply fully the methodology and the parameters.

The following table summarises the situation before the 1st April 2021.

Figure 1c – Adoption of the WACC Notice⁹

	Year of adoption (RA report 2021)	Did you apply the Commission Notice of 6th November 2019?	Did you use the transition period for not applying or partially applying the Notice?	Did you notify the WACC after the adoption of the Commission Notice	-if yes did you receive comments from the Commission?	Please provide further details on the comments received
DE	2021	Yes completely	Yes	Yes	No	No comment
LV	2021	Yes completely	No	No	0	The implementation of WACC according to commission methodology was delayed due to complications with the adoption of the economic replicability test.
FR	2021	Yes completely	No	Yes	No	No comment
ES	2020	Yes completely	Yes	Yes	No	No comment
HU	2020	Yes completely	No	No	0	
PL	2020	Yes completely	No	Yes	Yes	A comment from the Commission concern only the formal procedure.
PT	2020	Yes completely	No	Yes	Yes	the comments were not directly linked to the WACC
CY	2021	Yes partially	Yes	No		
RO	2020	Yes partially	Yes	Yes	Yes	The Commission considered ANCOM's justification for non-application of the Notice (i.e. the BEREC WACC parameters report was not published when ANCOM calculated and nationally consulted the draft measure) to be a valid reason
HR	2020	Yes partially	No	No		
RS	2020	Yes partially	Yes	No		
ME	2021	No	No	No		
DK	2020	No	No	No		No pricing decisions in 2021, a new market decisions is under way. In the process of negotiating commitments with multiple SMP operators, we have used the EC WACC method (and BEREC figures) for setting a 2021 WACC; however, given the lack of pricing decision it is not yet in charge.
EL	2020	No	No	No		
LT	2020	No	No	No	No	WACC calculations are based on the legislation in Lithuania
IE	2020	Value in charge before the issue of EC notice				
BE	2019	Value in charge before the issue of EC notice				
CZ	2019	Value in charge before the issue of EC notice				
IT	2019	Value in charge before the issue of EC notice				
MT	2019	Value in charge before the issue of EC notice				
NO	2018	Value in charge before the issue of EC notice				

⁹ In red are those NRAs that have updated their WACC since the last year report BoR (20) 210.

SE	2018	Value in charge before the issue of EC notice				A new WACC decision will be coming into effect on 1 st July 2021, therefore this is not included in the report due to the fact that the cut-off date is 1 st April 2021. This decision have been notified and assessed taking fully into account the WACC notice and te WACC BEREC Report 2020 (SE/2021/2313)
SI	2018	Value in charge before the issue of EC notice				
SK	2018	Value in charge before the issue of EC notice				
FI	2017	Value in charge before the issue of EC notice				
BG	2016	Value in charge before the issue of EC notice				
LU	2016	Value in charge before the issue of EC notice				
AT	2015	Value in charge before the issue of EC notice				A new WACC decision has been taken into account, but not included in the report due to the fact that cut-off date is 1 st April 2021. This decision have not yet been notified.
LI	2014	Value in charge before the issue of EC notice				

Source: BEREC RA database 2021

5.2 WACC Nominal pre-tax synthetic value

Figure 2 reports the main statistics related to nominal pre-tax WACC for all NRAs that have provided information in 2021 (29 NRAs¹⁰ for fixed and 24¹¹ for mobile) and, separately, for the EU members states (25 NRAs for fixed market and 21 for mobile) which are subject to the same Regulatory framework (including the WACC Notice). Main statistics for the 6 NRAs that fully apply the WACC Notice and the corresponding BEREC WACC Report (DE, ES, FR, LV, PL, PT) are provided separately (in green).

¹⁰ AT,BE,BG,CY,CZ,DE,DK,EL,ES,FI,FR,HR,HU,IE,IT,LT,LU,MT,PL,PT,RO,SE,SI,SK,LV,NO,RS,ME,LI.

¹¹ AT,BE,BG,CY,CZ,DK,EL,ES,FI,FR,HR,HU,IE,IT,LU,MT,PT,SE,SK,LV,NO,RS,ME.

Figure 2 - Main statistics nominal pre-tax WACC

	Average	Median	Standard Deviation	Relative Standard Deviation	Maximum	Minimum
WACC fixed Nominal Pre-tax 29 NRAs; (2020-31)	6.58%	6.51%	1.50%	22.82%	10.28%	4.04%
(2019-32)	(7.22%)	(7.1%)	(2.06%)	(28.53%)	(13.40%)	(3.33%)
(2018-32)	(7.71%)	(7.28%)	(2.23%)	(28.87%)	(13.45%)	(4.04%)
	(7.96%)	(7.73%)	(2.34%)	(29.39%)	(14.30%)	(4.04%)
WACC mobile Nominal Pre-tax 24 NRAs; (2020-25)	6.95%	6.97%	1.28%	19.84%	10.20%	4.45%
(2019-26)	(8.03%)	(7.58%)	(1.88%)	(23.42%)	(14.02%)	(5.55%)
(2018-26)	(8.59%)	(8.11%)	(2.17%)	(25.27%)	(14.29%)	(5.55%)
	(8.73%)	(8.11%)	(2.21%)	(25.37%)	(14.29%)	(5.66%)
WACC fixed Nominal Pre-tax 25 EU NRAs; (2020-24 NRAs)	6.47%	6.51%	1.28%	19.84%	8.64%	4.45%
(2019-26)	(7.07%)	(7.13%)	(1.40%)	(19.81%)	(10.68%)	(4.54%)
(2018-26)12	(7.60%)	(7.28%)	(1.87%)	(24.60%)	(13.45%)	(4.62%)
	(7.86%)	(7.73%)	(1.96%)	(25.00%)	(14.30%)	(14.30%)
Wacc mobile Nominal Pre-tax; 21 EU NRAs (2020-20)	6.73%	6.89%	1.32%	19.67%	9.33%	4.45%
(2019-23)	(7.31%)	(7.17%)	(0.96%)	(13.17%)	(9.33%)	(5.55%)
(2018-23)	(8.22%)	(7.63%)	(1.89%)	(23.03%)	(14.29%)	(5.55%)
	(8.34%)	(7.89%)	(1.92%)	(22.97%)	(14.29%)	(5.66%)

Source: BEREC RA database 2021

The average WACC values currently in force for fixed and mobile markets have decreased in comparison to the previous year (values in brackets).¹³ Also the relative standard deviation is decreasing mainly due to less outliers, as reported in the box-plot in Figure 4.¹⁴

In Figure 3 WACC values for the fixed and mobile markets have been ranged (from lowest to highest including the year of the adoption for the fixed market). The current country credit ratings (source: Moody's)¹⁵ are also shown. The six NRAs that fully apply the WACC Notice as well as the BEREC parameters estimation in BoR (20) 116 have been highlighted in green. Of the 29 NRAs with fixed WACC values, 24 also have provided information on the mobile market. Among the 24 NRAs that have estimated a mobile market WACC one, 8 NRAs have estimated a common WACC for the fixed and the mobile market; the value has increased since last year; 11 have estimated a higher WACC for the mobile market (on average +0.70% in line with past year); and 4 NRAs have estimated a lower mobile WACC (on average -0.19% in line with past year). It should be pointed out that estimating a different mobile WACC is becoming less relevant due to the introduction of the Delegated Act for mobile termination rates¹⁶, thus the actual differences may be due to the fact that NRAs are updating the mobile WACC less frequently or have ceased updating.

¹² The information related to EU Member States refer to AT, BE, BG, CY, CZ, DE, DK, EL, ES, FI, FR, HR, HU, IE, IT, LT, LU, LV, MT, PL, PT, RO, SE, SI, SK. EE did not provide information, NL did not evaluate a fixed WACC in a formal decision recently due to the fact that fixed regulatory framework has been annulled. For this reason there is no fixed WACC in charge until the regulation is restored (in figure 1 the following indication "-" has been included for this reason).

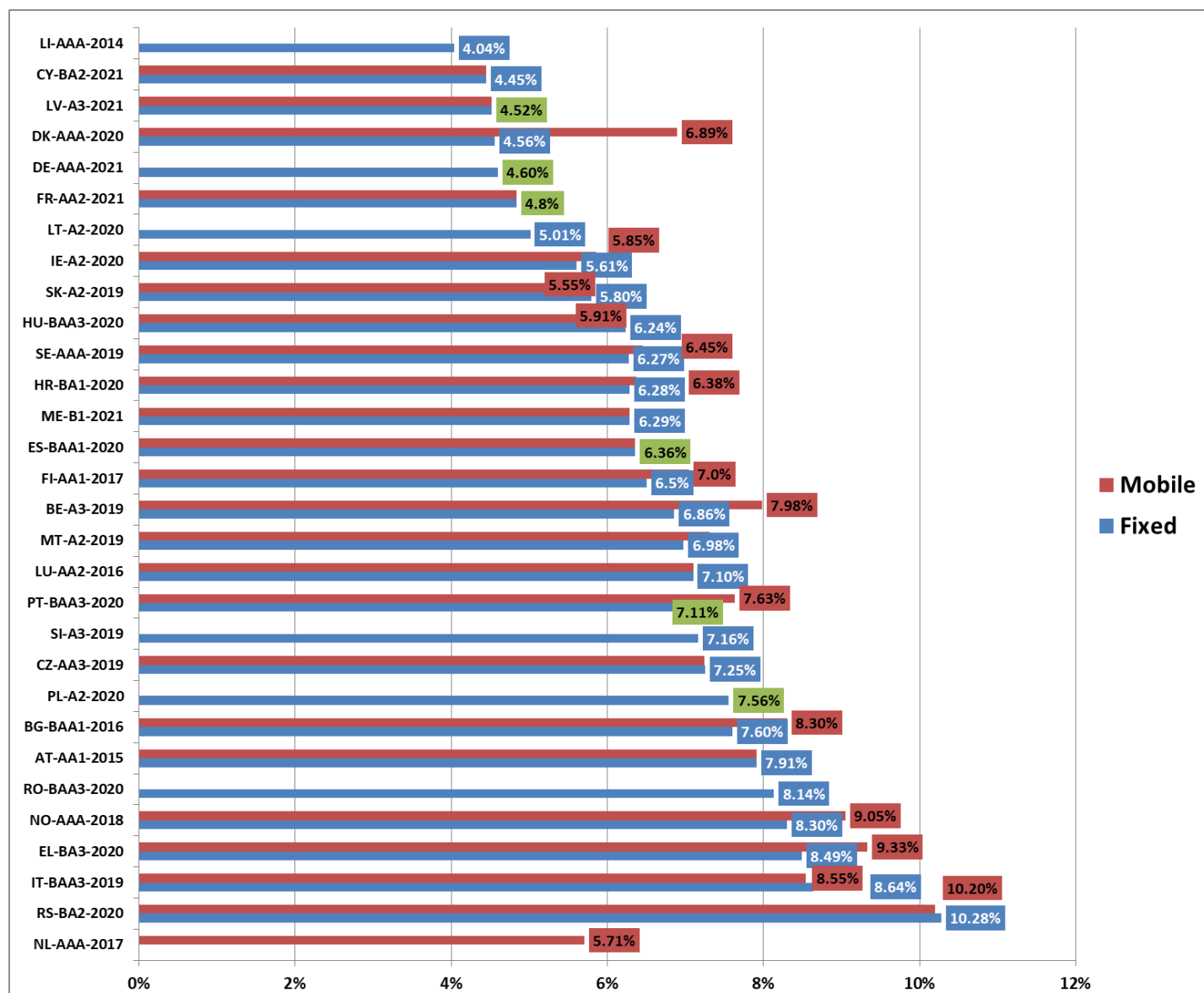
¹³ In the tables the information of previous year's statistics are also given providing the year of estimation and the corresponding number of countries included.

¹⁴ In descriptive statistics a box plot is a method for graphically depicting groups of numerical data through their quartiles. It represents the median (bold black line) the 25th and 75th percentiles of the distribution (upper and lower part of the red square) and the dotted lines indicates variability outside the upper and lower quartiles. Values are plotted as individual points (yellow dots), showing outliers.

¹⁵ BoR(21)86.

¹⁶ EUROPEAN COMMISSION Brussels, 18.12.2020 C(2020) 8703 final COMMISSION DELEGATED REGULATION (EU) /... of 18.12.2020 supplementing Directive (EU) 2018/1972 of the European Parliament and of the Council by setting a single maximum Union-wide mobile voice termination rate and a single maximum Union-wide fixed voice termination rate

Figure 3 - Nominal pre-tax WACC - fixed and mobile markets



Source: BEREC RA database 2021

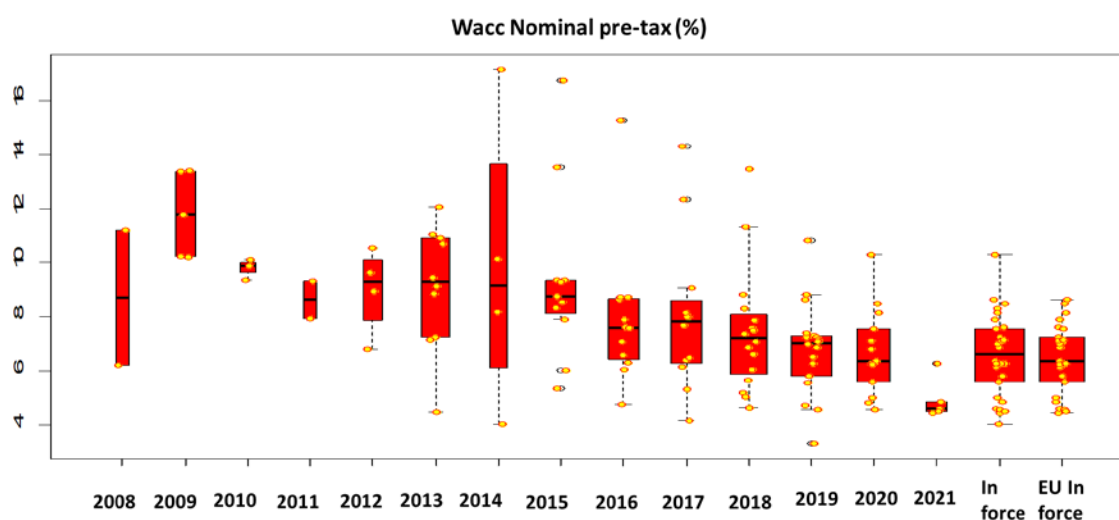
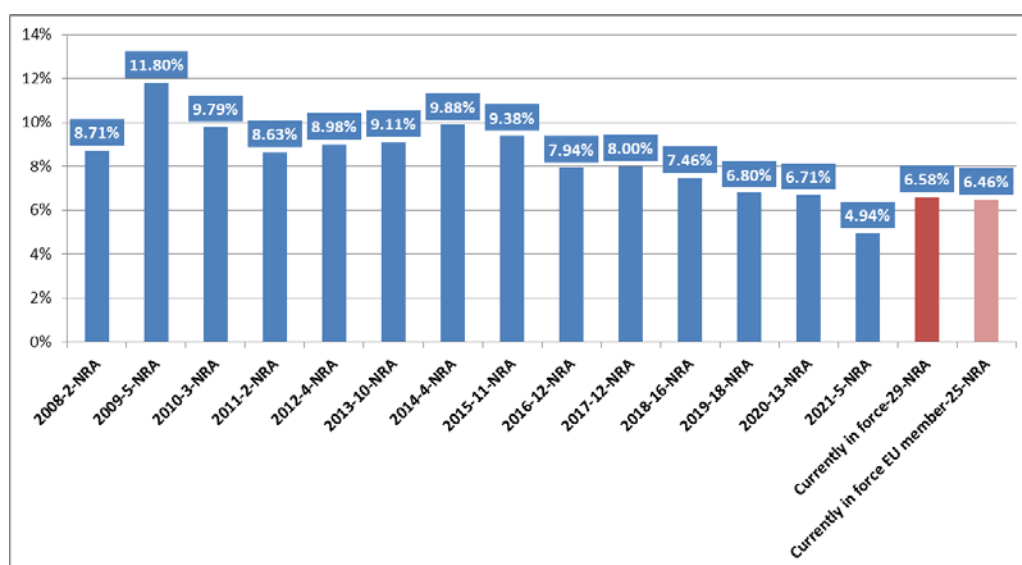
Figure 4 shows the average year-by-year values (NRAs that have calculated WACC in the corresponding year) and the resultant box plot of the nominal pre-tax WACC for the fixed market. The box plot in this figure only provides information about the dispersion between values while the average value is reported in figure 2. The objective is to provide information on the dispersion around the average value.

The average value currently in force is derived by averaging values that are in use at the cut-off date of the current report independent of the year of the decision.¹⁷

The average WACC has been continuously decreasing since 2017.

¹⁷ DE: the real pre-tax fixed WACC in force equals 4,39%. DK: a real pre-tax WACC of 4.9% is used in the LRAIC mobile model.

Figure 4 - Nominal pre-tax WACC (fixed market 2008-2021)



Source: BEREC RA database 2021

In order to explore the WACC parameters' weight with respect to the final WACC value, the regression presented in BoR (17) 169 and in BoR (19) 240 was updated (see Appendix II). The regression can provide a quantitative approach useful for understanding the level of harmonisation of the parameters in light of the WACC Notice published by the Commission, taking into account that the harmonisation process relates to both the methodology and the values of some parameters. Data shows – in line with the previous exercise – that the differences of the final WACC values over time can be mainly explained by parameters in the WACC calculation that are more “country related” such as the RFR, ERP and Tax rate, with a less relevant role for sector specific parameters such as beta, gearing and debt premium. This is consistent with survey results on “methodologies applied” that confirm that beta, gearing and debt premium were estimated mainly on a “notional” basis (see also Appendix II) even prior to the Notice.

This year 13 NRAs have provided new WACC values, i.e. nearly 50% of NRAs participating in the survey.

By taking into account only the most recent estimations along the time line (i.e. the three most recent values for each NRA) in the pooled regression analysis, the results show that the ERP, the second most relevant parameter after RFR in explaining WACC differences last year, is this year becoming less relevant than “Tax” parameters in explaining the differences in final WACC values .¹⁸

This result is in line with the fact that the ERP estimation through a notional approach by most NRAs (due to the application of the WACC Notice) is reducing its spread. This is reflected in recent time series panel data that has shown that the most relevant parameters are RFR and Tax to explain differences in WACC; typical country parameters, for the first time since 2017. ERP, beta, gearing and debt premium in this order of relevance provide a less important contribution to explaining differences in final WACC values if we take into account the most recent data estimation which shows that the application of the WACC Notice starts to have a material convergent effect.

5.2.1 Risk Free Rate

see BoR (17) 169¹⁹, BoR (18) 167²⁰ and BoR (20) 116²¹ BoR (21)86²² for definition and general financial theory

Main output from the survey.

Based on the replies provided in the 2021 survey the following statistics have been derived for all responding NRAs and for EU NRAs separately (2020-2018 values in brackets).²³

Figure 5 – Nominal Risk Free Rate

2021	Average	Median	Standard Deviation	Relative Standard Deviation	Maximum	Minimum
Nominal RFR-fixed market; 29 NRAs (2020-31) (2019-32)(2018-32)	1.96% (2.52%) (2.70%) (3.00%)	2.16% (2.30%) (2.50%) (2.59%)	1.07% (1.95%) (1.90%) (2.11%)	54.71% (77.28%) (70.18%) (70.54%)	4.62% (10.04%) (10.04%) (10.04%)	0.17% (0%) (0.31%) (-0.17%)
Nominal RFR-mobile market: 24 NRAs (25-2020) (2019-26)(2018-26)	2.09% (2.73%) (3.11%) (3.18%)	2.12% (2.38%) (2.58%) (2.72%)	1.07% (1.86%) (1.92%) (2.02%)	50.87% (68.03%) (61.94%) (63.43%)	4.62% (10.04%) (10.04%) (10.04%)	0.57% (0.82%) (0.91%) (0.48%)
Nominal RFR-fixed market EU: 25 EU NRAs (24-2020) (2019-26)(2018-26)	1.76% (2.24%) (2.34%) (2.70%)	2.05% (2.27%) (2.34%) (2.59%)	0.89% (1.26%) (1.32%) (1.71%)	50.74% (56.34%) (56.18%) (63.30%)	3.01% (6.39%) (6.39%) (7.21%)	0.17% (0.27%) (0.31%) (-0.17%)
Nominal RFR mobile market EU: 21 EU NRAs (20-2020) (2019-23)(2018-23)	1.84% (2.16%) (2.68%) (2.74%)	1.95% (2.22%) (2.54%) (2.54%)	0.85% (0.86%) (1.24%) (1.37%)	46.06% (40.03%) (46.25%) (49.85%)	3.55% (3.73%) (6.39%) (6.39%)	0.57% (0.82%) (0.91%) (0.48%)

Source: BEREC RA database 2021

¹⁸ This result should be read in the applied framework that show consistent and efficient estimation of the model parameters including the suppression of outlier values from the pool of observations (see Annex II for details).

¹⁹ https://BEREC.europa.eu/eng/document_register/subject_matter/BEREC/reports/7316-BEREC-report-regulatory-accounting-in-practice-2017.

²⁰ https://BEREC.europa.eu/eng/document_register/subject_matter/BEREC/opinions/8257-BEREC-position-paper-input-to-the-commission8217s-wacc-consultation-2018.

²¹ https://BEREC.europa.eu/eng/document_register/subject_matter/BEREC/download/0/9364-BEREC-report-on-wacc-parameter-calculati_0.pdf.

