

RA Report Chapter 5 - WACC

Table of Contents

5. The Weighted Average Cost of Capital (WACC)	4
5.1 Introduction and main goals of the section	4
5.2 WACC Nominal pre-tax synthetic value.....	11
5.2.1 Risk Free Rate	17
5.2.2 Equity Risk Premium (ERP)	25
5.2.3 Beta	32
5.2.4 The cost of debt	43
5.2.5 Gearing Ratio	52
5.2.6 Tax rate	60
5.2.7 Other Adjustments	62
5.3 NGA Risk premium.....	63
Appendix I - WACC parameter quantitative analysis	67

Table of Figures

Figure 1 - WACC database and frequency of update/calculation	7
Figure 2 - Main statistics nominal pre-tax WACC	12
Figure 3 - Nominal pre-tax WACC	13
Figure 4 - Nominal pre-tax WACC (fixed market 2008-2023).....	13
Figure 5 – WACC Notice adoption 2021-2023	16
Figure 6 – WACC values and WACC Notice adoption 2021-2023	17
Figure 7 – Nominal Risk Free Rate	18
Figure 8 - Nominal Risk Free Rate.....	19
Figure 9 – WACC Notice adoption 2021-2023 (RFR).....	20
Figure 10 - Distribution of time windows RFR (fixed market).....	21
Figure 11 - Main methodology to estimate RFR.....	22
Figure 12 - Methodology used to estimate RFR (fixed market).....	22
Figure 13 - Main methodologies and time windows (frequency, number of NRAs)	23
Figure 14 - Adjustments applied to RFR (fixed market).....	24
Figure 15 - RFR evolution over time (fixed market).....	25
Figure 16 - ERP values	26
Figure 17 - ERP	27
Figure 18 – WACC Notice adoption 2021-2023 (ERP).....	28
Figure 19 – Methodologies for estimating ERP (fixed market)	29
Figure 20 - Methodologies used to determine ERP	30
Figure 21- Methodologies used to determine ERP and RFR.....	31
Figure 22 - Time windows used for ERP/RFR.....	32
Figure 23 - Equity and Asset Beta values (fixed market).....	33
Figure 24 – WACC Notice adoption beta	36
Figure 25 – Equity Beta values and distribution	37
Figure 26 – Before and after WACC Notice adoption 2021-2023 (beta).....	38
Figure 27 – WACC Notice adoption 2021-2023 (beta) (methodologies evolution).....	38
Figure 28 – Methodologies for estimating Beta.....	39
Figure 29 - NRAs not applying the WACC Notice: Beta notional methodology	39
Figure 30 – NRAs not applying the WACC Notice: Beta methodology for sampling period and time windows	40
Figure 31 - Beta/RFR time windows.....	41
Figure 32 - Time window adjustments to Equity Beta	42
Figure 33 - Equity Beta evolution over time	43
Figure 34 – Cost of debt values	44
Figure 35 – NRAs that adopt the WACC Notice approach (debt premium)	45
Figure 36 - Cost of debt value and distribution.....	46
Figure 37 - Before and after WACC Notice adoption 2021-2023 (Debt premium/Cost of debt) ..	47
Figure 38 – Methodologies evolution of cost of debt over time (2019-2023) for the 18 NRAs that applied the WACC Notice.....	48
Figure 39 - Methodology used for estimating cost of debt.....	49
Figure 40 - Cost of debt calculated through debt premium	50
Figure 41 - Bond lengths used for estimating cost of debt/RFR.....	50
Figure 42 - RFR/cost of debt time windows	51
Figure 43 - Adjustments to cost of debt.....	52
Figure 44 - Evolution of cost of debt over time	52
Figure 45 - Gearing ratio	53
Figure 46 - NRAs that adopted the WACC Notice approach (gearing)	54
Figure 47 - Gearing values	55
Figure 48 – WACC Notice adoption 2021-2023 (Gearing).....	56
Figure 49 - Methodologies evolution of gearing over time (2019-2023) for the 18 NRAs that adopted the WACC Notice	56