²² https://BEREC.europa.eu/eng/document_register/subject_matter/BEREC/reports/9977-BEREC-report-on-wacc-parameter-calculations-according-to-the-european-commissions-wacc-notice-of-6-november-2019

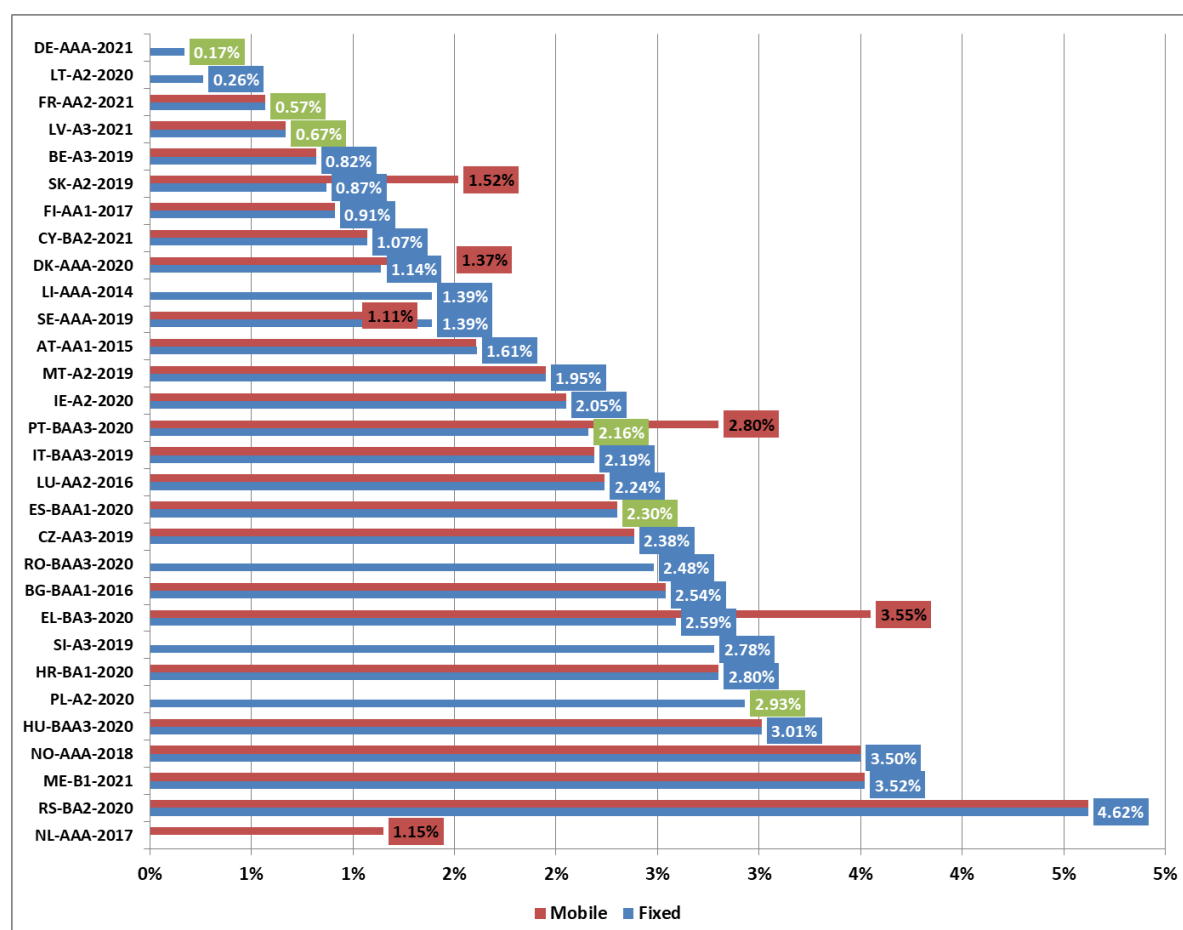
²³ Data includes adjustments that can be attributed to RFR, as declared by NRAs, consistent with the final WACC estimation.

In line with previous years there has been a steady decrease of the RFR, following the international downward trend of interest rate evolution - even if the differences among countries have remained relatively stable. It should be noted that differences are more pronounced when non-EU members are included in the sample.

Considering the 6 NRAs that have fully applied the WACC Notice and corresponding BEREC Report, ES has nevertheless applied a QE adjustment of 1% this year, thus providing a more stable final WACC value estimation in comparison to their previous value, applying the transition period according to point 71 of the WACC Notice.

In Figure 6 the nominal risk free rate is reported for fixed and mobile markets (where available). Five NRAs that have estimated both fixed and mobile WACC have a different value for the RFR while last year there were 8; this is due mainly to different years of estimation²⁴ rather than a different methodology or application of the methodology.

Figure 6 – Nominal Risk Free Rate (fixed and mobile markets)



Source: BEREC RA database 2021

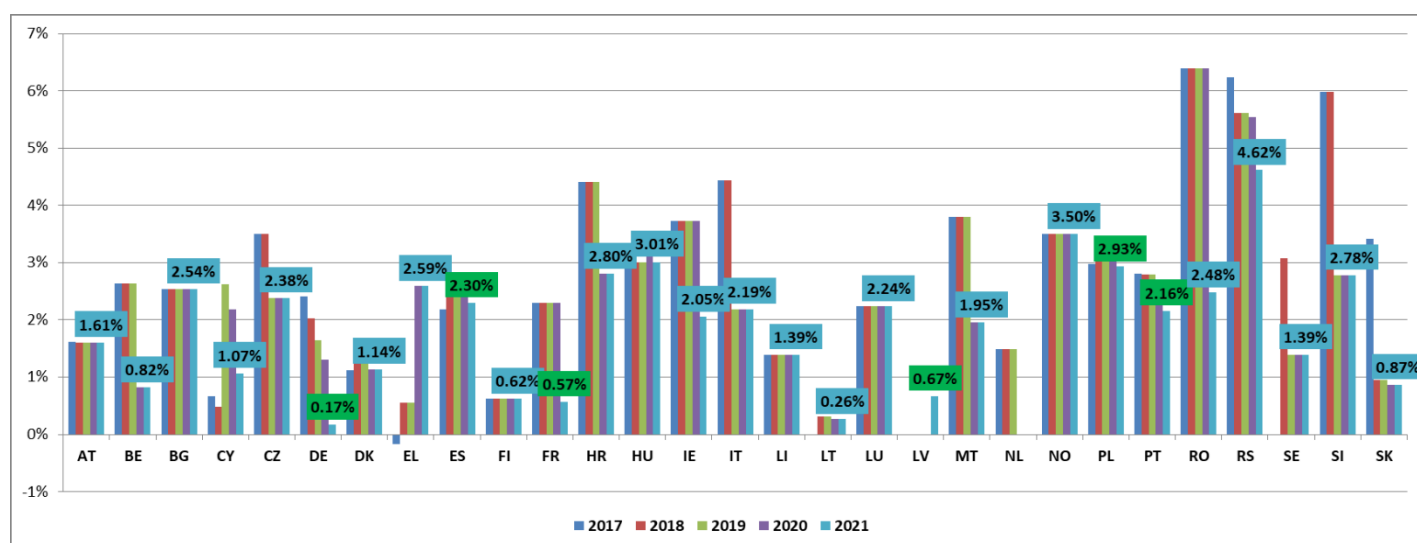
In Figure 7 the evolution of the RFR values for 2017-2021 is reported for the fixed market, taking into account current RFR values according to the data reported in Figure 1.²⁵ Green flags show those NRAs that have fully adopted the Commission notice, blue flags the corresponding current value for

²⁴ On the y-axis the date of the estimation for the fixed market is reported in line with the data provided in the RA EWG database as reported in Figure 1.

²⁵ In Figure 7 missing data for the specific year means that the value is not available in the RA database as it is shown in Figure 1 (notwithstanding to the value applied by NRAs for that year).

the other NRAs. A decrease of the nominal RFR for all 6 countries becomes apparent with a substantial change for DE and FR, moving from an averaging windows of 10 years in previous RFR estimations to 5 year in the RFR estimation according to the WACC Notice.

Figure 7 - Nominal Risk Free Rate (fixed market 2017-2021) value in force



Source: BEREC RA database 2021

The following figures compare the main methodologies/approaches used by NRAs to estimate RFR. The answers have been based on a set of pre-defined alternatives as reported in the figure.

Figure 8 - Main methodology in use to estimate RFR

Main methodology	
Domestic bond	Refers to the use of own country bond
Country-specific bond	Refers to the use of a specific bond from a different country
Other	A mix of methodologies and judgement is used to derive an estimate taking into account a mix of domestic and other country bond
Benchmarking	the RFR is estimated by referenced to RFR values used by other NRAs

Source: BEREC RA database 2021

Figure 9 and Figure 10 show the complete summary of methodologies currently applied by NRAs for estimating the RFR for the fixed and mobile markets. Red flags report the most frequent approach (in green the corresponding methodology applied by the NRAs that fully apply the Commission Notice). Most NRAs have taken into account the main elements of the methodology outlined in the

WACC Notice.²⁶ Moreover NRAs that have changed methodology since last year’s report have now partially adopted the Commission Notice approach moving to domestic and 10 years bonds instead of using a different approach (CY, IE)²⁷.

Figure 9 - Methodology used to estimate RFR (fixed market)

	Do you evaluate the Real Risk Free Rate in order to compute the Nominal Risk free Rate?		Methodology/Country bond	Bond length		Sampling period used		Averaging window		Average methodology		Quantitative Easing		
	Yes											Yes		
Nominal Risk Free Rate	Yes	4	domestic bond	16+6	1 year	1	Daily	8	Spot rate	1	Arithmetic average	16+6	Yes	3
			country specific bond	3	3 years	0	Weekly	3	3 months	1	Geometric Average	0		
			other benchmarking	3	5 years	0	Monthly	6+6	6 months	0	Moving Average	0		
				0	10 years	18+6	Other	2	1 Year	4	Median	1		
					20 years	0			2 Years	0	Other	2		
					Other	2			3 Years	4				
									5 Years	10+6				
								10 Years	1					
								Others	0					

Source: BEREC RA database 2021

Figure 10 - Methodology used to estimate RFR (mobile market)²⁸

	Do you evaluate the Real Risk Free Rate in order to compute the Nominal Risk free Rate?		Methodology/Country bond	Bond length		Sampling period used		Averaging window		Average methodology		Quantitative Easing		
	Yes											Yes		
Nominal Risk Free Rate	Yes	5	domestic bond	16+3	1 year	2	Daily	8	Spot rate	1	Arithmetic average	14+3	Yes	3
			country specific bond	1	3 years	0	Weekly	2	3 months	0	Geometric Average	0		
			other benchmarking	3	5 years	0	Monthly	6+3	6 months	0	Moving Average	0		
				0	10 years	15+3	Other	1	1 Year	2	Median	1		
					20 years	0			2 Years	1	Other	2		
					Other	2			3 Years	4				
									5 Years	7+3				
								10 Years	1					
								Others	1					

Source: BEREC RA database 2021

As in 2020, most NRAs have used a nominal estimation of the RFR without first evaluating a real risk-free rate. A real risk-free rate has been estimated in the fixed market by 5 NRAs (BE, IE, MT, NO, PL).

²⁶ SE and DK have previously fallen into the 5 years averaging-window category although they have used respectively 7 years and 6 years. RS: due to the low liquidity of their own country bonds and low values compared to previous estimations, has decided to use the ECB European bond estimation based on AAA countries, adjusted for country risk premium.

²⁷ Both CY and IE removed adjustments of the RFR evaluation since last year’s report.

²⁸ 2 NRAs (DE, PL) of 6 that fully apply the WACC Notice do not calculate a mobile WACC, 1 NRA (PT) that applies the WACC Notice has a different mobile WACC in charge because the WACC Notice has not been applied due to the fact that the evaluation was prior to the WACC Notice’s entry into force.

A more consistent approach among NRAs in terms of the main methodologies used for estimating the RFR is evident, also for the use of the averaging window. In comparison to previous years, the number of NRAs that use a 5 year averaging windows has increased. RFR estimation can be influenced by country specific issues such as exchange rates and expected inflation.

Combining the approaches in terms of general methodology (geographical scope: domestic or country-specific) and time windows (the more differentiated parameters to estimate the RFR), the following statistics emerge (Figure 11).²⁹

Figure 11 - Main methodology and time windows (frequency, number of NRAs)³⁰

RFR		Geographical scope			Total
		Domestic bond	Country specific	Others	
Time windows	<=1	6	0	0	6
	<=3	0	2	2	4
	>=5	9+6	1	1	17
	Total	21	3	3	27

RFR		Geographical scope			Total
		Domestic bond	Country specific	Others	
Time windows	<=1	BG,CY,FI, LT,MT,SK			6
	<=3		BE,RO	AT,HR	4
	>=5	CZ,DK,HU, IE,IT,LU, NO,SE, SI,DE,ES,F R,LV,PL,PT	LI	RS	17
	Total	21	3	4	27

Source: BEREC RA database 2021

Two main groups (6 NRAs, 7 in 2020) and 15 NRAs (11 in 2020) have used domestic bonds and time windows that are: i) less than 1 year (BG, CY FI, LT, MT, SK) or ii) greater than or equal to 5 years (CZ, DK, HU, IE, IT, LU, NO, SE, SI, DE, ES, FR, LV, PL, PT).

Note that when “country specific” or “Other” is chosen as the main category for RFR, a “country risk premium” is generally included in the cost of equity and time windows are less relevant in this case.

Values currently in force have also been influenced by the time of estimation as shown in the corresponding figure.

In case of a heavy impact of the financial crisis in the past, some countries have stated that they have used German government bonds as a benchmark (CY, EL): these bonds are in fact less affected by fluctuations in short-term interest rates which may influence price control for 3 to 5 years.

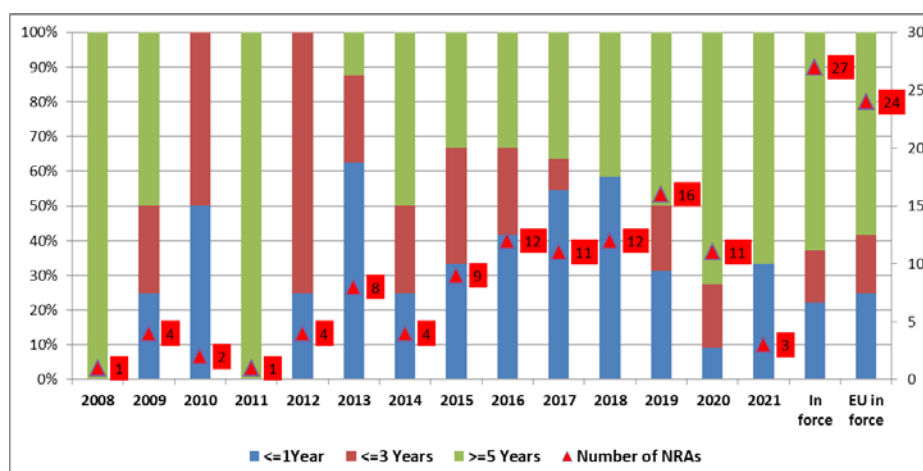
Looking at the distribution of the “time windows” used by NRAs in 2013-2021, when many NRAs have updated WACC, an increase in the number of NRAs that have chosen time windows >=5 especially in the last two years (2019-2020), when the Commission WACC Notice was published, can be seen;

²⁹ NRAs that have a different approach in comparison to previous year's report are shown in red.

³⁰ In the matrix (e. g. Figure 9), the first figure indicates the frequency of the methodological mix, the second mentions NRAs. NRAs listed in red have a different category in comparison to the previous year, in green the NRAs that have fully adopted the WACC Notice.

about 60% of NRAs have used a time windows equal to 5 years for the estimation of the WACC in line with the WACC Notice.

Figure 12 - Distribution of time windows RFR (fixed market)



Source: BEREC RA database 2021

Some countries have applied adjustments to the estimation of the RFR as reported in the following figure. The year of update is also provided.

Figure 13 - Adjustments applied to RFR (fixed market)

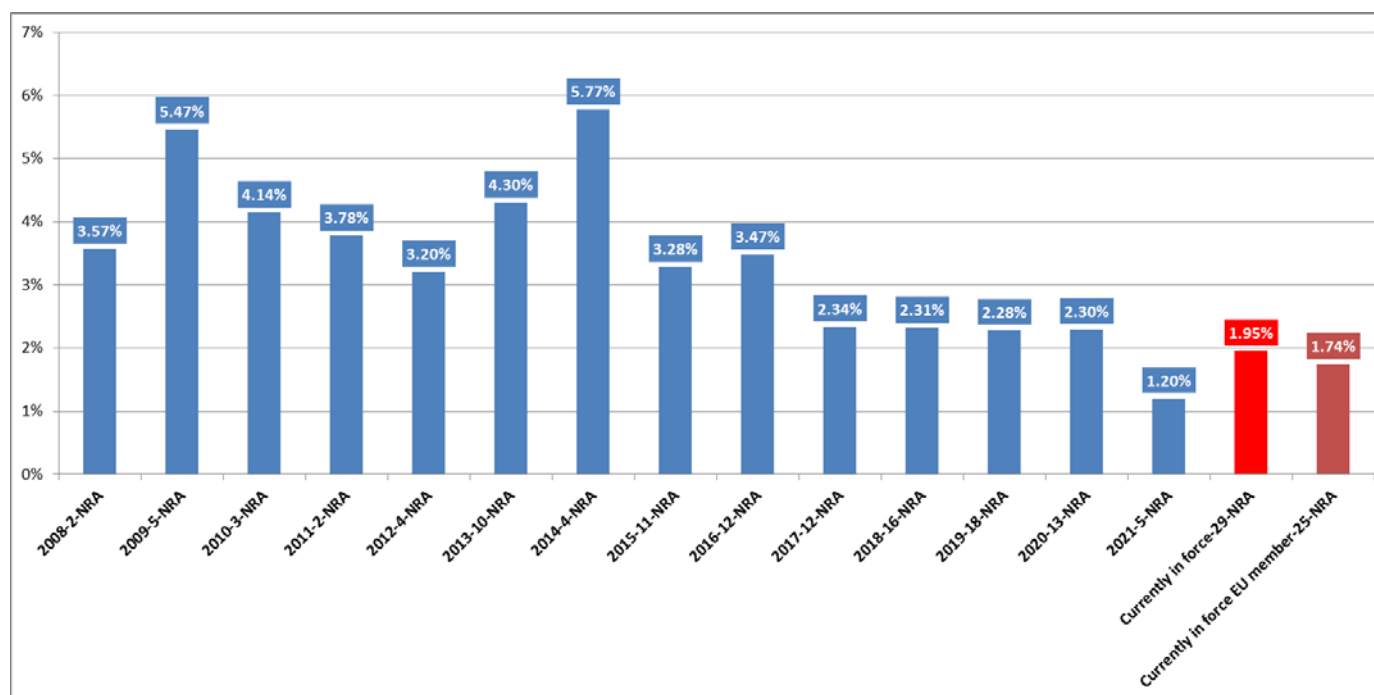
	Nominal RFR	Nominal risk free rate without adjustment	Country risk premium (%)	Size premium value (%)	Consistency with ERP estimation (historical data on ERP on different bond length)	Other adjustment: Size of adjustment (%)	Description of adjustment and how the adjustment was made
DK-2020 (previous report)	1.14% (1.14%) (1.32%) (1.56%)	0.66% (0.66%) (0.84%) (1.10%)			0.4% (0.4%) (0.4%) (0.4%)	0.08% (0.08%) (0.076%) (0.076%)	QE
ES-2020 (previous report)	2.30% (2.48%) (2.54%) (2.18%)	1.30% (1.48%) (1.54%) (1.18%)				1% (1%) (1%) (1%)	QE
RO-2020 (previous report)	2.48% (6.39%)	0.31% (3.19%)	2.17% (3.20%)				Damodaran

Source: BEREC RA database 2021

In Figure 14 the adopted average year-by-year nominal RFR includes only NRAs that have indicated an update for the WACC value in the corresponding year. The average value currently in force is derived by averaging values in line with the information provided in Figure 1.

The RFR has slightly decreased over the years in line with lower yields of domestic bonds, also due to quantitative easing (QE) purchase programs. Looking at QE, two NRAs that have updated their WACC within the last two years have taken this into account (DK, ES).

Figure 14 - RFR evolution over time (fixed market)



Source: BERC RA database 2021

In conclusion:

- NRAs that use domestic bonds as a methodology for estimating the RFR together with a less than one-year averaging window explained their approach by aspiring to achieve consistency with a forward looking approach with respect to the financial situation. In this case, the deviation from the spot rate is a way to overcome short term volatility. The number of NRAs that use a short averaging windows has decreased over time , additionally the WACC Notice motivated NRAs to harmonise their approach. Four NRAs that have previously applied a shorter than 5 year averaging window have moved to a 5 year averaging window since the WACC Notice came into force (ES, IE, PL, PT, HU, RS).

NRAs that use domestic bonds and an averaging window greater or equal to 5 years explained their approach with the pursuing of “regulatory objectives” - thus granting predictability, consistency and transparency - and overcoming the effects of QE.³¹

The main motivation behind the choice of the harmonised EU approach by applying the WACC Notice.

5.2.2 Equity Risk Premium (ERP)

see BoR (17) 169, BoR (18) 167 and BoR (20) 116 for definition and general financial theory

Main output from the survey.

Using the replies to the 2021 survey the following statistics have been derived for all responding NRAs and for EU NRAs separately (2020-2018 values in brackets).

³¹ One NRA (DE) declared that a high fluctuation of the regulatory WACC over time is not in line with the requirements of the German legislation. Therefore the mean of the computed real pre-tax WACC and the previous BNetzA real pre-tax WACC value has been applied.

Figure 15 - ERP values (fixed and mobile markets)

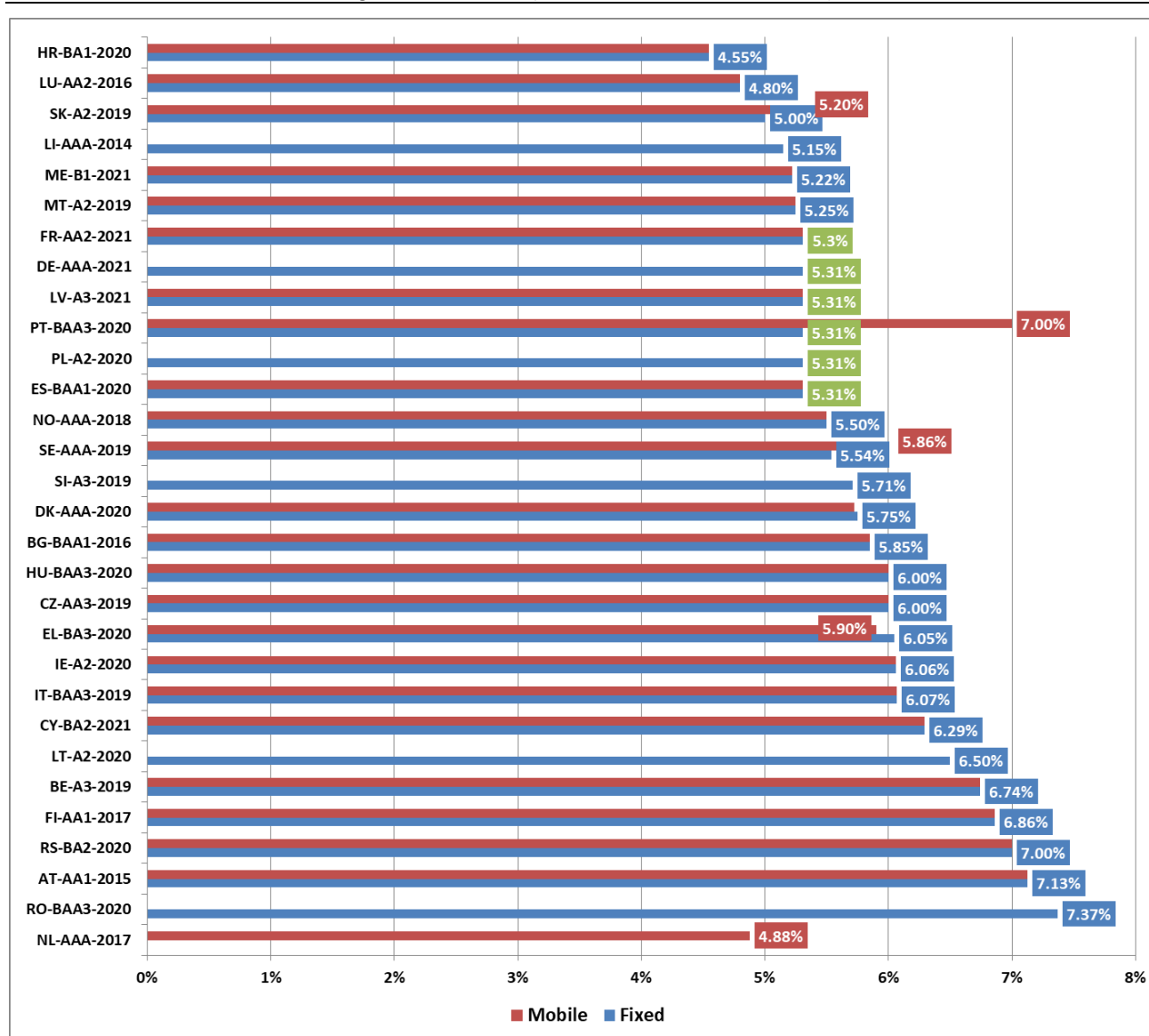
	Average	Median	Standard Deviation	Relative Standard Deviation	Maximum	Minimum
Equity Risk Premium (fixed); 29-NRAs (2020-31) (2019-32)(2018-32)	5.80% (5.76%) (5.93%) (5.90%)	5.71% (5.75%) (5.63%) (5.45%)	0.72% (0.77%) (1.52%) (1.90%)	12.43% (13.29%) (25.57%) (32.14%)	7.37% (7.25%) (13.14%) (14.46%)	4.55% (4.55%) (4.55%) (3.10%)
Equity Risk Premium (mobile): 24 NRAs (2020-25) (2019-26)(2018-26)	5.83% (6%) (5.95%) (5.90%)	5.86% (5.86%) (5.80%) (5.60%)	0.73% (1.28%) (1.40%) (1.69%)	12.57% (21.28%) (23.47%) (28.55%)	7.13% (11.10%) (11.88%) (11.88%)	4.55% (4.55%) (4.55%) (3.10%)
Equity Risk Premium EU (fixed): 25 EU NRAs (2020-24) (2019-26)(2018-26)	5.81% (5.77%) (6.05%) (6.03%)	5.75% (5.85%) (5.79%) (5.60%)	0.72% (0.76%) (1.65%) (2.07%)	12.30% (13.18%) (27.27%) (34.42%)	7.37% (7.14%) (13.14%) (14.46%)	4.55% (4.55%) (4.55%) (3.10%)
Equity Risk Premium EU (mobile): 21 EU NRAs (2020-20) (2019-23)(2018-23)	5.81% (5.75%) (5.96%) (5.93%)	5.86% (5.86%) (5.85%) (5.70%)	0.72% (0.76%) (1.48%) (1.78%)	12.45% (13.24%) (24.77%) (29.99%)	7.13% (7.13%) (11.88%) (11.88%)	4.55% (4.55%) (4.55%) (3.10%)

Source: BEREC RA database 2020

The average and median values for ERP in the fixed market have remained stable and their deviations are decreasing over time. The 6 NRAs that have applied the WACC Notice have used a single EU ERP value as calculated by BEREC in BoR(20)116.

Figure 16 reports ERP ranking with the indication of individual Country Rating (Moody's).

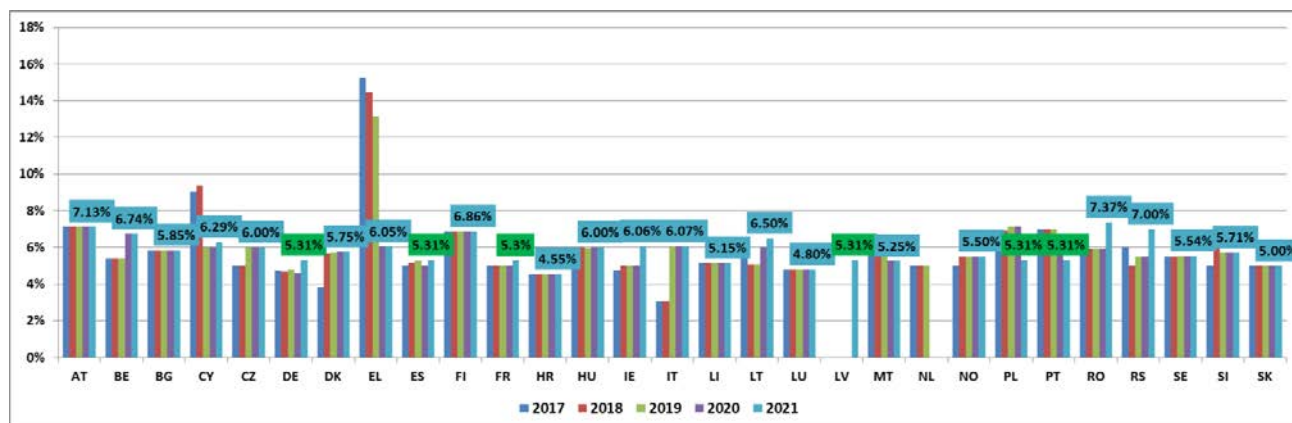
Figure 16 - ERP (fixed and mobile markets)



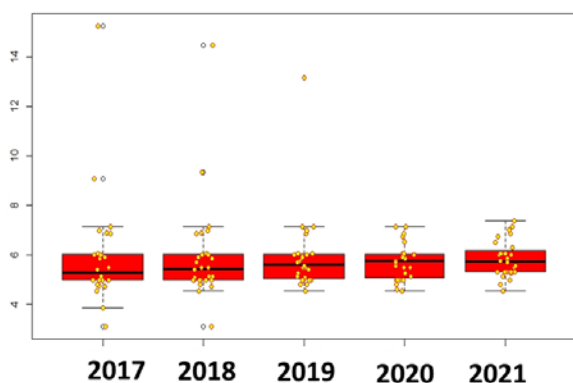
Source: BEREC RA database 2021

Figure 176 shows that when a separate mobile WACC has been estimated, the ERP is equal for fixed and mobile markets; only 5 out of 25 NRAs have provided differing values, mainly due to different times of adoption of the decisions (as in the case of the RFR).

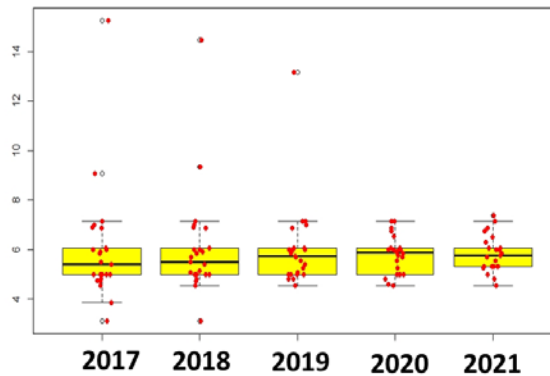
Figure 17 - ERP currently in force (fixed market 2017-2021)



ERP fixed (%)



EU- ERP fixed (%)



Source: BEREC RA database 2021

Figure 17 portrays the evolution of ERP over time (years 2017 to 2021) as well as the dispersion of the distribution of the ERP; it is decreasing in combination with a decreasing number of NRAs that estimate a value which can be considered an outlier.

Figure 18 and Figure 19 compare the main approaches used by NRAs to estimate the ERP for fixed and mobile markets. The answers have been based on a set of pre-defined alternatives. The 6 NRAs that fully apply the WACC Notice are reported separately in green.

Figure 18 – Methodologies for estimating ERP (fixed market)

	Methodology (General)		Specific Methodology		-If historical data Average methodology		-if benchmarking is indicated in the methodology section please indicate the average used from other countries							
	Equity risk premium	Notional value	6+6	Historical data	10+6	Arithmetic average	7+6	Arithmetic average	2					
country specific		6	Dividend grow model		Geometric Average		Geometric Average							
other		7	Historical+DGM		Moving Average		Moving Average							
benchmarking		2	Historical+DGM+Suvey	1	Median		Median							
									Survey	2	Other	3	Other	
									Historical+Survey	4	Arithmetic and Geometric	2		

Source: BEREC RA database 2020

Figure 19 - Methodologies for estimating ERP (mobile market)

	Methodology (General)		Specific Methodology		-If historical data Average methodology		-if benchmarking is indicated in the methodology section please indicate the average used from other countries							
	Equity risk premium	Notional value	5+3	Historical data	8+3	Arithmetic average	5+3	Arithmetic average						
country specific		6	Dividend grow model	1	Geometric Average	0	Geometric Average							
other		7	Historical+DGM	1	Moving Average	0	Moving Average							
benchmarking		2	Historical+DGM+Suvey	2	Median	1	Median							
									Survey	1	Other	2	Other	
									Historical+Survey	4	Arithmetic and Geometric	2		

Source: BEREC RA database 2021

In terms of the geographical scope of the methodology, differently from the previous situation reported in past RA reports, a clear preference emerges with a notional European ERP thanks to the adoption of the WACC Notice, with 50% of NRAs adopting a notional approach (while in 2020 roughly one third of NRAs adopted a notional approach). As in the last year, two NRAs have adopted a benchmarking approach based on values from other NRAs (BG, MT). Considering the methodology applied, historical data alone is the most frequently used methodology (it was prevalent even before the adoption of the WACC Notice).

According to some NRAs, a notional approach is generally preferred due to unreliable/missing own country-specific data and also because this approach may provide more reliable results.

In terms of the weight given to historical data, the ERP estimation by NRAs generally derives from a combination of data and judgement. Even in cases when NRAs use a clear cut methodology for ERP

estimation, this is generally compared with other sources of evidence as a safeguard/sanity check (even if these further sources are not directly used for the estimation of the final value).

The largest group of NRAs has used historical data alone (16); the second largest group has used historical data together with a survey and/or a DGM-Survey approach (7 NRAs); 2 NRAs have estimated ERP only through surveys.

In Figure 20 the main indicators on the “geographical scope” (notional vs. country specific) and the kind of information used in terms of weight given to the past are compared.³² The situation is largely unchanged in comparison to last year, only one NRA has changed methodology.

NRAs that have used only historical data generally have taken into account long-time series.³³ When a mixed approach has been chosen for the geographical scope (“other”), the estimation generally has taken into account many sources, also from different European countries.

Figure 20 - Methodologies used to determine ERP (fixed)³⁴

	Historical data	Historical data + (DGM/Survey)	Survey	Total
Notional	4+6	1	0	11
Country specific	4	0	2	6
Other	2	4	0	6
Total	16	5	2	23

	Historical data	Historical data + (DGM/Survey)	Survey	Total
Notional	CZ,HR,RS, SI,DE,ES,FR, LV,PL,PT	SE		11
Country specific	AT,IE,IT,LI		FI,RO	6
Other	NO,SK	BE,DK,HU, LU	0	6
Total	16	5	2	23

Source: BEREC RA database 2021

A clear preference for notional with historical data can be seen through the adoption of the WACC Notice. Relatively weak correlations, in terms of the main motivations behind NRAs methodological choices in defining ERP, may be observed from the data collected³⁵.

³² Note that not all NRAs have provided specific information on each methodological category.

³³ More than 100 years, taking as source DMS time series, Damoradan, Duff & Phelps, Pickett, as well as national bank sources. In some cases more than one source is used.

³⁴ Countries that have changed methodology in comparison to last year's report are shown in red. In green the 6 NRAs that have fully applied the Commission Notice. The first indicates the frequency of the methodological mix the second mentions NRAs.

³⁵ Main motivations behind NRAs methodological choices in defining ERP set in the questionnaire were: i) Regulatory predictability; ii) Consistency with RFR estimation and overall Total Market Return (TMR); iii) Reflect country specific conditions; iv) Consistency with market index used to estimate beta; v) Availability of evidence; vi) Other regulatory decisions.

Predictability and transparency objectives are the main motivations behind a stronger emphasis on historical data. According to some NRAs, a notional approach is generally preferred in case of unreliable/missing own country-specific data. When a notional approach has been used in combination with historical data and other methodologies (DGM/Survey) this is generally motivated by the desire to combine predictability with a forward-looking perspective in the ERP estimation. The use of a pure forward-looking approach to estimate ERP is generally motivated by trying to include more country specificity in terms of macroeconomic conditions.

Figure 21 reports and compares the motivations behind the choice of parameters that contribute to the cost of equity (ERP and RFR) for the last two years.

Figure 21- Methodologies used to determine ERP and RFR (fixed markets)³⁶

		ERP			
		Notional value	country specific	other	benchmarking
RFR	domestic bond	4+6	3	6	2
	country specific bond	0	2	1	0
	other	2	1	0	0

		ERP			
		Notional value	country specific	other	benchmarking
RFR	domestic bond	CZ,LT,SE,SI, DE,ES,FR,LV ,PL,PT	IE,IT	DK,EL,HU,L U,NO,SK	BG,MT
	country specific bond		LI,RO	BE	
	other	HR,RS	AT		

Source: BEREC RA database 2021

The comparison shows that 2 NRAs that have used their own country specific ERP have also estimated RFR with domestic bonds, providing the same geographical scope for the equity component RFR and ERP (they were 7 last year), while 10 NRAs have used domestic bonds and a notional approach for the ERP.

Another relevant point is the relation between the “averaging windows” considered for estimating the RFR and the “data source” (historical vs forward-looking approach) for ERP estimation (Figure 22). This may be relevant in order to understand if a clear picture emerges showing the preference of NRAs for a forward-looking approach on RFR estimation (i. e. shorter time windows) rather than on ERP.

³⁶ Countries that have changed methodology in comparison to last year’s report are shown in red. In green the 6 NRAs that have fully applied the Commission Notice. The first indicates the frequency of the methodological mix the second mentions NRAs.

Figure 22 - Time windows used for ERP/RFR (fixed market)

		ERP			
		Historical data	Historical data + other	Survey	Total
RFR	<= 1 year	1	0	1	2
	<= 3 year	2	1	1	4
	>= 5 years	7+6	4	0	17
Total		16	5	2	23

		ERP		
		Historical data	Historical data + other	Survey
RFR	<= 1 year	SK		FI
	<= 3 year	AT,HR	BE	RO
	>= 5 years	CZ,IE,IT,LI, NO,RS,SI, DE,ES,FR, LV,PL,PT	DK,HU,LU ,SE	

Source: BEREC RA database 2021

Figure 22 shows that the most frequent approach (increasing) is to estimate the RFR on the basis of a 5 year averaging window and the ERP using historical time series. Deviations from pure historical time series are mainly due to the choice of adding more data sources (“sanity check”) in order to estimate the parameter.

Another element analysed in the questionnaire is the type of averaging method used when historical data are used. Most NRAs use an arithmetic average (13 NRAs for the fixed market).

5.2.3 Beta

see BoR (17) 169, BoR (18) 167 and BoR (20) 116 for definition and general financial theory

Main results of the survey

Using the replies provided for the 2021 survey the following statistics have been derived for all responding NRAs and for EU NRAs separately (2020, 2019 and 2018 values in brackets).³⁷

³⁷ Asset betas/Equity betas are calculated with reference to different market indexes, thus comparison should be considered in the light of this fact.

Figure 23 - Equity and Asset Beta values (fixed and mobile markets)

2021 Data		Average	Median	Standard Deviation	Relative Standard Deviation	Maximum	Minimum
Fixed Market	Equity beta – 29 NRAs (2020-31) (2019-32) (2018-32)	0.79 (0.83) (0.84) (0.83)	0.79 (0.83) (0.85) (0.82)	0.14 (0.13) (0.13) (0.14)	17.13% (15.36%) (15.51%) (15.53%)	1.09 (1.11) (1.11) (1.11)	0.45 (0.5) (0.5) (0.5)
	Asset beta - 16 NRAs (2020-18) (2019-18) (2018-18)	0.53 (0.55) (0.54) (0.53)	0.53 (0.54) (0.55) (0.54)	0.08 (0.06) (0.04) (0.06)	14.73% (11.18%) (7.55%) (12.06%)	0.71 (0.71) (0.62) (0.64)	0.43 (0.46) (0.43) (0.43)
	Beta debt - 5 NRAs (2020-4) (2019-3) (2018-3)	0.11 (0.11) (0.14) (0.14)	0.1 (0.1) (0.1) (0.1)	0.02 (0.02) (0.07) (0.07)	15.31% (18.18%) (49.49%) (49.49%)	0.14 (0.14) (0.22) (0.22)	0.10 (0.1) (0.1) (0.1)
Mobile market	Equity beta - 24 NRAs (2020-25) (2019-26) (2018-26)	0.81 (0.85) (0.84) (0.86)	0.82 (0.85) (0.82) (0.82)	0.14 (0.11) (0.11) (0.13)	17.13% (13.33%) (13.24%) (15.33%)	1.09 (1.05) (1.05) (1.21)	0.45 (0.60) (0.62) (0.62)
	Asset beta - 15 NRAs (2020-15) (2019-14) (2018-14)	0.56 (0.59) (0.57) (0.58)	0.53 (0.60) (0.60) (0.61)	0.08 (0.09) (0.1) (0.09)	14.73% (15.61%) (16.98%) (15.82%)	0.71 (0.81) (0.69) (0.69)	0.43 (0.47) (0.33) (0.33)
	Beta debt – 4 NRAs (2020-4) (2019-3) (2018-3)	0.13 (0.14) (0.16) (0.16)	0.13 (0.12) (0.15) (0.15)	0.04 (0.05) (0.06) (0.06)	34.40% (34.82%) (38.47%) (38.47%)	0.2 (0.2) (0.22) (0.22)	0.1 (0.1) (0.1) (0.1)
Fixed Market EU NRAs	Equity beta -25 NRAs (2020-24) (2019-26) (2018-26)	0.81 (0.85) (0.85) (0.84)	0.79 (0.85) (0.86) (0.84)	0.13 (0.14) (0.14) (0.13)	16.16% (16.18%) (16.04%) (16.02%)	1.09 (1.11) (1.11) (1.11)	0.45 (0.50) (0.50) (0.50)
	Asset beta – 12 NRAs (2020-12) (2019-14) (2018-14)	0.54 (0.56) (0.55) (0.54)	0.53 (0.55) (0.55) (0.55)	0.08 (0.07) (0.06) (0.07)	14.73% (12.78%) (10.28%) (13.40%)	0.71 (0.71) (0.64) (0.64)	0.43 (0.46) (0.45) (0.43)
	Beta debt -4 NRAs (2020-1) (2019-2) (2018-2)	0.11 (0.14) (0.16) (0.16)	0.10 (0.14) (0.16) (0.16)	0.02 (0) (0.08) (0.08)	18.18% (0) (53.03%) (53.03%)	0.14 (0.14) (0.22) (0.22)	0.1 (0.14) (0.1) (0.1)
Mobile Market EU NRAs	Equity beta - 21 NRAs (2020-20) (2019-23) (2018-23)	0.82 (0.85) (0.85) (0.87)	0.83 (0.86) (0.82) (0.82)	0.13 (0.11) (0.11) (0.13)	16.27% (12.87%) (13.32%) (15.51%)	1.02 (1.02) (1.05) (1.21)	0.45 (0.60) (0.62) (0.62)
	Asset beta - 13 NRAs (2020-12) (2019-13) (2018-13)	0.57 (0.58) (0.57) (0.58)	0.53 (0.57) (0.60) (0.61)	0.1 (0.1) (0.10) (0.09)	17.45% (16.96%) (17.37%) (15.82%)	0.81 (0.81) (0.69) (0.69)	0.48 (0.47) (0.33) (0.33)
	Beta debt – 2 NRAs (2020-1) (2019-2) (2018-2)	0.15 (0.2) (0.16) (0.16)	0.15 (0.2) (0.16) (0.16)	0.07 (0) (0.08) (0.08)	47.14% (0) (53.03%) (53.03%)	0.2 (0.2) (0.22) (0.22)	0.1 (0.2) (0.10) (0.10)

Source: BEREC RA database 2021

Average values for 2021 are slightly decreasing. Considering fixed and mobile markets, no major differences can be detected. In relation to the 6 NRAs that have applied the WACC Notice, the following is seen: i) 5 out of 6 NRAs (FR, ES, PL, PT, LV) have used the arithmetic average of the corresponding values of the peer group of companies in BoR (20) 116; ii) DE has considered to evaluate the equity beta from a weighted average over capitalization (own estimation) of the corresponding beta equity of the peer group. Only 3 out of 6 NRAs (FR, ES, LV) have estimated the equity beta from the arithmetic average of the unlevered beta of the peer group in line with point 48-50 of

the WACC Notice.³⁸ In this latter case the arithmetic average of the equity beta has been derived from the following formula using the arithmetic average of the asset beta of the peers reported in BoR(20)116 equal to 0.53, the corresponding average gearing equal to 37% and a beta debt equal to 0.1 finding an equity beta equal to 0.78.

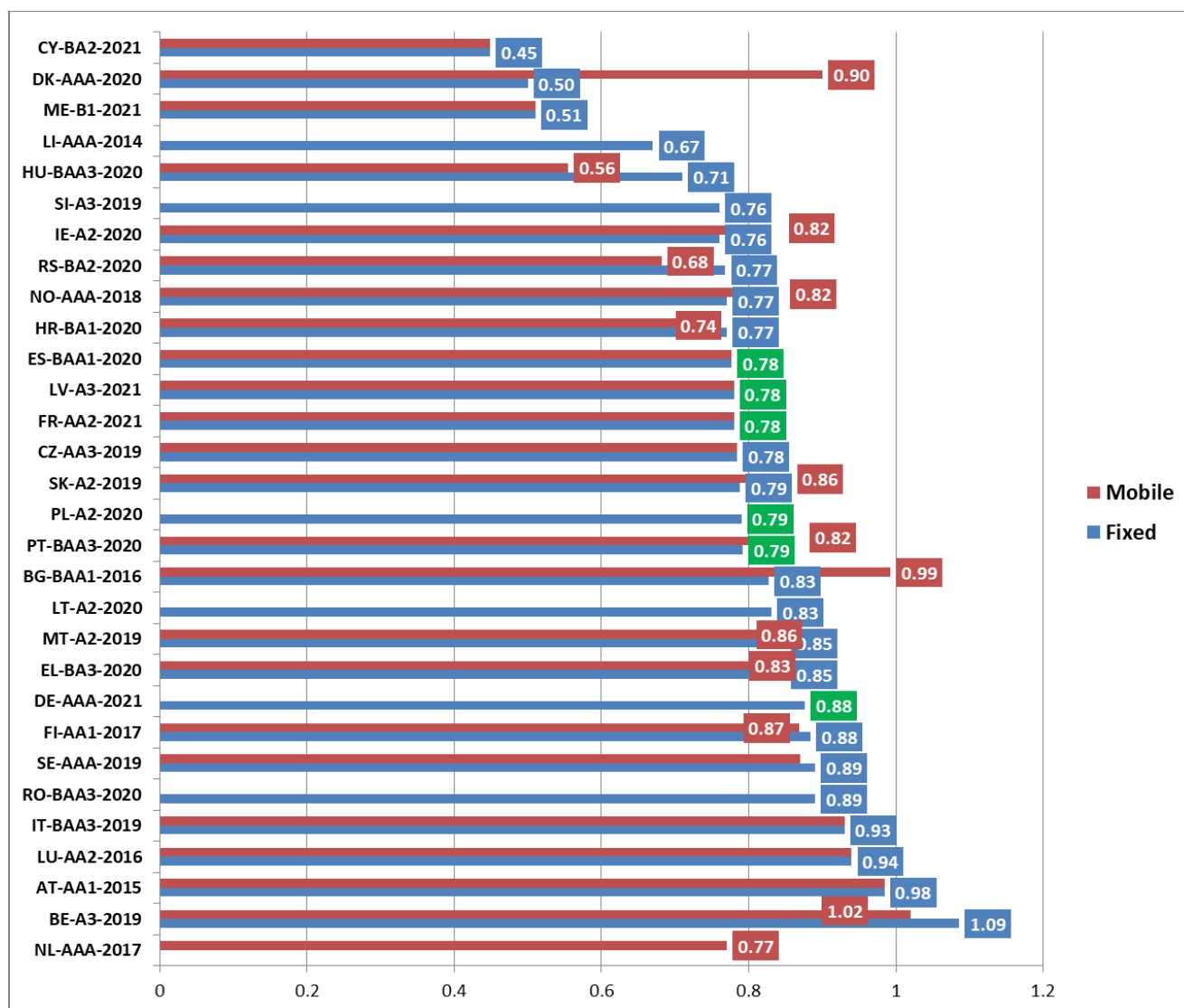
$$\beta_E = (\beta_A - \beta_D * g) * \frac{1}{1 - g}$$

Two NRAs (PT, PL) have instead evaluated the equity beta using the arithmetic average of the equity beta of the peers reported in BoR(20)116 finding 0.79 as equity beta directly. The six NRAs that applied the notice did not modify the peer group of companies considered in BoR(20)116.

Figure 24 reports Equity Beta values estimated by each NRA ranging from lower to higher values.

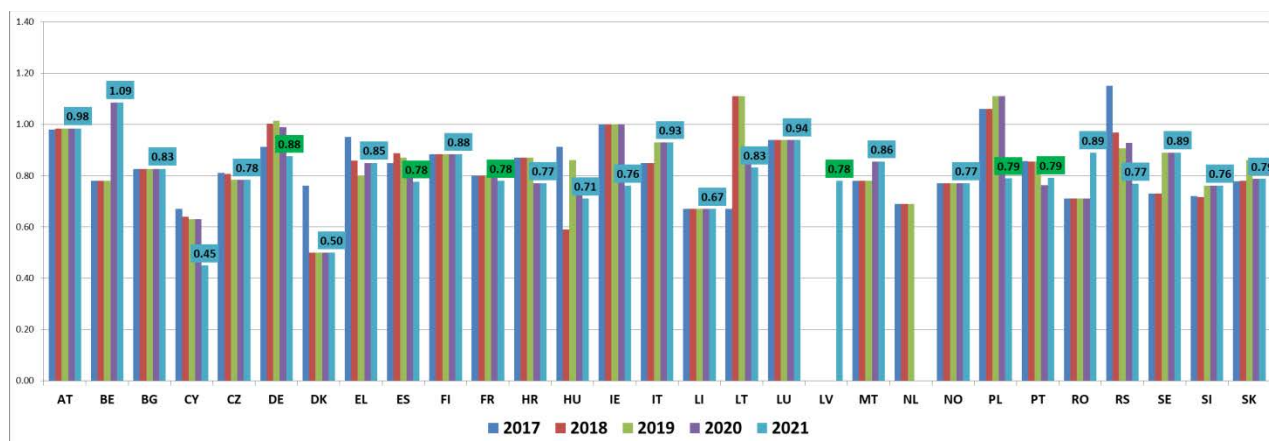
³⁸ Dealing with the asset beta (operating beta) of a peer group provides the best estimation of the corresponding systematic risk of an hypothetically efficient operator in the industry represented by the peers. Considering the arithmetic average of the beta equity of a peer group directly can slightly polarise the estimation of the systematic risk due to the fact that the levered beta of each company also includes the risk related to the level of gearing of the specific company, which is not related to the risk of the operating business.

Figure 24 – Equity Beta values and distribution (fixed and mobile markets)



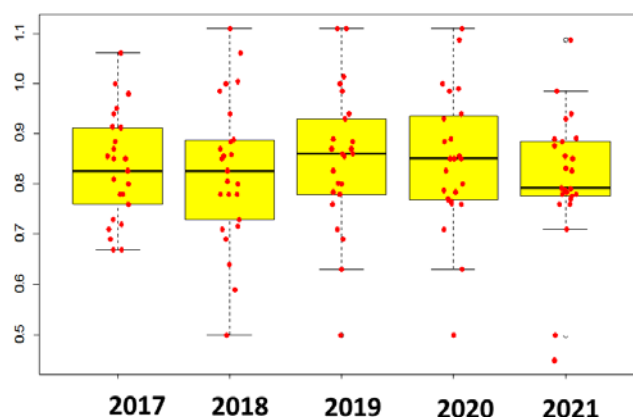
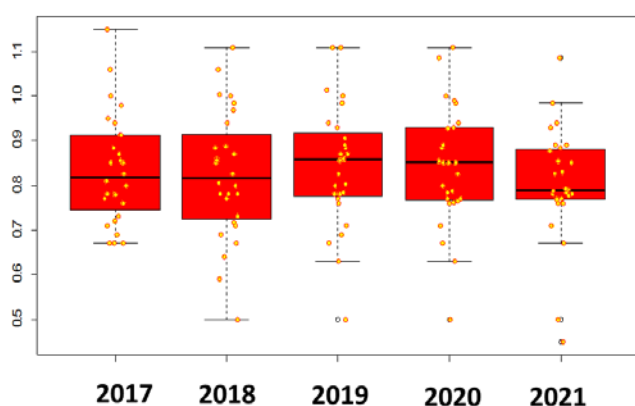
Source: BEREC RA database 2021

Figure 25 – Equity Beta values in fixed markets (2017-2021)



Equity beta fixed

Equity beta fixed EU



Source: BEREC RA database 2021

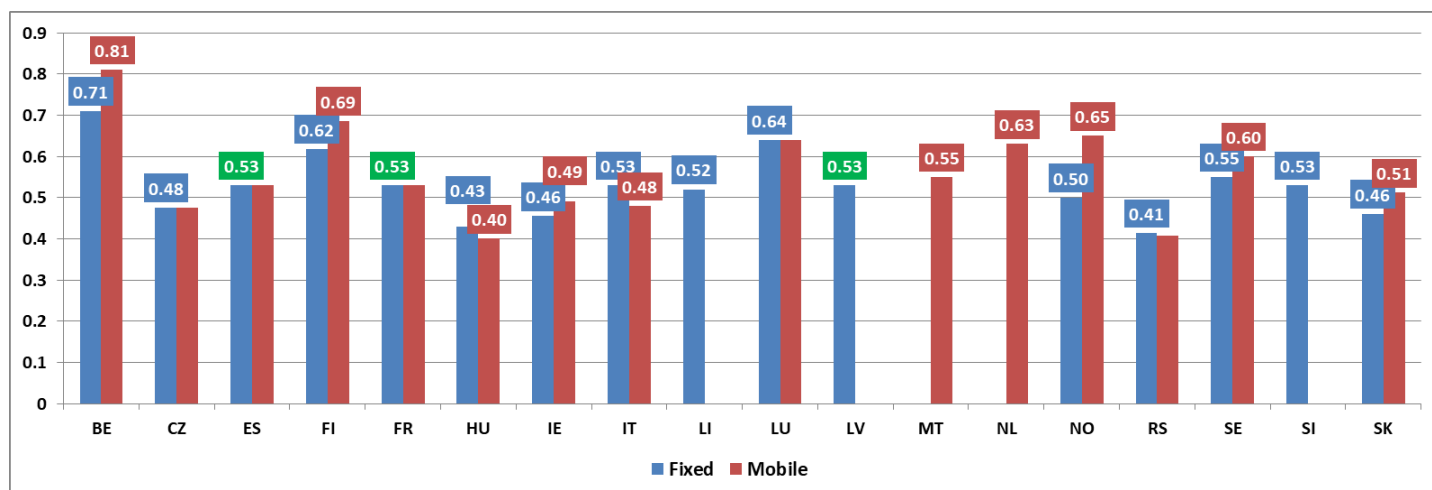
Among the 24 NRAs that have evaluated a separate WACC for the mobile market, 10 (7 in 2020) NRAs have estimated the same beta for the fixed and mobile market; 6 (10 in 2020) NRAs have estimated a higher mobile beta (on average + 0.127 (+0.027)(+0.11)(+0.15))³⁹; 7 NRAs estimated a lower mobile beta (on average - 0.05 (-0.12)(-0.072) (-0.14)).⁴⁰ In comparison to the previous year differences between fixed and mobile estimation have decreased in line with empirical evidence that the risk parameters of fixed and mobile operators are not differing since most telecommunication operators are generally integrated in fixed and mobile markets.⁴¹

³⁹ "+" or "-" is referred to with respect to fixed beta.

⁴⁰ Information collected in 2020, 2019 and 2018 reported in brackets.

⁴¹ S. Stephan and N. Wernet (2017) "The beta in the WACC for regulated fixed and mobile telecommunications services: its role and robust estimation" Passau, Germany, International Telecommunications Society.

Figure 26 - Asset Beta (fixed and mobile markets)



Source: BEREC RA database 2021

The following figures summarises the different approaches used by NRAs to estimate the beta (mobile and fixed markets); in green the 6 NRA that fully apply the WACC Notice.

Figure 27 – Methodologies for estimating Beta (fixed market)

	Methodology	-if notional/others (if applicable) please indicate the average used (average to get the asset/equity beta from the comparable)		Sampling period		Time window		Adjustment Used		Market reference index used		Do you unlever your beta?		- if yes which formula do you apply?		-if benchmarking is indicated in the methodology section please indicate the average used from other countries		
Beta (equity)	notional (generic operator)	15+6	Arithmetic	5+5	daily	3	1 week	Dimson	1	Own Country	0	yes	14+3	Modigliani-Miller	10+3	Arithmetic average	1	
	SMP Operator	3	Weighted Average	1	weekly	8+6	1 month	Bayesian	2	European	13+6	no	4+3	Miles & Ezzell		Weighted Average	1	
	Other benchmarking	1	Median	0	monthly	3	3 month	Blume	3	Word	3			Hamada	2	Median	1	
		3	Other	0	other	2	6 months	Vasicek						Other	2	Other	0	
							12 months	others	3									
							2 years	No Adjustment	7+6									
						3 years		4										
						5 years		10+6										
						10 years												
						others												

Source: BEREC RA database 2021

Figure 28 - Methodologies for estimating Beta (mobile market)

	Methodology	-if notional/others (if applicable) please indicate the average used (average to get the asset/equity beta from the comparable)		Sampling period		Time window		Adjustment Used		Market reference index used		Do you unlever your beta?		- if yes which formula do you apply?		-if benchmarking is indicated in the methodology section please indicate the average used from other countries		
Beta (equity)	notional (generic operator)	18+3	Arithmetic average	6+3	daily	6	1 week	0	Dimson	1	Own Country	2	yes	16+3	Modigliani-Miller	11+3	Arithmetic average	0
	SMP Operator	0	Weighted Average	0	weekly	8+3	1 month	0	Bayesian	3	European	12+3	no	3	Miles & Ezzell	0	Geometric Average	0
	Other	3	Median	5	monthly	2	3 month	0	Blume	3	World	1			Hamada	1	Moving Average	0
	benchmarking	1	Other	2	other	1	6 months	0	Vasicek	0					Other	4	Median	0
							12 months	1	others	1							Other	0
							2 years	2	No Adjustment	7+3								
							3 years	7										
						5 years	6+3											
						10 years	0											
						others	1											

Source: BEREC RA database 2021

The most frequent methodology used by NRAs to estimate a notional beta is based on a peer group of Telecom comparators (23 NRAs for the fixed market).

Figure 29 - Main Beta estimation methodologies and values (fixed and mobile markets 2021)⁴²

	Fixed Market			Mobile Market		
	Equity beta	Asset Beta	Countries	Equity beta	Asset Beta	Countries
SMP Operator	0.81 (0.81) (0.83) (0.84)	0.54 (0.54) (0.53) (0.50)	BG,LT,SI	- (0.74) (0.68)	- (0.55) (0.46)	
notional (generic operator)	0.80 (0.84) (0.85) (0.82)	0.56 (0.55) (0.55) (0.54)	AT,BE,CY,CZ,DK,DE,ES,FI,FR,HR,HU,IE,IT,LU,LV,MT,PL,PT,RS,SE,SK	0.81 (0.84) (0.82) (0.82)	0.59 (0.60) (0.50) (0.65)	AT,BE,BG,CY,CZ,DK,ES,FI,FR,HR,HU,IE,LU,MT,NL,PT,RS,SE,SK
Other	0.75 (0.87) (0.88) (0.83)	0.50 (0.61) (0.53) (0.51)	NO	0.88 (0.93) (0.93) (0.98)	0.57 (0.57) (0.59) (0.61)	IT,NO
benchmarking	0.78 (0.76) (0.73) (0.73)	0.52 (0.51) (0.51)	EL,LI,RO	0.83 (0.83) (0.78)	- (0.50)	EL

Source: BEREC RA database 2021

Where a notional approach has been chosen, the number of comparable operators varies between 7 and 20, mainly European. Some NRAs have chosen the peer group in line with their main business: fixed, mobile or broadcasting.

One NRA has applied a regression directly to the equity beta of each peer group member, considering as weight the percentage of revenues in each sector (fixed and mobile and other revenues) (DK), in order to differentiate the Beta for fixed and mobile.

Another NRA (LU) has proved that no difference between fixed and mobile beta can be found by applying a regression on asset beta finding no statistical significance between the estimated beta and the weights of revenues failing the corresponding beta decomposition.⁴³ One NRA (RS) has applied the peer group reported in the BEREC WACC parameters Report BoR (20) 116.

The way the average beta is estimated from the peer group may differ according to the different kind of averaging methods chosen. The median is more frequent in case of a higher number of comparative values.

⁴² Countries that have changed methodology in comparison to last year's report are shown in red. In green the 6 NRAs that fully applied the Commission Notice. The first indicates the frequency of the methodological mix the second mention NRAs. In case of mobile in red are highlighted NRAs that have different approach with respect to fixed.

⁴³ <https://assets.ilr.lu/telecom/Documents/ILRLU-1461723625-156.pdf>

Figure 30 - Beta notional methodology (fixed market)⁴⁴

Countries	Methodology	Number of peers	Average used
BE	notional (generic operator)	SMP + 8 EU peers	Other
CH	notional (generic operator)	12 historical telco companies (CH+EU)	Median
CZ	notional (generic operator)	19 telecom companies, criteria for selection: the shares of the firms are liquidly traded, the firms are active in telecom industry in European countries, market capitalization more that 1 billion EUR, and no acquisitions or mergers.	Median
DK	notional (generic operator)	14 operators. The beta for every operator is then regressed with the opeartors share of mobil/fixed/other revenue to calculate the beta if the operator were 100 % mobile or 100 % fixed.	Arithmetic average
FI	notional (generic operator)	15 telecom companies	Median
HR	notional (generic operator)	17 companies for peer group with head quateers in EU	
HU	notional (generic operator)	19, European operators listed on the stock exchanges	Median
IE	notional (generic operator)	12, European operator	Other
IT	notional (generic operator)	10 Europen SMP operators	Arithmetic average
LU	notional (generic operator)	13 selected peers (integrated companies)	Arithmetic average
SE	notional (generic operator)	12 European operators (integrated)	Arithmetic average
SK	notional (generic operator)	10, European telecom operators listed on the stock exchange	Median

Source: BEREC RA database 2021

Figure 31 shows that if a different beta is evaluated for fixed and mobile markets in case a notional approach is applied, the number and the kind of comparative values chosen mostly reflect a specific mobile target. In other cases the difference in beta values is due just to different timing of the estimation.

Figure 31 - Beta Fixed and mobile notional methodology⁴⁵

Country	Methodolgy fixed	Number of peers	Kind of average	Methodolgy mobile	Number of peers	Kind of average
AT	notional (generic operator)			notional (generic operator)		
BE	notional (generic operator)	9 peers	Other	notional (generic operator)	6 peers	Other
BG	SMP Operator			notional (generic operator)		
CY	notional (generic operator)	21 peers		notional (generic operator)	21 peers	
CZ	notional (generic operator)	19 peers	Median	notional (generic operator)	19 peers	Median
DK	notional (generic operator)	14 peers	Arithmetic average	notional (generic operator)	14 peers	Arithmetic average
FI	notional (generic operator)	15 peers	Median	notional (generic operator)	6 peers	Median
HR	notional (generic operator)	17 peers		notional (generic operator)		
HU	notional (generic operator)	19 peers	Median	notional (generic operator)	9 peers	
IE	notional (generic operator)	12 peers	Other	notional (generic operator)	12 peers	Other
IT	notional (generic operator)	10 peers	Arithmetic average	Other	4 peers	Arithmetic average
LU	notional (generic operator)	13 peers	Arithmetic average	notional (generic operator)	13 peers	Arithmetic average
MT	notional (generic operator)		Median	notional (generic operator)		Median
NL				notional (generic operator)	6 peers	Arithmetic average
PT				notional (generic operator)	5 peers	Arithmetic average
RS	notional (generic operator)			notional (generic operator)	10 peers	
SE	notional (generic operator)	12 peers	Arithmetic average	notional (generic operator)		Arithmetic average
SK	notional (generic operator)	10 peers	Median	notional (generic operator)	10 peers	Median

Source: BEREC RA database 2021

⁴⁴ NRAs that have provided information on all elements are shown. The 6 NRAs that fully apply the WACC Notice are not reported separately due to the fact that no modifications have been made to the peer group included in BoR(20)116.

⁴⁵ NRAs that have provided information on all elements are shown. The 6 NRAs that fully apply the WACC Notice are not reported separately due to the fact that no modifications have been made to the peer group included in BoR(20)116.

Concerning the sampling period, daily and weekly sampling are the most frequent approaches used. In general, the choice of the sampling period does not seem to be correlated with the time window approach used as reported in Figure 32 (2019 and 2020 figures in brackets). The application of the WACC Notice serves to reduce methodological differences between NRAs approach on estimating the corresponding parameters.

Figure 32 - Beta methodology for sampling period and time windows (fixed)⁴⁶

		Fixed				
		Time windows				
		<=2 Years	<=3 Years	>=5 Years	Others	Total
Sampling period	daily	1(2)(1)	1(2)(4)	2(2)(2)	0(0)(0)	4(6)(7)
	weekly	0(0)(1)	2(3)(2)	5+6(5)(5)	0(0)(0)	13(8)(8)
	monthly	0(0)(0)	0(0)(0)	3(5)(5)	0(0)(0)	3(5)(5)
	Others	0(0)(0)	1(1)(1)	0(0)(0)	0(0)(0)	1(1)(1)
	Total	1(2)(2)	4(6)(7)	16(12)(12)	0(0)(0)	21(20)(21)

	Fixed market		
	Methodology	Sampling period	Time windows
BE	notional (generic operator)	daily	2 years
CZ	notional (generic operator)	weekly	5 years
DK	notional (generic operator)	daily	3 years
FI	notional (generic operator)	weekly	3 years
HR	notional (generic operator)	other	3 years
HU	notional (generic operator)	weekly	5 years
IE	notional (generic operator)	weekly	5 years
IT	notional (generic operator)	weekly	5 years
LT	SMP Operator	monthly	5 years
LU	notional (generic operator)	daily	3 years
RS	notional (generic operator)	monthly	3 years
SE	notional (generic operator)	weekly	5 years
SK	notional (generic operator)	monthly	5 years

Source: BEREC RA database 2021

With reference to the averaging windows chosen for the estimation of the beta, the approach among NRAs is more variable with three main clusters (two, three and five years). The number of NRAs that use an averaging windows smaller than 5 years is decreasing over time.

The motivation behind these choices is related (i) to the importance given to a theoretical approach for providing a reliable estimation of the beta, (ii) to the need to be consistent with the estimation of other parameters such as the RFR, (iii) to the availability of data from referenced sources such as

⁴⁶ NRAs that provided information on all elements are shown. The 6 NRAs that fully apply the WACC Notice are not reported separately.

Bloomberg and (iv) a shorter time period is more relevant for the purpose of forming a forward-looking beta.

The averaging windows used for estimating RFR and Beta are the same in 12 cases out of 21 for the fixed market where information is available for all indicators (Figure 33). In comparison to last year's report the tendency is to have a longer averaging window both for the RFR and Beta estimation. Also in this case the adoption of the WACC Notice methodology lead to an increased harmonisation of the approach adopted by NRAs.

Figure 33 - Beta/RFR time windows (fixed)⁴⁷

Fixed Market

		Beta (Time windows)			
		<=2 Years	<=3 Years	>=5 Years	Total
RFR (time windows)	<=1 Year	0 (1) (2)	1 (2) (2)	2 (3) (4)	3(6) (8)
	<=3 Years	1 (2) (1)	1 (2) (3)	0 (1) (1)	2 (5) (5)
	>=5 Years	0 (0) (0)	2 (2) (2)	8+6(8) (7)	16 (10) (8)
	Total	1 (3) (3)	4 (6) (7)	16 (12) (12)	21 (21) (22)

		Beta (Time windows)			
		<=2 Years	<=3 Years	>=5 Years	Total
RFR (time windows)	<=1 Year		FI	LT,SK	3
	<=3 Years	BE	HR		2
	>=5 Years		LU,RS	CZ, DK, HU IE,IT, NO,SE,SI,	10
	Total	1	4	10	15

Source: BEREC RA database 2021

A choice of averaging window for beta >=5 years and differing from the one for the RFR is mainly motivated by predictability, reliability and stability objectives reducing variability over time, but also by theoretical reasons such as having enough data to reduce the standard error in the estimation (i. e. in case a sampling period is longer than daily).

Concerning the adjustment used for estimating the equity beta of SMP or comparable companies (Figure 34), there is no clear view, some 5 NRAs (use a Bayesian/Blume adjustment. Some NRAs apply the Blume/Bayesian adjustment explaining their choice (i) to report evidence from an academic study,⁴⁸ (ii) remarking that in case of "off the shelf" data provided by Bloomberg, the Blume adjustment is applied, (iii) stating that the Blume adjustment reflects future risk. Other NRAs (6 NRAs), do not make any adjustments considering that there is no reason for applying it. The application of the WACC notice has increased the consistency between NRAs in not applying any adjustment also in this case.

⁴⁷ NRAs that have provided information on all element are shown. The NRAs that fully apply the WACC Notice are not reported separately.

⁴⁸ Pablo Fernández, Beta used by professors: A survey with 2500 answers, IESE CIIF, Business School, University of Navarra, Working Paper, WP-822, September, 2009.

Generally, the application of an adjustment is made where a shorter time windows for beta estimation is in use; this is consistent with the idea that with less data available, the estimation of the equity beta may be less reliable.

Figure 34 - Time window adjustments to Equity Beta (fixed)⁴⁹

	Time Windows			
	<=2 Years	<=3 Years	>=5 Years	Total
No Adjustment	0(1)(2)	1(2)(1)	5+6(5)(5)	12(8)(8)
Blume	0(1)(1)	1(1)(1)	2(2)(2)	3(4)(4)
Vasiecek	0(0)(0)	0(1)(1)	0(0)(0)	0(1)(1)
Bayesian	0(0)(0)	1(1)(2)	1(2)(2)	2(3)(4)
Dimson	1(1)(0)	0(0)(0)	(0)(0)	1(1)(0)
Others	0(1)(0)	1(0)(1)	1(1)(1)	2(2)(2)
Total	1 (4)(3)	4(5)(6)	15(10)(10)	20 (19)(19)

Source: BEREC RA database 2021

Most NRAs apply an unlevered beta before estimating the final equity beta (17 NRAs) including NRAs that apply the WACC Notice. Concerning the unlevering formula the most widely used is the Modigliani-Miller formula (Miller being the same formula without tax⁵⁰).

Concerning the market index, most NRAs (19 NRAs) use a European index (STOXX Europe TMI Telecommunications; STOXX Europe TMI, MSCI Europe Index). Some NRAs estimate the equity beta for each comparable on a specific country index (e. g. every comparable beta is estimated on its own country market index). In case of a World index, the MSCI is used by 3 NRAs. A country specific index is typically used when the beta is evaluated only for the SMP operator (2 NRAs).

The chosen approach is generally motivated by the fact that the specific index provides a reliable data source and is consistent with earlier decisions.

Sensitivity analysis on the time windows, adjustments and the choice of market index shows a relevant variability of the estimation (see annex 1 of BoR (17) 169). A notional approach can reduce a certain level of variability.

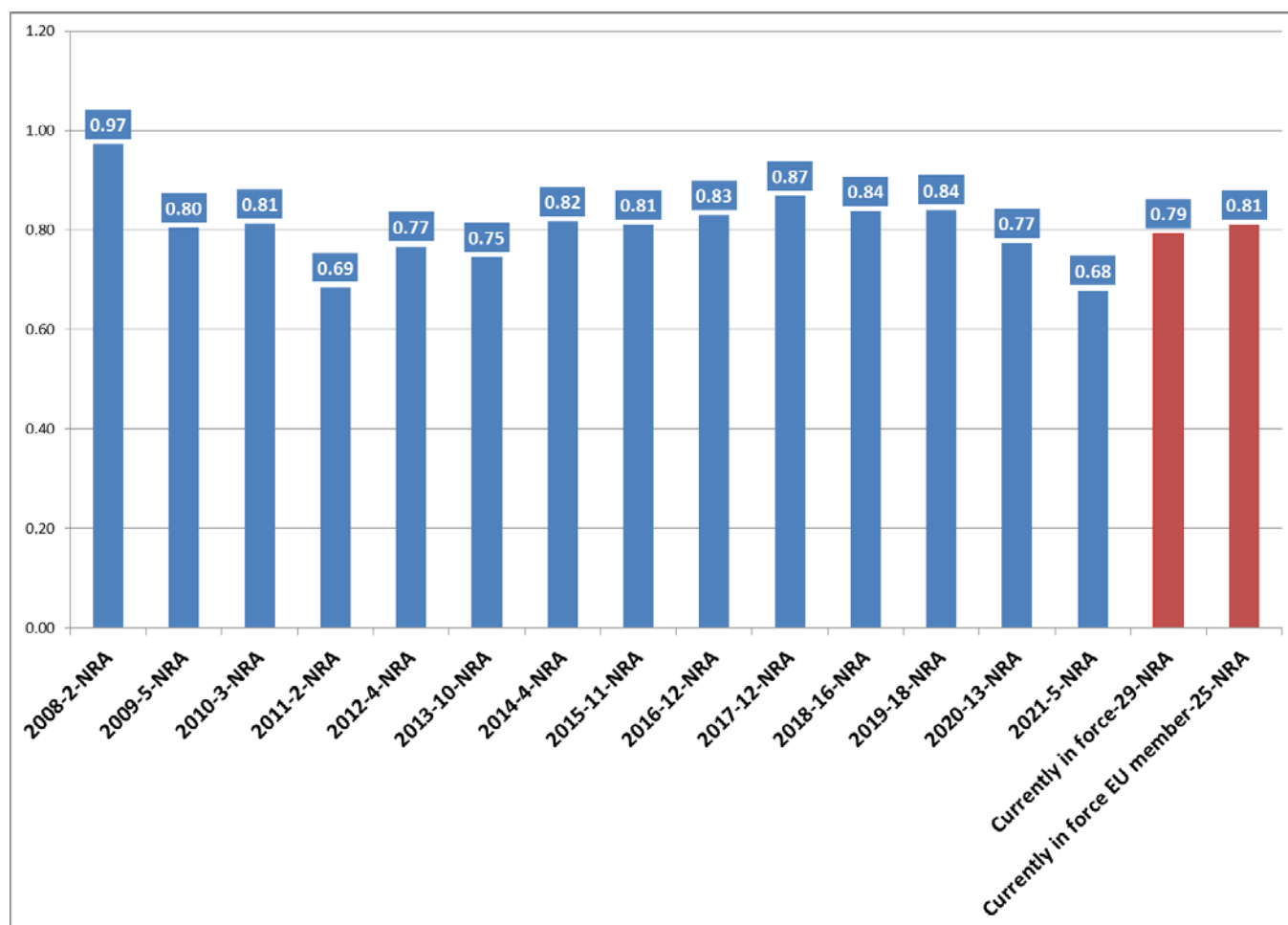
Overall, in the period 2008-2021, estimated beta values have remained relatively stable⁵¹.

⁴⁹ NRAs that have provided information on all elements are shown. The NRAs that fully apply the WACC Notice are not reported separately.

⁵⁰ Sometimes the same formula is referred to as "Hamada formula".

⁵¹ The variability may be explained by the number of observations (e. g. one NRA in 2011).

Figure 35 - Equity Beta evolution over time (fixed market)



Source: BEREC RA database 2021

Concerning the principle of “internal consistency”, a slight correlation can be found in the choice of the beta and gearing approach with respect to the price control methodology. Generally, if a BU approach is in use as cost allocation method, a “notional beta” is applied (this relation is missing for the cost of debt).

5.2.4 The cost of debt

see BoR (17) 169, BoR (18) 167 and BoR (20) 116 for definition and general financial theory

Main output from the survey.

Using the replies provided for the 2021 survey the following statistics have been derived for all responding NRAs and for EU NRAs separately (2020, 2019 and 2018 values in brackets).

Figure 36 – Cost of debt values

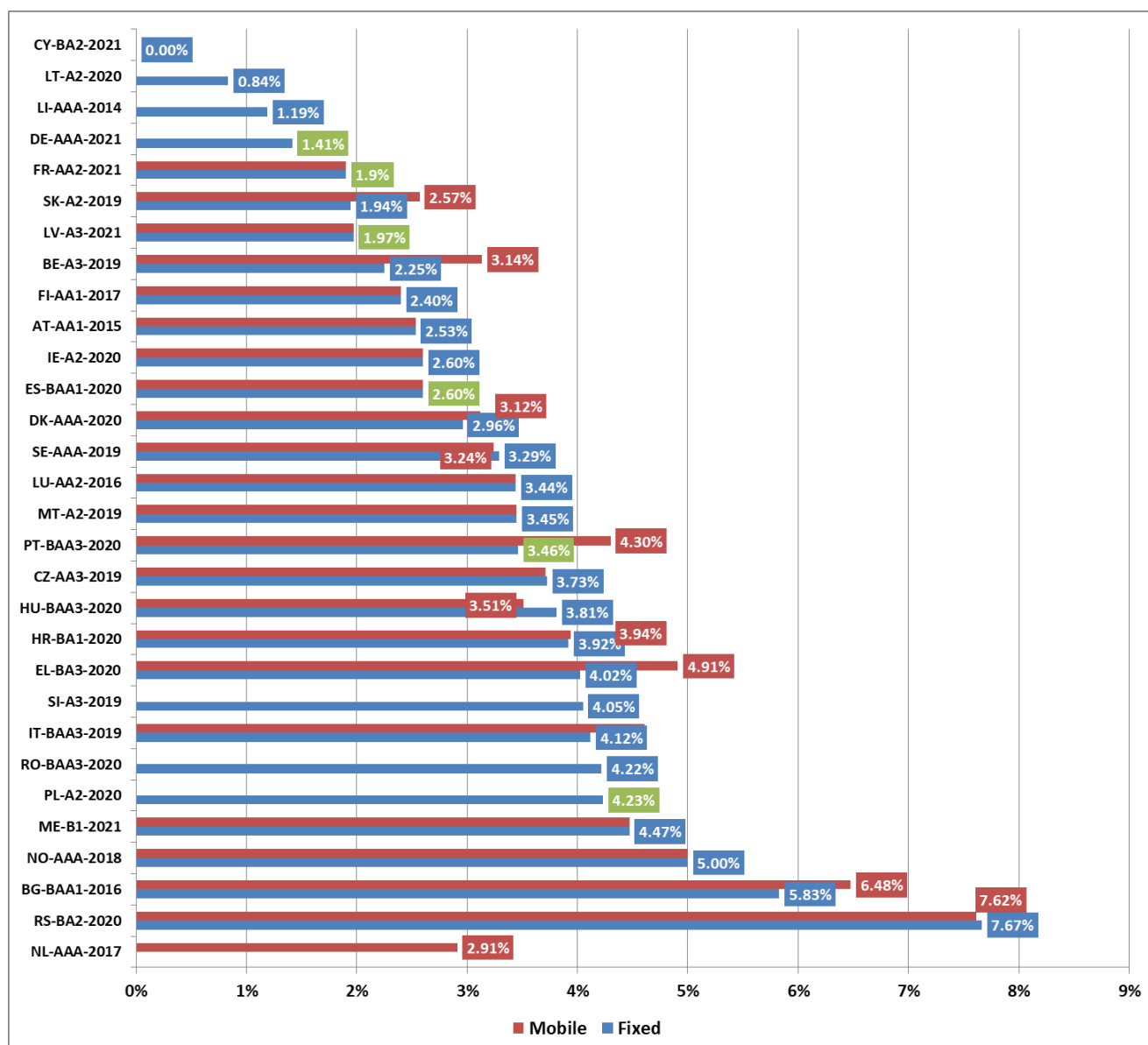
	Average	Median	Standard Deviation	Relative Standard Deviation	Maximum	Minimum
Cost of debt fixed market 29-NRAs (2020-31) (2019-32) (2018-32)	3.22% (3.81%) (4.00%) (4.30%)	3.44% (3.90%) (3.98%) (4.43%)	1.56% (2.03%) (2.03%) (2.08%)	48.44% (53.33%) (50.89%) (48.31%)	7.67% (8.58%) (8.58%) (8.77%)	0.00% (0.00%) (0.00%) (0.00%)
Cost of debt mobile market 24-NRAs (2020-27) (2019-26) (2018-26)	3.52% (4.20%) (4.44%) (4.60%)	3.34% (3.94%) (4.35%) (4.35%)	1.55% (2.07%) (2.00%) (2.06%)	44.20% (49.21%) (45.12%) (44.77%)	7.62% (8.91%) (8.58%) (8.58%)	0.00% (0.00%) (0.00%) (0.00%)
Cost of debt fixed market 25-EU NRAs (2020-24) (2019-26)(2018-26)	3.00% (3.55%) (3.79%) (4.12%)	3.29% (3.59%) (3.81%) (4.39%)	1.26% (1.67%) (1.74%) (1.74%)	42.05% (47.11%) (45.92%) (42.14%)	5.83% (7.84%) (7.84%) (7.84%)	0.00% (0.00%) (0.00%) (0.00%)
Cost of debt mobile market 21-EU NRAs (2020-20) (2019-23)(2018-23)	3.21% (3.52%) (4.09%) (4.25%)	3.14% (3.45%) (4.16%) (4.16%)	1.30% (1.43%) (1.78%) (1.82%)	40.25% (40.58%) (43.54%) (42.87%)	6.48% (6.48%) (7.84%) (7.84%)	0.00% (0.00%) (0.00%) (0.00%)

Source: BEREC RA database 2021

In Figure 37 the currently estimated cost of debt for the fixed and mobile market is shown. The respective credit rating and its year of estimation is also reported.

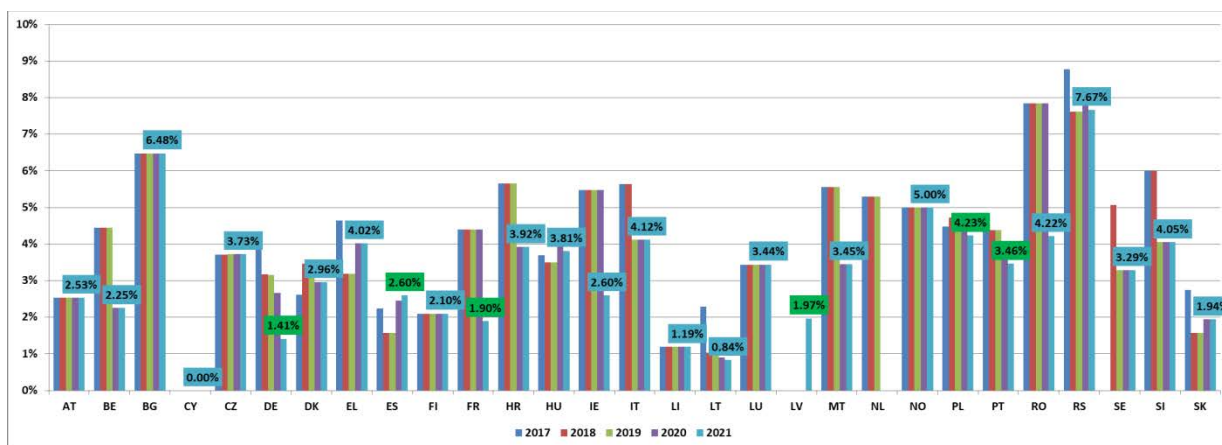
5 out of 6 NRAs (ES, FR, LV, PL, PT) that have fully adopted the WACC Notice have applied the same debt premium over the national RFR as the arithmetic average of the debt premium of the peer group reported in the BoR(20)116, which is equal to 130 points. One NRA (DE) has used a weighted average of market capitalisation of the debt premium reported in BoR(20)116. No NRAs has removed or added any peers from the one reported in the BEREC peer group.

Figure 37 - Cost of debt value and distribution (fixed and mobile markets)

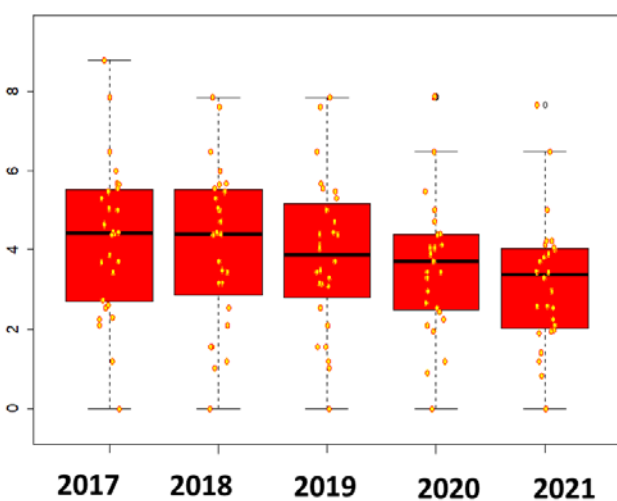


Source: BEREC RA database 2021

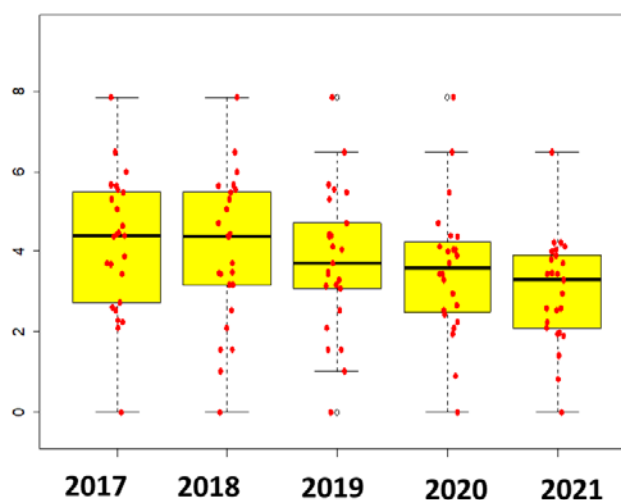
Figure 38 - Evolution of cost of debt over time (2018-2020)



Cost of Debt Fixed (%)



Cost of Debt Fixed EU (%)



Source: BEREC RA database 2021

The overall situation is quite stable over time even if it the decrease in the level of the averages is due to the corresponding decrease of the RFR that is generally included in the corresponding cost of debt.

The following figures summarise the different approaches used by NRAs to estimate the cost of debt for fixed and mobile markets. For the fixed market, the approach outlined in the WACC Notice is the most frequent one; the effort by BEREC in evaluating the debt premium from the secondary traded market data (not freely available) has shifted the most frequent approach about how the market value of debt is taken into account by NRAs. For the mobile market, where an updated value of WACC is becoming less relevant, the data source for estimating the market value of the debt premium is still the nominal bond yield.

Figure 39 - Methodology used for estimating cost of debt (fixed market)

	Methodology	Cost of debt/debt-premium		Market/book value		-if "Market value"/"Other" (if applicable) Source data		-if "Market value"/"Other" (if applicable) bond window		-if "Market value"/"Other" (if applicable) Average window		-if "Market value"/"Other" (if applicable) Average methodology (with respect to the historical series included in the Average window)		If notional approach is used for the peer group please indicate the average used		
Cost of debt (RFR+ Debt premium)	notional (generic operator)	11+6	Debt premium	14+6	Book value	2	Secondary traded market	2+6	1 year	0	Spot rate	2	Arithmetic average	7+6	Arithmetic	2+5
	SMP Operator	4	Cost of Debt	6	Market Value (Company bond)	11+6	Nominal bond yield	6	3 years	0	3 months	0	Geometric Average	0	Median	0
	Other	4			Other	4	Other	5	5 years	2	6 months	0	Moving Average	0	Weighted Average	1
	benchmarking	1							10 years	5+6	1 Year	2	Median	0	Other	0
									20 years	1	2 Years	0	Other	1		
									Hybrid	1	3 Years	2				
									Other	3	5 Years	2+6				
											10 Years	1				
											Others	1				

Source: BEREC RA database 2021

Figure 40 - Methodology used for estimating cost of debt (mobile market)

	Methodology	Cost of debt/debt-premium		Market/book value		-if "Market value"/"Other" (if applicable) Source data		-if "Market value"/"Other" (if applicable) bond window		-if "Market value"/"Other" (if applicable) Average window		-if "Market value"/"Other" (if applicable) Average methodology (with respect to the historical series included in the Average window)		If notional approach is used for the peer group please indicate the average used		
Cost of debt (RFR+ Debt premium)	notional (generic operator)	10+3	Debt premium	16+3	Book value	0	Secondary traded market	1+3	1 year	1	Spot rate	1	Arithmetic average	7	Arithmetic	2+3
	SMP Operator	2	Cost of Debt	4	Market Value (Company bond)	14+3	Nominal bond yield	7	3 years	0	3 months	0	Geometric Average	0	Median	0
	Other	8			Other	3	Other	5	5 years	3	6 months	0	Moving Average	0	Weighted Average	0
	benchmarking	0							10 years	6+3	1 Year	1	Median	0	Other	0
									20 years	0	2 Years	0	Other	1		
									Hybrid	0	3 Years	4				
									Other	3	5 Years	2+3				
											10 Years	1				
											Others	3				

Source: BEREC RA database 2021

For the fixed market, the most frequent approach used by NRAs is a notional one (17 NRAs, 14 last year), the category "Other" is now chosen by only 4 NRAs which reflects a mix of approaches (SMP and notional); the SMP cost of debt is considered by 4 NRAs. The application of the WACC Notice has increased the consistency in the corresponding methodological approach applied by NRAs.

Most NRAs estimate a debt premium instead of estimating the cost of debt directly, mostly when using a notional approach (see Figure 41). On the other hand, when the cost of debt refers to the SMP operator, a direct cost of debt is generally estimated. When using a notional approach, NRAs generally use the same peer group used for estimating beta and gearing according to a specific credit

rating (at least BBB).⁵² Most NRAs use bond windows or time to maturity in line with those used for RFR (generally 10 year average)

There is a large consistency between fixed and mobile markets; few NRAs have a marginally different approach to fixed and mobile markets.

Figure 41 - Cost of debt calculated through debt premium (fixed)⁵³

Fixed		
	Cost of debt calculated through debt premium	Cost of Debt
Notional (generic operator)	10+6(14) (12)	1(0) (1)
SMP operator	1(1)(1)	3(3)(4)
Other	1(7)(7)	3(3)(3)
Benchmarking	0(0)(1)	1(0)(0)

	Cost of debt calculated through debt premium	Cost of Debt
Notional (generic operator)	BE, CZ,DK,FI,HR,HU,IE,LI NO,SE	RS
SMP operator	AT	BG,IT,LT
Other	IE,LU,MT, SI SK	LU
Benchmarking		RO

Source: BEREC RA database 2021

With reference to the data source used, most NRAs use the market value of peer group companies' nominal bond yields. A book value approach is used typically in case of SMP cost of debt.

Concerning the bond lengths, the most common approach is to use 10 year bonds, in line with the bond length used to estimate RFR, as shown in the next figure.

Figure 42 - Bond lengths used for estimating cost of debt/RFR (fixed markets)

		Bond length						
		1 Year	3 Years	5 Years	10 Years	20 Years	Hybrid	Other
RFR	1 Year	0	0	0	0	0	0	0
	3 Years	0	0	0	0	0	0	0
	5 Years	0	0	0	0	0	0	0
	10 Years	0	0	2(2)(2)	5+6(9)(8)	1(1)(1)	2(2)(1)	2(4)(5)
	20 Years	0	0	0	0	0	0	0
	Other	0	0	0	0	0	0	(1)(1)

Source: BEREC RA database 2021

NRAs generally choose averaging windows in accordance with their choice of averaging windows used for the RFR. "Other" is chosen only when the cost of debt is estimated based on the nominal

⁵² One NRA declared that the level of debt of the SMP operator is negligible and for this reason it is considered equal to 0.

⁵³ NRAs that provided information on all elements are shown. The NRAs that fully apply the WACC Notice are not reported separately.

bond yield and not when the secondary traded market is used as a source. Moreover, when “other” is chosen, NRAs generally consider in their calculation all bonds not yet expired that are emitted in a range of time that cannot strictly correspond with the time windows used for the RFR estimation.

In every case the results of the methodological survey are in line with the general principle expressed in the BoR (18) 167 where BEREC understands the need for consistency in the averaging windows used for the cost of debt and RFR, but also recognises the necessity for some NRAs to be flexible due to the problem of data availability. This statement is losing strength when applying the WACC Notice and the corresponding BEREC Report.

Figure 43 - RFR/cost of debt time windows (fixed and mobile markets)⁵⁴

		Cost of debts			Total
		<=1 Year	<=3 years	>= 5 Years	
RFR	<=1 Year	1(2)(2)	(0)(0)	0(1)(1)	1(3)(3)
	<=3 Years	0(1)(1)	1(2)(1)	1(2)(2)	2(5)(4)
	>= 5 Years	3(3)(2)	2(2)(2)	3+6(4)(4)	14(9)(8)
Total		4(6)(5)	3(4)(3)	10(7)(7)	17(17)(15)

		Cost of debts		
		<=1 Year	<=3 years	>= 5 Years
RFR	<=1 Year	ES,SK		
	<=3 Years		BE	HR
	>= 5 Years	CZ,HU,RS	LU,SE	IE,IT,SI

Source: BEREC RA database 2021

Concerning specific adjustments to the cost of debt, two NRAs have applied the following:

Figure 44 - Adjustments to cost of debt

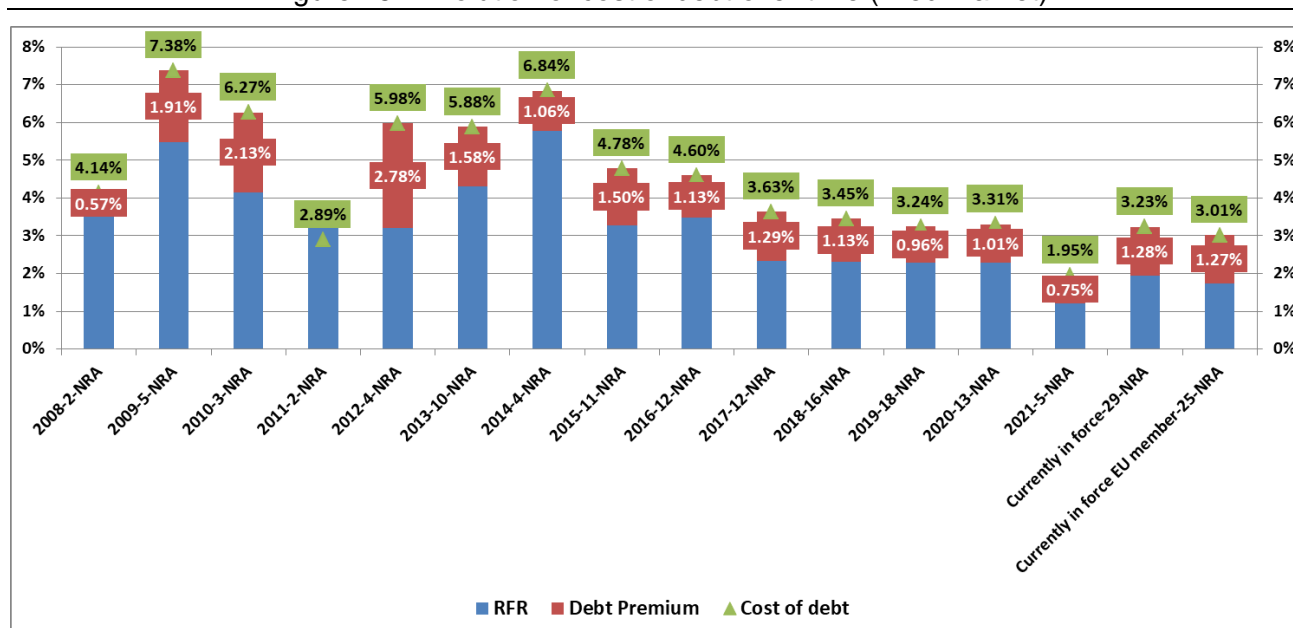
	Cost of debt	Cost of debt without adjustment	Adjustment (%)	Motivation
PL-2020	5.44%	4.23%	1.21%	Tax shield treatment
RS-2020	7.67%	6.27%	1.65%	Adjustment is made using the inflation rate for Serbia and Eurozone, since the initial value of cost of debt is in EUR. Inflation adjustment was made using Fisher equation: Pretax Cost of debt*(1+ Projected Inflation Rate for RS)/(1+Projected Inflation Rate for Eurozone)
	(7.86%)	(6.85%)	(1.02%)	
	(7.61%)	(6.48%)	(1.13%)	
	(8.77%)	(7.23%)	(1.54%)	

Source: BEREC RA database 2021

The next figure shows the evolution over time of the cost of debt and the RFR (fixed market).

⁵⁴ NRAs that provided information on all elements are shown. The NRAs that fully apply the WACC Notice are not reported separately.

Figure 45 - Evolution of cost of debt over time (fixed market)



Source: BEREC RA database 2021

5.2.5 Gearing Ratio

see BoR (17) 169, BoR (18) 167 and BoR (20) 116 for definition and general financial theory

Main results of the survey.

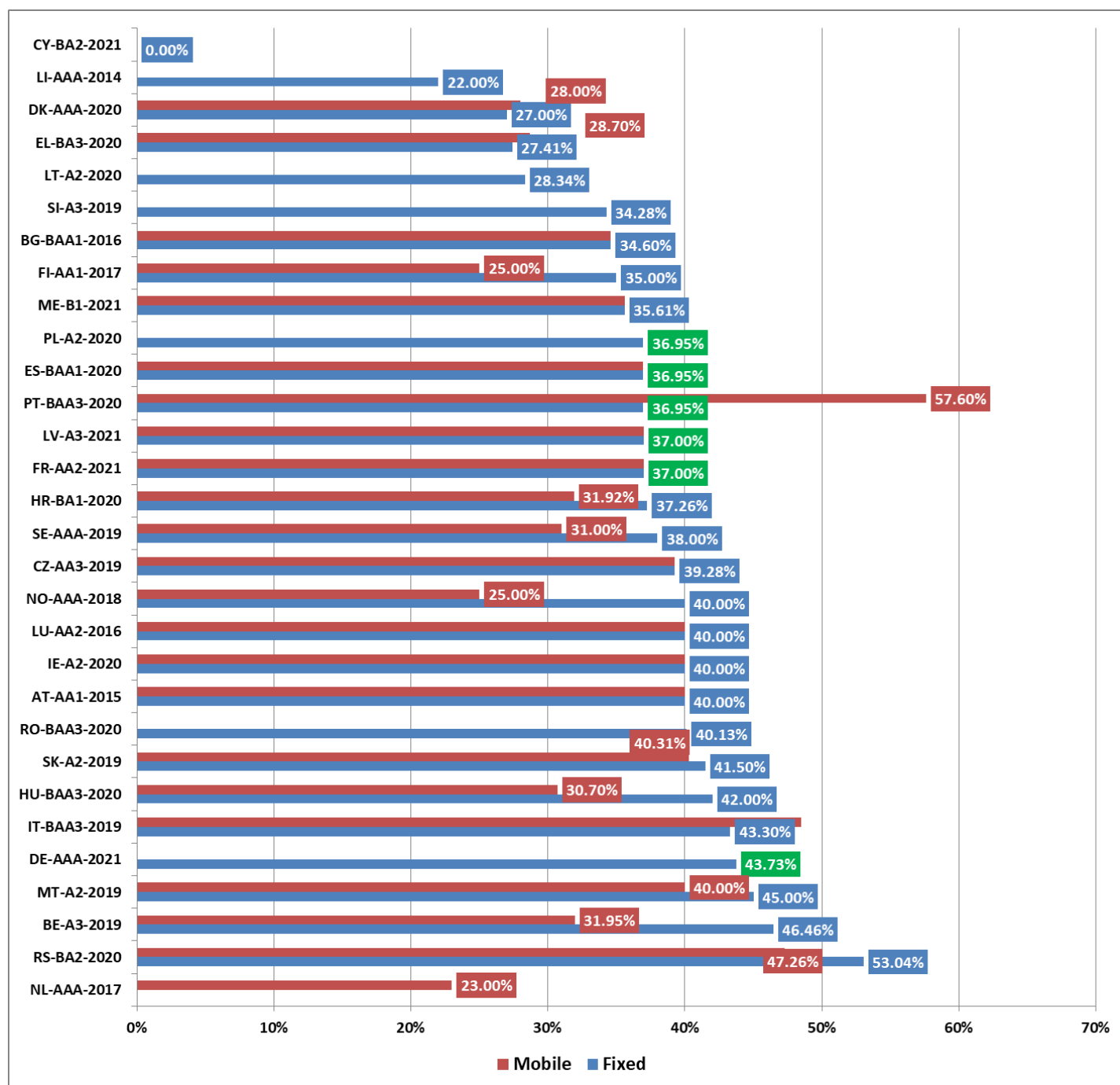
Using the replies provided for the 2021 survey the following statistics have been derived for all responding NRAs and for EU NRAs separately (2020, 2019 and 2018 values in brackets).

Figure 46 - Gearing ratio (fixed and mobile markets)

	Average	Median	Standard Deviation	Relative Standard Deviation	Maximum	Minimum
Gearing fixed market – 29-NRAs	36.51%	37.26%	9.39%	27.71%	53.04%	0.00%
(2020-31)	(37.79%)	(39.54%)	(9.99%)	(26.44%)	(57.89%)	(0.00%)
(2019-32) (2018-32)	(37.70%) (37.28%)	(39.93%) (39.85%)	(9.71%) (10.04%)	(26.76%) (26.93%)	(54.79%) (55.62%)	(0.00%) (0.00%)
Gearing mobile market 24-NRAs	34.56%	36.28%	10.85%	31.40%	57.60%	0.00%
(2020-27)	(33.62%)	(34.60%)	(10.91%)	(32.44%)	(57.60%)	(0.00%)
(2019-26) (2018-26)	(33.53%) (33.34%)	(34.55%) (33.25%)	(12.34%) (12.50%)	(36.79%) (37.50%)	(57.60%) (57.60%)	(0.00%) (0.00%)
Gearing fixed market 25-EU NRAs	36.33%	37.26%	9.06%	24.93%	46.46%	0.00%
(2020-24)	(37.84%)	(39.41%)	(10.65%)	(28.14%)	(57.89%)	(0.00%)
(2019-26)(2018-26)	(37.24%) (37.27%)	(40%) (40%)	(10.61%) (10.65%)	(28.48%) (28.58%)	(55.62%) (55.62%)	(0.00%) (0.00%)
Gearing mobile market 21-EU NRAs	34.36%	36.95%	11.08%	32.24%	57.60%	0.00%
(2020-20)	(33.45%)	(34.28%)	(11.59%)	(34.66%)	(57.60%)	(0.00%)
(2019-23)(2018-23)	(33.95%) (33.85%)	(34.60%) (34.50%)	(12.91%) (13.13%)	(38.02%) (38.78%)	(57.60%) (57.60%)	(0.00%) (0.00%)

Source: BEREC RA database 2021

Figure 47 - Gearing values (fixed and mobile markets)

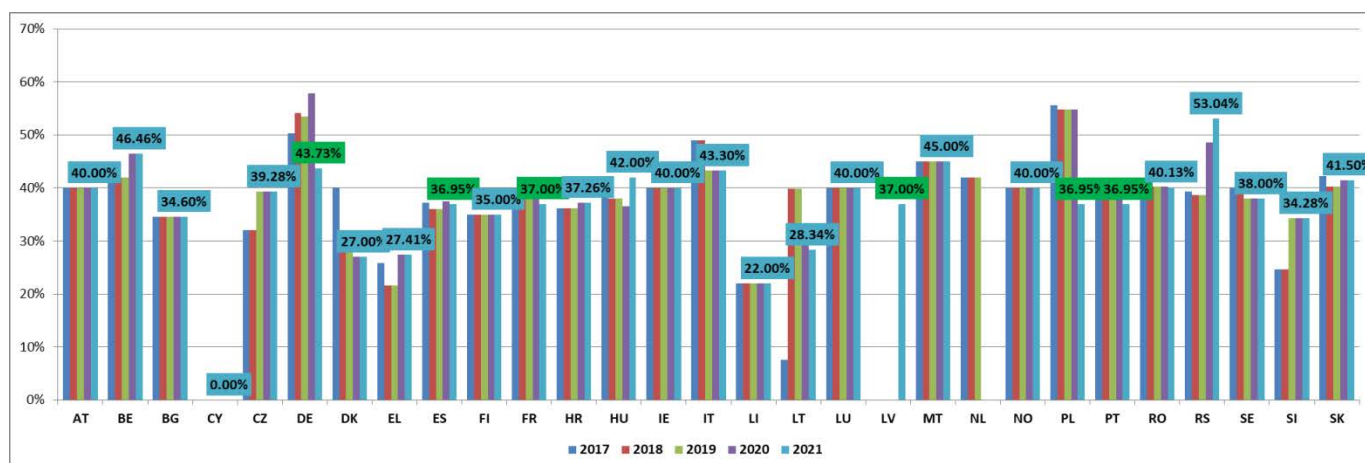


Source: BEREC RA database 2021

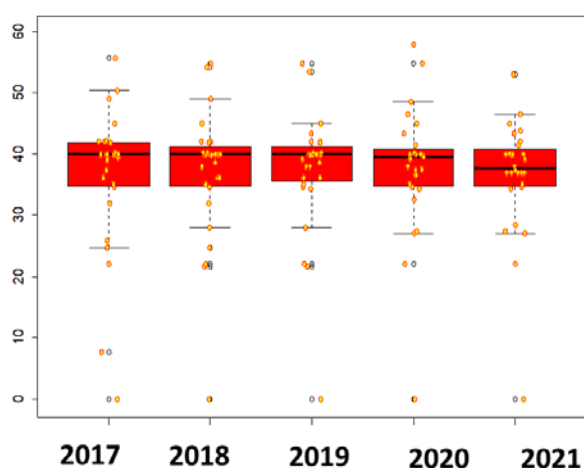
In Figure 49 the gearing currently estimated for the fixed and mobile market is shown.

5 out of 6 NRAs (ES, FR, LV, PL, PT) that have fully adopted the WACC Notice have applied the same gearing value as the arithmetic average of the gearing of the peer group reported in the BoR(20)116, that is equal to 37%. One NRA (DE) has used a weighted average of market capitalisation of the gearing of the peer group reported in BoR(20)116.

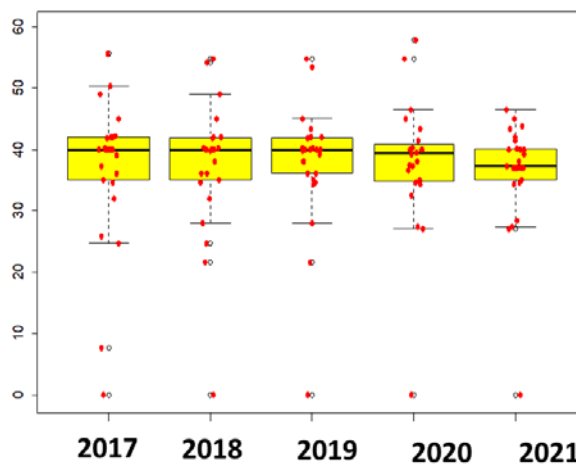
Figure 48 - Gearing values (fixed market 2017-2019)



Gearing Fixed (%)



Gearing Fixed EU (%)



Source: BEREC RA database 2021

The following figures summarise the different approaches used by NRAs to estimate the gearing parameters (fixed and mobile markets). The adoption of the WACC Notice contributes to an increase in the weight of the most frequent approach in use by NRAs for estimating the gearing component.

Figure 49 - Gearing methodology (fixed market)

	Methodology		Debt component (if applicable)		Equity component (if applicable)		-if notional value "Average methodology"		-if benchmarking is indicated in the methodology section please indicate the average used from other countries	
Gearing	notional (generic operator)	13+6	Book value	3+6	Book value	1	Arithmetic	6+5	Arithmetic average	1
	SMP Operator	5	Market Value	5	Market Value	8+6	Median	2		
	Other	3	Other	0	Other	1	Weighted Average	1		
	benchmarking	1					Other	3		

Source: BEREC RA database 2020

Figure 50 - Gearing methodology (mobile market)

	Methodology		Debt component (if applicable)		Equity component (if applicable)		-if notional value "Average methodology"		-if benchmarking is indicated in the methodology section please indicate the average used from other countries	
Gearing	notional (generic operator)	15+3	Book value	4+3	Book value	0	Arithmetic	8+3	Arithmetic average	0
	SMP Operator	1	Market Value	4	Market Value	8+3	Median	2		
	Other	2	Other	0	Other	0	Weighted Average	0		
	benchmarking	0					Other	2		

Source: BEREC RA database 2021

The vast majority of NRAs has used a “notional” approach, and, in general, do not adjust the gearing according to national circumstances. Moreover they have used the value of the notional gearing to unlever the beta. The gearing is generally estimated taking into account the same averaging window used for beta estimation. In line with last year’s report, most NRAs have used a notional approach equal to their approach for estimating the beta. This is confirmed by NRAs that currently fully applied the WACC Notice. All six NRAs have used the same approach for estimating all the company parameters: same peer group and same averaging methodology.

Concerning their data source, most NRAs have used book value for the debt component and market value for the equity component.

When the debt component is estimated via the book value, generally long term and short term debt without netting off the cash is considered.⁵⁵

⁵⁵ Cash is considered useful to operate the business (rather than being available to pay off debt).

Figure 51 - Gearing methodology (fixed) ⁵⁶

	Debt component			Equity component		
	Book value	Market value	Other	Book value	Market value	Other
notional (generic operator)	5+6(4) (4)	4(4) (3)	0(2) (2)	(0) (0)	9+6(8) (7)	0(2) (2)
SMP Operator	1(2) (2)	1(1) (0)	0(0) (0)	1(1) (1)	1(2) (1)	1(0) (0)
Other	0(2) (2)	0(1) (1)	0(0) (0)	0(0) (0)	0(3) (3)	0(0) (0)
benchmarking	0(0) (0)	0(0) (0)	0(0) (0)	0(0) (0)	0(0) (0)	0(0) (0)
Total	12(8) (8)	5(6) (4)	0(2) (2)	1(1) (1)	16(13) (11)	1(2)(2)

	Debt Component			Equity component		
	Book value	Market value	Other	Book value	Market value	Other
notional (generic operator)	DK,EL,HR,IT, LU,	BE,HU,SE SK			BE,DK,EL,H R,HU,IT,LU, SE,SK	
SMP Operator	LI	SI		LI	SI	NO
Other						
benchmarking						
Total	6	5	0	1	10	1

Source: BEREC RA database 2021

Figure 52 and Figure 53 indicate that the gearing methodology is influenced mainly by the main methodology used for the beta estimation, while gearing also influences the debt premium estimation.

Considering the methodologies used by all NRAs for the cost of debt, gearing and beta (company/industry specific parameters) it becomes clear that the gearing estimation is important since (i) it determines the weight placed on the cost of equity and cost of debt, (ii) it is used to un-lever and re-lever the beta, (iii) it influences the size of the cost of debt. The adoption of the WACC Notice, as for the other parameters, is providing a reduction in the spread of the methodologies in accordance with a notional approach based on a peer group.

⁵⁶ NRAs that provided information on all elements are shown. The NRAs that fully apply the WACC Notice are not reported separately.

Figure 52 - Methodology gearing and cost of debt estimation (fixed markets)⁵⁷

		Cost of debt				
		notional (generic operator)	SMP Operator	Other	Benchmarking	Total
Gearing	notional (generic operator)	9+6 (12) (12)	2(2) (2)	2(4)(4)	0(0)(0)	19(18)(18)
	SMP Operator	2(2)(1)	2(2)(3)	1(2)(3)	0(0)(0)	5(6) (7)
	Other	0(0)(0)	0(0)(0)	1(3)(2)	0(0)(1)	1(3)(3)
	Benchmarking	0(0)(0)	0(0)(0)	0(0)(0)	1(0)(0)	1(0)(0)
Total		17(14)(14)	4(4)(5)	4(9)(9)	1(0)(1)	26(27)(28)

		Cost of debt				
		notional (generic operator)	SMP Operator	Other	Benchmarking	Total
Gearing	notional (generic operator)	BE,CZ,DK,FI,HR,IE,HU,RS,SE	AT,IT	LU,SK		13
	SMP Operator	LI,NO	BG,LT	SI		5
	Other			MT		1
	Benchmarking				RO	1
Total		11	4	4	1	20

Source: BEREC RA database 2021

Figure 53 - Methodology gearing and beta estimation (fixed markets)⁵⁸

		Beta				
		notional (generic operator)	SMP Operator	Other	Benchmarking	Total
Gearing	notional (generic operator)	13+6 (18) (18)	0 (0)(0)	0(0)(0)	0 (0)(0)	19(18)(18)
	SMP Operator	0 (2) (1)	3 (3)(5)	1 (0)(0)	1 (1)(1)	5(6)(7)
	Other	1 (2)(1)	0 (0)(0)	0 (2)(2)	1 (0)(1)	2(4)(4)
	Benchmarking	0 (0)(0)	0(0)(0)	0 (0)(0)	1 (0) (0)	1(0)(0)
Total		20 (22)(21)	3 (3) (5)	1 (2)(2)	3 (1)(2)	27(28) (29)

		Beta				
		notional (generic operator)	SMP Operator	Other	Benchmarking	Total
Gearing	notional (generic operator)	AT,BE,CZ,DK,FI,HR,HU,IE,IT,LU,RS,SE,SK				13
	SMP Operator		BG,LT,SI	NO	LI	5
	Other	MT			EL	2
	Benchmarking				RO	1
Total		14	3	1	3	21

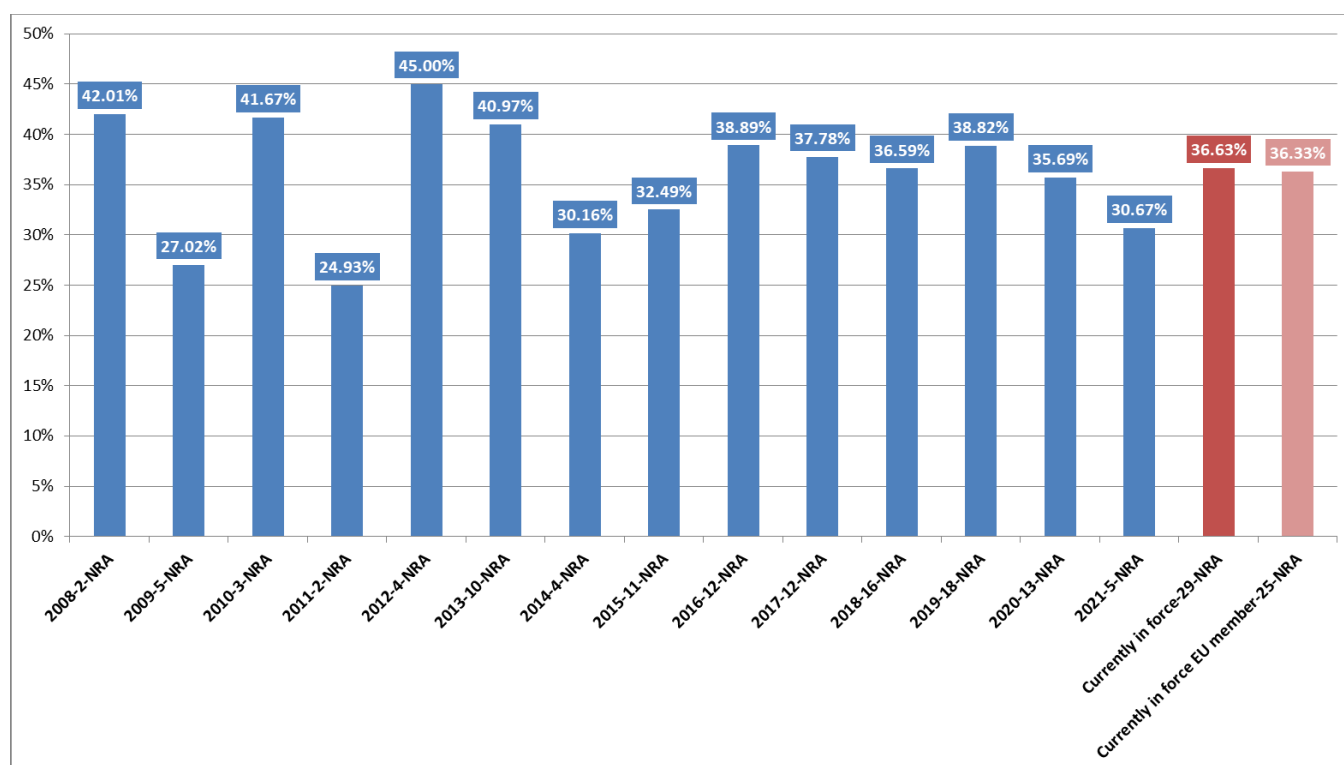
Source: BEREC RA database 2021

⁵⁷ NRAs that provided information on all elements are shown. The NRAs that fully apply the WACC Notice fully are not reported separately.

⁵⁸ NRAs that provided information on all elements are shown. The NRAs that fully apply the WACC Notice fully are not reported separately.

The evolution over time of the gearing estimation is reported in Figure 54.

Figure 54 – Evolution of gearing over time



Source: BEREC RA database 2021

5.2.6 Tax rate

Concerning the corporate tax rate in use the following statistics emerge (2018-2020 figures in brackets):

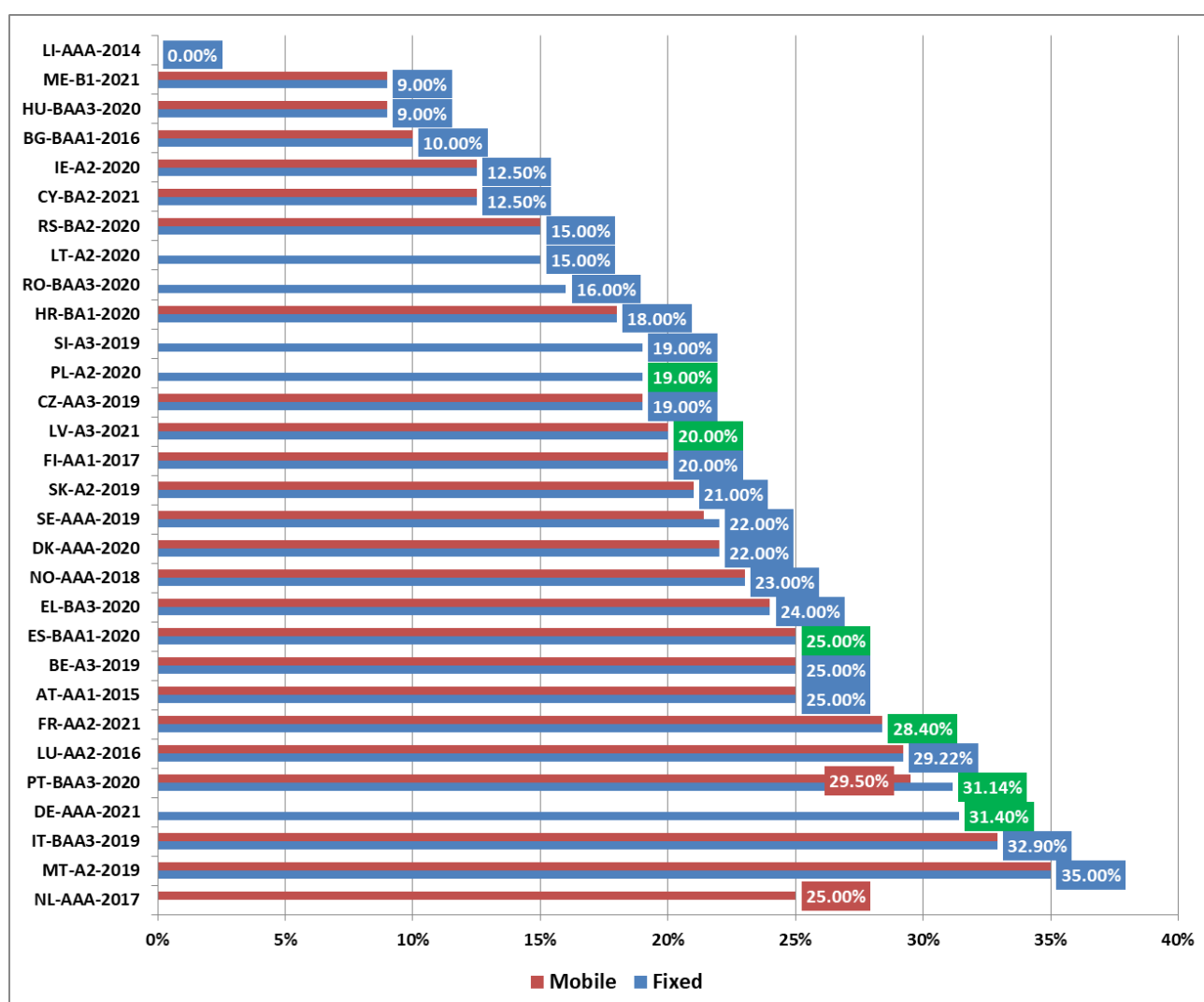
Figure 55 - Corporate tax rate (fixed and mobile markets)

	Average	Median	Standard Deviation	Relative Standard Deviation	Maximum	Minimum
Tax rate fixed market – 29-NRAs (2020-31) (2019-32) (2018-32)	20.31% (20.02%) (21.07%) (21.09%)	20.00% (20.00%) (20.45%) (20.45%)	8.09% (7.75%) (8.34%) (8.48%)	39.85% (38.72%) (39.57%) (40.19%)	35.00% (35.00%) (35.00%) (36.00%)	0.00% (0.00%) (0.00%) (0.00%)
Tax Rate mobile market 24-NRAs (2020-27) (2019-26) (2018-26)	21.31% (21.17%) (21.81%) (22.93%)	21.70% (21.40%) (21.00%) (21.00%)	7.26% (7.66%) (7.83%) (8.03%)	34.07% (36.19%) (35.87%) (36.60%)	35.00% (35.00%) (35.00%) (36.00%)	9.00% (9.00%) (9.00%) (9.00%)
Tax rate fixed market 25-EU NRAs (2020-24) (2019-26)(2018-26)	21.68% (21.57%) (22.51%) (22.54%)	21.00% (21.50%) (21.50%) (22.00%)	7.11% (7.21%) (7.73%) (7.91%)	32.77% (33.43%) (34.33%) (35.08%)	35.00% (35.00%) (35.00%) (36.00%)	9.00% (9.00%) (9.00%) (9.00%)
Tax Rate mobile market 21-EU NRAs (2020-20) (2019-23)(2018-23)	22.12% (22.43%) (22.57%) (22.70%)	22.00% (21.40%) (22.00%) (22.00%)	7.09% (7.66%) (7.78%) (7.99%)	32.05% (36.19%) (34.45%) (35.21%)	35.00% (35.00%) (35.00%) (36.00%)	9.00% (9.00%) (9.00%) (9.00%)

Source: BEREC RA database 2021

As already mentioned, taxation is also an important parameter to explain WACC variations between NRAs - it represents a typical country-specific parameter. Needless to say it is not a parameter that NRAs have an influence over.

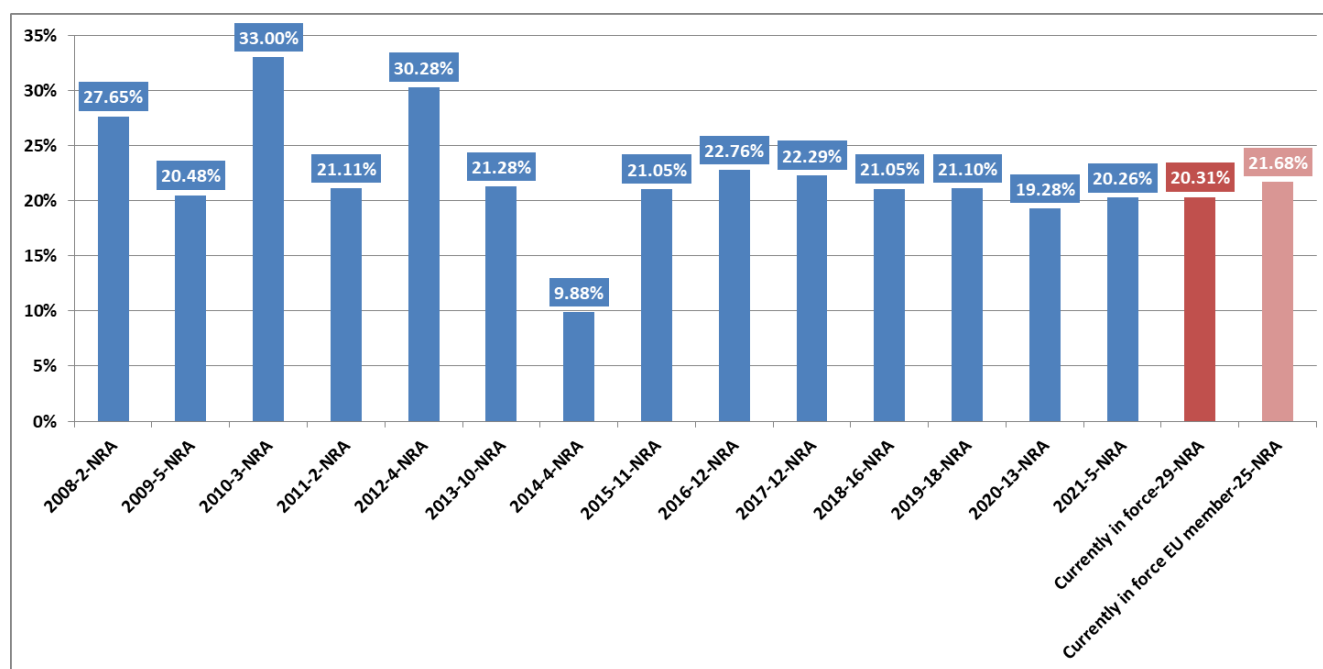
Figure 56 - Tax rate currently in use (fixed and mobile markets)



Source: BEREC RA database 2021

The time evolution of the tax rate adopted is reported in Figure 57.

Figure 57 - Evolution of tax rate over time (fixed market 2008-2020)



Source: BEREC RA database 2021

5.2.7 Other Adjustments

The practice by some NRAs to adjust the value of WACC parameters posed an issue in some cases of Article 7/a evaluation processes by the European Commission.

In order to better understand the use of adjustments, specific questions have thus been addressed in the 2021 questionnaire on technical adjustments on single parameters estimation and, in general, on the cost of equity.

In Figure 58, NRAs that apply an adjustment to the cost of equity are listed (in bracket the adjustment applied in 2020, 2019 and - 2018).⁵⁹

Technical adjustments to the cost of equity are evaluated as: Post tax cost of equity (RFR+ Equity Beta*ERP) + "Adjustment". The following adjustments do not include other adjustments reported in previous sections.

In comparison to the previous years' reports the practice of using adjustment is decreasing over time with some NRAs having removed the adjustment (i.e. BE, HU, SI).

⁵⁹ In Figure 60 only fixed market adjustments are shown.

Figure 58 - Adjustments to the cost of equity

	Adjustmet for cost of equity	Motivation
CZ	0.64 (0.64%) (0.64%) (0.42%)	The country risk premium captures risks connected with investments in the local (Czech) market that are directly included neither into the risk free rate nor into the equity risk premium derived from the developed stock markets. The specific calculation method for estimating the country risk premium was based on a widely accepted approach developed by prof. Damodaran and represents the difference between the product of a country default risk and ratio of stock and bond markets volatility and a country default risk. The formula for that calculation is as follows: $CRP = RS * (\sigma_c / \sigma_b) - RS$ Where: CRP country risk premium RS country default risk σ_c standard deviation of stock market revenues σ_b standard deviation of bond market revenues
DE	0.74% (-0.63%) (-0.88%) (-0.92%)	It is applied making the average between the real pretax WACC estimated using the EU Commission Notice methdology and the previous estimation. The adjustment is allowed also taking into account the transition period of the Notice as well
NO	0.35% (0.35%) (0.35%)	
RS	1.25% (0.91%) (1.01%) (1.38%)	As for the cost of debt Adjustment is made using the inflation rate for Serbia and Eurozone, since the initial values of cost of equity are in EUR. Infation adjustment was made using Fisher equation.
SK	1.94% (1.94%) (1.94%) (1.94%)	Size premium

Source: BEREC RA database 2020

The number of NRAs that have applied adjustment to the cost of equity has decreased and a full adoption of the WACC Notice would no longer provide for adjustments. Technical adjustments are generally motivated to take into account national specificity with the main motivation being stability considerations.

5.3 NGA Risk premium

In this section an overview of NGA WACC estimation is provided without looking at the price control applied to the NGA wholesale regulated product for which the information is also available in the RA section of the report. More concretely, it provides an update on NGA risk premium calculations.

The following situation emerges from the survey: 10 NRAs have estimated a risk premium for FTTH networks, 3 NRAs have applied this risk premium to the FTTC services without differentiating the final value from the one applied to FTTH (DK, LU, SI).

In general it is not possible to obtain a clear view of the corresponding systematic or non-systematic risk taken into account in this NGA risk premium. Uncertainty of demand is the main source of risk, but the general concerns reported in the NGA recommendation are: i) uncertainty relating to the costs of deployment; ii) uncertainty relating to technological progress; iii) uncertainty relating to market dynamics and the evolving competitive situation, such as the degree of infrastructure-based and/or cable competition; iv) macroeconomic uncertainty can have an influence about the level of risk included in the market. The risk is generally applied to all the kinds of infrastructure, both active and passive.

Figure 59 - Risk premium

	Do you apply an NGA premium?	Do you apply a premium to FTTC?	If yes, please provide the nominal %	Do you apply a premium to FTTB?	If yes, please provide the nominal %	Do you apply a premium to FTTH?	If yes, please provide the nominal %	What kind of risks do you take into account?	Which infrastructure do you apply the premium to?	How do you estimate the premium (please explain briefly)	How do you apply the premium (please explain briefly i.e. if you also include a premium for duct access products etc.)	Other comments
BE	Yes	No	0	Yes	1.59%	Yes	1.59%	other	Passive and Active	Increased beta and cost of debt and a worse credit rating; based on qualitative arguments	Different WACCs for different networks. We have a legacy WACC, a cable WACC, a FTTH WACC, and a mobile WACC	
CZ	Yes	No	-	Yes	1.41%	Yes	1.41%	Uncertainty relating to market dynamics, dependence on the business cycle, market size and capacity, intensity of competition, barriers to entry, position in relation to suppliers and customers, competitiveness of services, prices, regulatory and financial risks.		The NGA risk premium represents a risk difference between the NGA and legacy networks, assessed separately for all relevant criteria. For this exercise a special model of complex box method for cost of equity estimation published by prof. Mařík was used. This method segments the total risk into partial risks which are then assessed separately. Individual risks associated with NGA networks are not estimated in their absolute values but relatively to risks of legacy networks, i.e. whether the risk is the same, higher or lower than for the legacy networks. Consistent risk factor is a value of 100 %, higher risk factor is more than 100 % and lower risk factor is lower than 100 %. Finally was calculated the weighted average from percentage values of risks. This average value represents the risk ratio of NGA networks and other technologies.		
DK	Yes	Yes	2.00%	Yes	2.00%	Yes	2.00%		Passive and Active	We evaluate the market conditions every time we issue a new price decision	DBA apply 2 %-point to the nominal WACC-value for fiber in Denmark except for a certain area around Copenhagen (DONG-area). In the DONG-area, the fiber network is fully developed, and therefore there is no risk and no need for a NGA risk premium.	BEREC
FI	Yes					Yes	-		Passive and Active	Study made by KPMG. One standard deviation is added to copper beta in order to get beta for fiber.		
FR	Yes					Yes					No risk premium is applied in the asymmetrical regulation. However, in the symmetrical regulation, Arcep has issued some non-binding methodological documents about tariffing FttH networks in less dense areas, mentioning the use of a NGA premium, with an indicative value of +2% on the main segment	
HR	Yes	No		Yes	1.97%	Yes	1.97%	The additional risk premium should reflect the risks related to the demand, like the risks related to the use of broadband access services NGA speeds (speeds higher than 30 Mbit/s). The data shows a significant increase in the use of NGA speeds in the Republic of Croatia - at the end of 2018, about 330,000 users in Croatia used NGA speeds, which is a significant increase in the last three years (more than five times). Furthermore, the lower risk premium is justified given that other operators are willing	Passive and Active	Benchmark methodology based on currently available data on EU member states	NGA risk premium is applied on civil engineering assets need to be built to provide FTTH/FTTB infrastructure	

								to invest in fibre optic access networks, as evidenced by the significant increase in announcements of intentions to set up fibre optic distribution networks of alternative operators in the last two years.				
IT	Yes	No				Yes	3.20%	0	Passive and Active	<p>Agcom evaluated through an option pricing model (mainly based on a DCF approach) the level of risk premium in a way to include two main risk factors:</p> <p>a) the “wait and see” option to postpone the investment when new information about demand/cost will be available</p> <p>b) the risk to open the network to third parties without having any first mover advantage.</p> <p>The two sources of risk are justified in Italy for FTTH, also for the next regulatory period 2019-2021, due to the specific conditions that show: i) already a national coverage with FTTC solution, achieved recently by the incumbent operator in combination with a low coverage of FTTH; ii) the fact that the investments in FTTH will be done at a national level by an alternative operator with a wholesale only model. The investment in FTTH solution in this context is not an independent choice by the SMP operator, but a reply to the competitive context.</p> <p>This means that the fast deployment of FTTH is a source of increased systematic risk not only for the incumbent but also for a generic operator, due to the fact that every operator deploying VHCN networks face demand uncertainty at retail and wholesale level in combination with the need to find new sources for substantial capital (capital leverage) for asset investments.</p>	In line with the objective of the NGA Recommendation the risk premium evaluated by AGCOM has been seen as an instrument to promote efficient investment by providing the right make or buy signal to the market taking into account the risks incurred by all investing undertakings. The level of the risk addressed is generally systematic and is related to speed up the investment in FTTH network in a context where there is uncertainty about demand for new services and no first mover advantage.	
LU	Yes	Yes	2.50%	Yes	2.50%	Yes	2.50%	other	Passive and Active	Benchmark + consideration of the evolution in the national broadband market (NGA coverage + demand for NGA products)	all NGA infrastructure	
PL	Yes	No		No		Yes	2.05%			As average premium from country, which uses NGA premium		
SI	Yes	Yes	2.50%	Yes	2.50%	Yes	2.50%	Beta comparison	Passive and Active	benchmarking	a premium on WACC value for fixed network	

Source: BEREC RA database 2021

Appendix I - WACC parameter quantitative analysis

Carried out since BoR(17)169, as new observations on WACC estimation become available, the time series on WACC estimation for causal inference analysis have been updated in order to identify parameters that may better explain WACC variations on a historical basis. Over time this exercise provides insight into the results of the evolution of the methodologies applied for each parameters. In this case, the independent variables (parameters for estimating WACC) are considered as causes of the dependent variable (WACC values). Causality exploration aims to determine whether a particular independent variable influences the dependent variable and to estimate the magnitude of the effect, if any.

We use the following regression model, which links the WACC values to six main parameters (data updated in 2021):⁶⁰

$$\text{WACC}_{i_k} = \text{Constant} + \beta_1 \text{RFR}_{i_k} + \beta_2 \text{Equity Beta}_{i_k} + \beta_3 \text{ERP}_{i_k} + \beta_4 \text{gearing}_{i_k} + \beta_5 \text{Debt premium}_{i_k} + \beta_6 \text{Tax}_{i_k}$$

(where i is the year of the data and k identifies countries involved).

Regression analysis can provide a deep understanding and numerical information on the causality between the dependent variable and each independent variable, taking into account information provided by other independent variables.

This cannot be addressed by a simple correlation analysis between each independent and the dependent variable as this only considers a measure of the extent the two variables move together, independently with respect to the information on variation provided by all other independent variables (thus not being able to prove real causality).

Several checks are needed to validate the use of a linearized model in order to infer or predict⁶¹. In case of a panel data analysis using a linear regression model, it is necessary, *inter alia*, to address the following main elements: i) linearity of the relationship between dependent and independent variables; ii) multicollinearity between independent variables; iii) homoscedasticity (constant variance) of the errors; iv) normality of the error distribution.

In the following, “sanity checks” of the proposed linear model have been addressed analysing the residual output of the model before addressing the relevance of variables that better explain observed WACC values.

Linearity

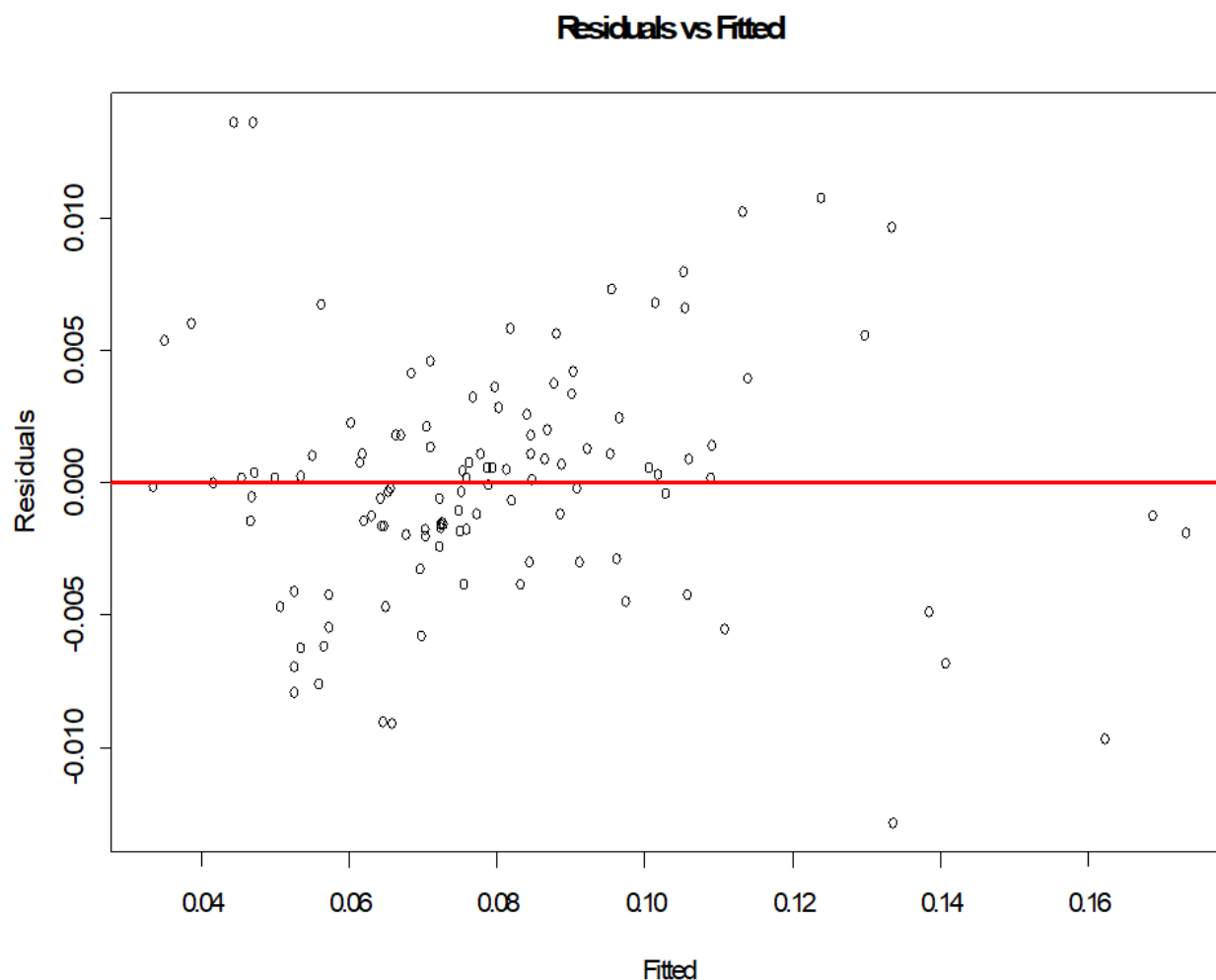
A first verification of the validity of the linear approximation is to detect if some path can be identified in the residual plot (y-axis) with respect to the expected values (x-axis). Points should be distributed symmetrically around a horizontal line in relation to an intercept equal to zero. Different trends indicate at first point the presence of some non-linearity in

⁶⁰ The parameters have been analysed not including adjustment not attributed to single parameters.

⁶¹ “Statistics for business and economics” Heinz Kohler 1994.

the model (Figure 60)⁶². The assumption that the average error $E(\varepsilon)$ is zero everywhere implies that the regression surface accurately reflects the dependency of Y on the X's.

Figure 60 - Linear approximation

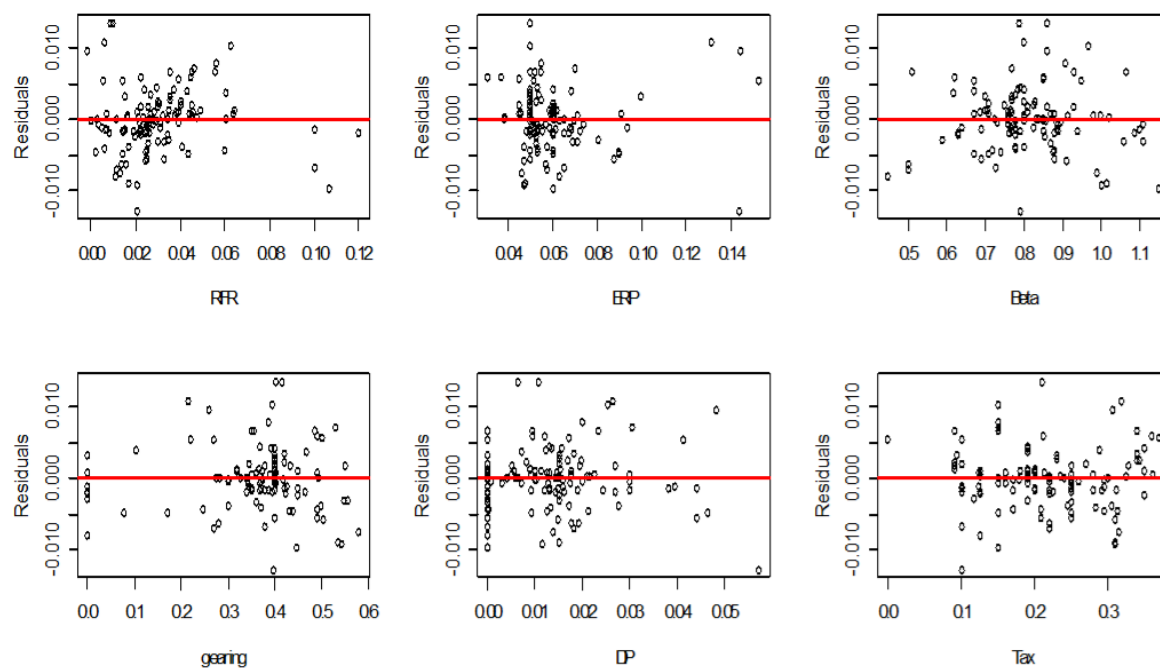


Source: BEREC RA database 2021

Moreover, a deeper analysis on each regressor should be considered plotting the residual previously represented with each independent variable. Also in this case non-linear effects could be detected when paths deviate from the “random” shape (visible in the residual plots).

⁶² The residual of an observed value is the difference between the observed value and the estimated value of the quantity of interest.

Figure 61 - Non-linear effects



Source: BEREC RA database 2021

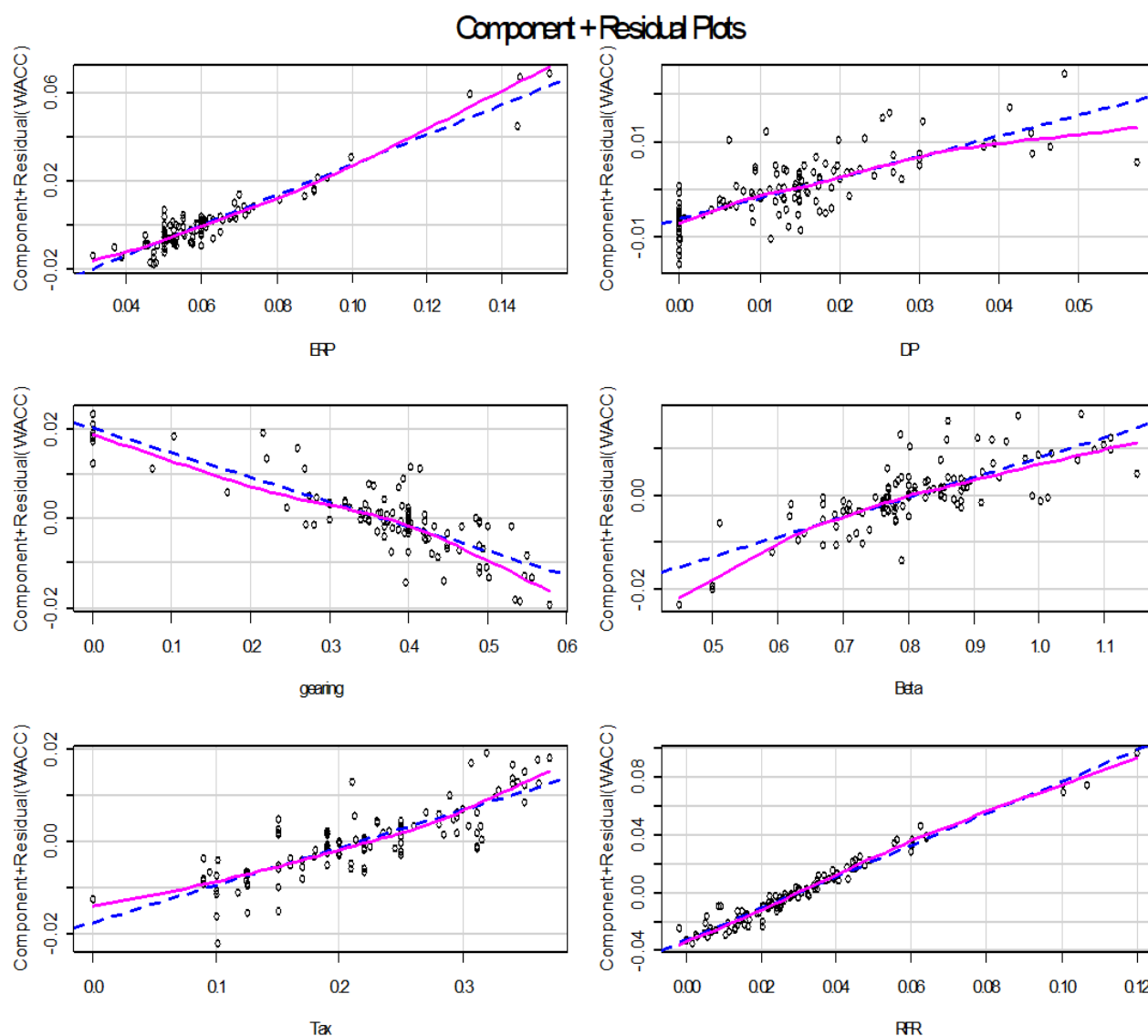
Another relevant measure to detect non-linearity in the model is provided through the use of the partial residual plot⁶³ (Figure 62), which, in case of multiple regression, shows the relationship between a given independent variable and the response variable, given that other independent variables are also in the model. Since in our case the dependent variable depends on six main parameters, the use of a partial residual plot is therefore more correct than simple single-variables scatter plots⁶⁴ (correlation measure).

In Figure 62 a nonparametric fitting (pink line) helps to assess whether the linear trend adequately captures the partial relationship between Y and X. The partial residual plot (blue line) highlights that linear approximation is good for each parameter.

⁶³ Partial residual plot includes $E_{ij} = (\text{residual}_i + \beta_j \cdot x_{ij})$ vs x_{ij} . This simply adds the linear component of the partial regression between Y and x_{ij} (which may be characterised by a nonlinear component) to the least squares residuals. The "partial residuals" E_{ij} are plotted versus x_{ij} , meaning that β_j is the slope of the simple regression of E_{ij} on x_{ij} . Through this plot both monotone and non-monotone non linearity can be detected.

⁶⁴ Regressing each independent variable with the dependent variable like a bi-variate model.

Figure 62 - Nonparametric fitting



Source: BEREC RA database 2021

Normality, multicollinearity, homoscedasticity

In Figure 63 summarised statistics are provided showing that all regressors are statistically significant with an adjusted R squared of 0.98. Moreover, the standard variance inflation factor (VIF) shows no multicollinearity among variables, thus further validating the model. We show hence (i) the residual graph against theoretical values, which looks completely casual, thus not revealing the existence of a residual systemic dependence among variables (already shown in Figure 60); (ii) the normal Q-Q plot of the standardised residues, which graphically verifies the assumption of normality of the erratic component of the linear model; (iii) the chart of square roots of standardised residues against theoretical values, and (iv) the graph of Cook distances, which let us identify three observations as possible outliers.

Figure 63 - Nominal panel data statistics

MODEL INFO:

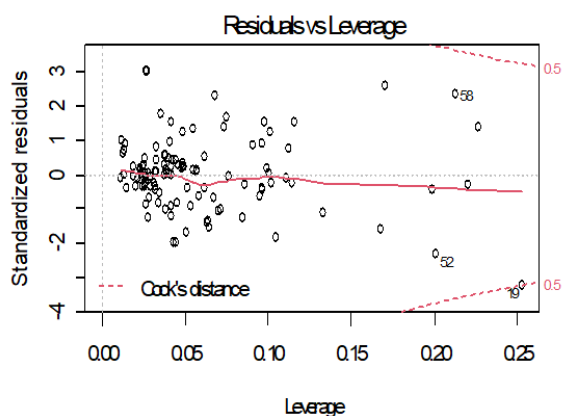
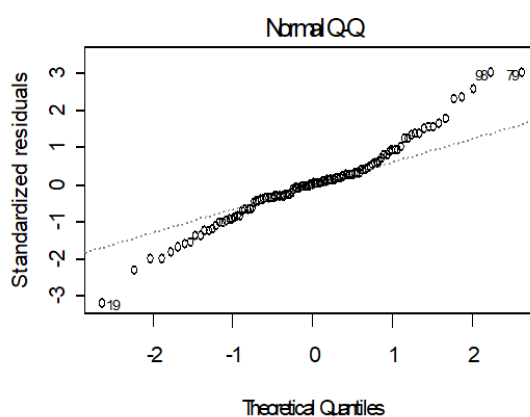
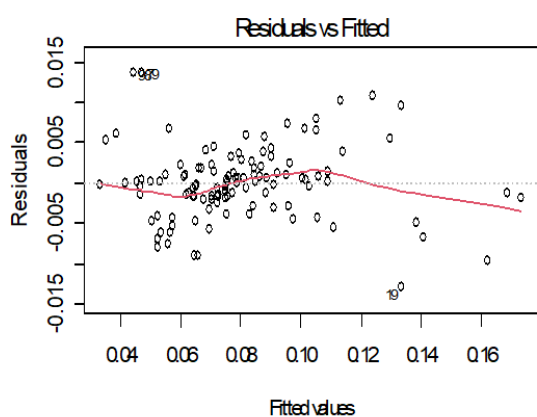
Observations: 117
 Dependent variable: WACC
 Type: OLS linear regression

MODEL FIT:

$F(6,110) = 628.59, p = 0.00$
 $R^2 = 0.97$
 Adj. $R^2 = 0.97$

Standard errors: OLS

	Est.	S.E.	t val.	p	VIF
(Intercept)	-0.03	0.00	-9.34	0.00	
ERP	0.68	0.03	23.27	0.00	1.78
DP	0.43	0.05	9.53	0.00	1.49
gearing	-0.05	0.01	-10.91	0.00	2.15
Beta	0.04	0.00	10.51	0.00	1.53
Tax	0.08	0.01	13.33	0.00	1.27
RFR	1.09	0.02	49.59	0.00	1.15



Source: BEREC RA database 2021

We hence show the same model without six possible outlier observations, by still finding similar results, as shown in Figure 64.⁶⁵

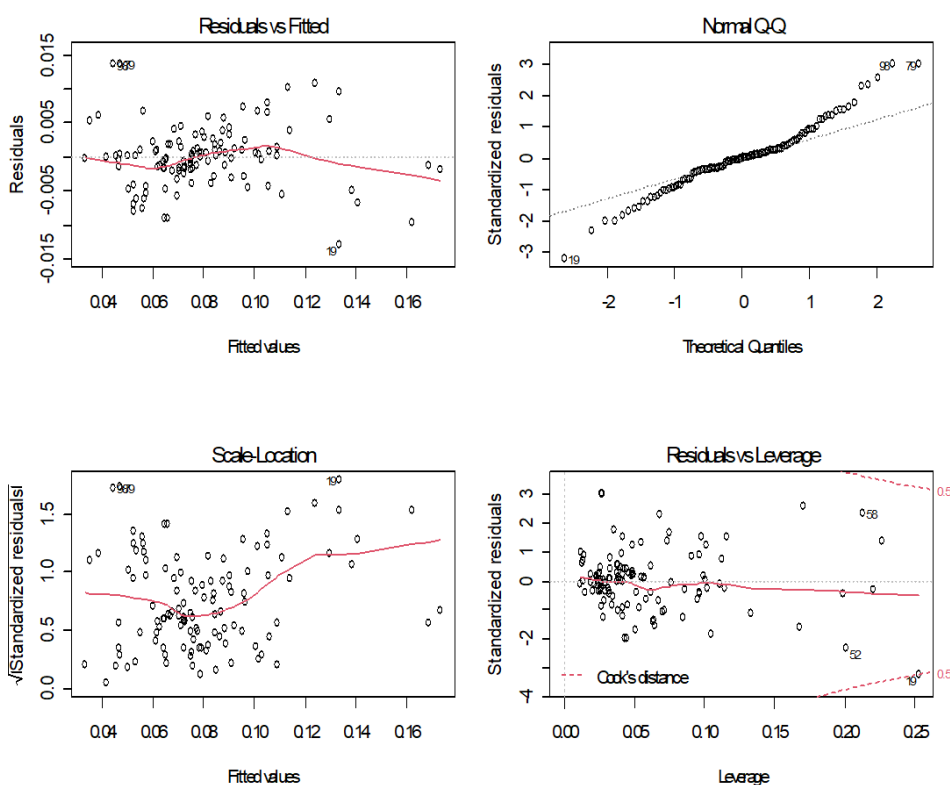
Figure 64 - Nominal panel data statistics without outliers

MODEL INFO:
Observations: 111
Dependent variable: WACC
Type: OLS linear regression

MODEL FIT:
 $F(6,104) = 652.23, p = 0.00$
 $R^2 = 0.97$
Adj. R² = 0.97

Standard errors: OLS

	Est.	S.E.	t val.	p	VIF
(Intercept)	-0.03	0.00	-7.72	0.00	
ERP	0.62	0.04	16.53	0.00	1.41
DP	0.39	0.04	9.50	0.00	1.25
gearing	-0.05	0.00	-11.72	0.00	2.27
Beta	0.04	0.00	11.66	0.00	1.54
Tax	0.07	0.01	13.30	0.00	1.29
RFR	1.14	0.02	52.49	0.00	1.14



Source: BEREC RA database 2021

⁶⁵ Global test and Breush-Pagan test have been carry on with a result to discard the null Hypothesis of Non linearity, Skewness, Kurtosis, Kind of Model (categorical/continuous), Heteroscedasticity.

Figure 65 shows the contribution to the increase in R-squared that each parameter produces when it is added to a model that already contains all of the other variables. Specifically, we include all N-1 variables in the model and we evaluate how well they fit in the model, like in a Backward elimination selection rule in a stepwise regression, and comparing the results with the Model specified with the N independent variable.

Since the change in R-squared analysis considers each variable as the last one entered into the model, the change represents the percentage of the variance one single variable explains that the other variables in the model cannot explain. In other words, this change in adjusted R-squared represents the amount of *unique* variance that each variable explains above and beyond the other variables in the model. We further estimate the Akaike Information Criterion,⁶⁶ comparing the value obtained with a model with N independent variables and the values obtained with models composed by N-1 variables. This analysis confirms what the R-square analysis already highlighted, in terms of relevance of the parameters and provides that no model overfitting problem comes out. In figure 67 we report statistics from the three analysis done, when all the observations are taken into account (n=117), when possible 6 “outliers” have been deleted (n=111), when only EU members are included (n=90).

Figure 65 - WACC Nominal pre-tax R² adjusted variations / AIC variations (full time series analysis)

Number of observation:	Total	RFR	ERP	Tax	gearing	beta	CD
117							
R ² Adj	97.01%	66.18%	14.55%	4.75%	3.17%	2.95%	2.42%
AIC	-1250.9	-366.65	-206.11	-110.45	-83.76	-79.39	-68.43
Number of observation:	Total	RFR	ERP	Tax	gearing	beta	CD
111							
R ² Adj	97.26%	71.83%	7.10%	4.58%	3.55%	3.51%	2.33%
AIC	-1222.12	-365.87	-141	-108.25	-91.41	-90.76	-67.36
Number of observation	Total	RFR	ERP	Tax	gearing	beta	CD
EU NRAs:							
90							
R ² Adj	96.12%	74.21%	11.82%	7.56%	5.94%	5.81%	2.80%
AIC	-996.48	-269.34	-124.94	-96.47	-82.73	-81.48	-48.07

Source: BEREC RA database 2021

The main conclusion prevails that most of the variability is explained by the RFR estimation and, to a lesser extent, by the ERP estimation. Looking at only EU member state countries, ERP is more relevant for understanding the causality variation of the final WACC value. All other parameters provide a much lower statistically significant explanation.

⁶⁶ The Akaike information criterion (AIC) is a measure of the relative quality of statistical models for a given set of data. Given a collection of models for the data, AIC estimates the quality of each model, relative to each of the other models. Hence, AIC provides a means for model selection. Given a set of candidate models for the data, the preferred model is the one with the minimum AIC value. 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.

In the sample there are some NRAs that update the WACC every year and others updating it only every market analysis. The outlined differences in the frequency of WACC estimation may produce an unbalanced sample that over/under-represents some countries in a way that can bias the estimation (intrinsic selection bias⁶⁷). In fact, even if we have considered that each WACC estimation is an independent observation, some parameters can be linked to country specificities, producing a selection bias problem. Such consideration is useful for taking into account the temporal dimension in a more effective way. We have repeated the previous analysis limiting the number of estimations for each NRA to the three more recent observations. From this sample we observe that beta is slightly more explanatory with respect to gearing when also considering older estimations, but it is relevant to observe that ERP has become less relevant for explaining differences between WACC values applied by NRAs. Tax, which is a country parameter, not under NRAs control, has become more relevant in explaining differences with respect to ERP since last year. These results confirm also the fact that by taking into account more recent data ERP is already less relevant in explaining differences between NRAs WACC, in line with a notional approach to estimation.

Figure 66 - WACC Nominal pre-tax R² adjusted variations / AIC variations (reduced time series analysis)

Number of observation: 80 observations	Total	RFR	ERP	Tax	gearing	beta	CD
R ² Adj	96.19%	74.11%	5.19%	5.30%	3.25%	4.84%	3.72%
AIC	-890.37	-236.97	-138.06	-73.74	-40.44	-52.87	-44.89
Number of observation: 64	Total	RFR	ERP	Tax	gearing	beta	CD
R ² Adj	96.73%	77.82%	6.67%	7.35%	4.16%	6.33%	3.44%
AIC	-719.93	-204.62	-70.3	-74.49	-51.63	-68.05	-45.12

Source: BEREC RA database 2021

⁶⁷ The Selection bias is the bias introduced by the selection of individuals, groups or data for analysis in such a way that proper randomization is not achieved, thereby ensuring that the sample obtained is not representative of the population intended to be analysed. It is sometimes referred to as the selection effect. Selection bias may lead to the distortion of a statistical analysis, resulting from the method of collecting samples. If the selection bias is not taken into account, then some conclusions of the study may be false.