Figure 50 - Gearing methodology	57
Figure 51 - Gearing methodology	58
Figure 52 - Methodology gearing and cost of debt estimation	59
Figure 53 – Evolution of gearing over time.....	60
Figure 54 - Corporate tax rate	60
Figure 55 - Tax rate currently in use	61
Figure 56 - Evolution of average tax rate over time (fixed market 2008-2023).....	62
Figure 57 - Adjustments to the cost of equity.....	63
Figure 58 - Risk premium.....	64
Figure 59 - Linear approximation	68
Figure 60 - Non-linear effects	69
Figure 61 - Nonparametric fitting	70
Figure 62 - Nominal panel data statistics	71
Figure 63 - Nominal panel data statistics without outliers.....	72
Figure 64 - WACC Nominal pre-tax R ² adjusted variations / AIC variations (full time series analysis)	73
Figure 65 - WACC Nominal pre-tax R ² adjusted variations / AIC variations (reduced time series analysis)	74

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 1 and, more in general, in fixed markets.¹ It also provided information on the evolution of the WACC value over time.

The 2020 and 2021 RA report (BoR (20) 210, BoR (21) 161) provided an update of the information reported since BoR (17) 169 both for parameter values and methodologies with a cut-off date respectively of 1st April 2020 and 2021 including a monitoring exercise of the adoption of the Commission WACC Notice (hereafter WACC Notice). The 2022 report started to benchmark the adoption of the WACC Notice and in the current report the follow-up activity is presented, with an up to date version of the WACC benchmark at the cut-off date of 1st April 2023.

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 by NRAs to the Commission in the EU electronic communication sector. In 2020, 2021, 2022 and 2023 BEREC calculated the main WACC parameters according to the methodology foreseen in the non-binding WACC Notice (BoR (20) 116) (BoR (21) 86), (BoR (22) 70), (BoR (23) 90).

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 WACC 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 WACC 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, BoR (22) 70, (BoR (23) 90) provides a specific guidance on the application of the WACC Notice to NRAs, providing single values for the RFR and ERP and range of values for the beta, gearing and cost of debt.

The WACC is also a relevant topic in the new Draft Gigabit Recommendation. BEREC released the requested opinion in BoR (23) 83, where it emphasized the benefit of the actual framework provided

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

by the (non binding) WACC Notice on efficient application of WACC calculation, which already gives a sustainable and consistent framework with the adequate flexibility for NRAs in application (see cases DE/21/2339, ES/22/2419 and, last, IT/23/2435).

Compared to the BEREK WACC parameters Reports (BoR (20) 116, BoR (21) 86, BoR (22) 70, BoR (23) 90), the present BEREK 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.

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 for legacy copper network and other fixed products if calculated (i.e. civil infrastructures)³ and the following main parameters of the WACC formula based on CAPM methodology – in force in April 2023: 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 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).⁴ The cells marked “X” indicate that in that year single values of each WACC parameter were collected in the RA EWG data base and new value is in charge with respect to the past. Colours provide information on the years where NRAs have taken a decision for the fixed market WACC since 2008: green marks for decisions, red for public consultations⁵, blue for decisions in force in 2023, after the cut-off date of the 1st April 2023, orange for the cases where NRAs declared that a regulated WACC is not any more in charge⁶.

WACC methodologies and values for the fixed market are recorded for 32 NRAs⁷. Most NRAs (18) update the WACC in line with their market analysis or when pricing decisions have been taken. In these cases, a market-specific WACC may be in force for 2 or more years. Some NRAs update yearly (9), but in some cases the update only comes into force when new pricing decisions will be taken.

The dataset used for the following analysis takes into consideration 150 observations for fixed market of all 6 parameters previously listed and 1 final value based on information collected and related to the period 2008-2023. The collected data refers to information provided by NRAs and is updated for the 2023 report.

³ Nono NRA calculates a different WACC for civil infrastructure access. BE calculates, other than legacy WACC, also a WACC for Cable and Broadcasting, while ES also a WACC for broadcasting.

⁴ The table (Figure 1 and 1c) reports the year of adoption [April N-1 to April N], or, when differing, of application.

⁵ 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 2023 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.

⁶ This is the case for BG, DK and NL. BG no longer evaluate the WACC, as all fixed markets (1 and 2) have been found competitive, DK declared that it is currently subject to a commitment period which has begun since 2021. The prices and the conditions are therefore framed in the applicable commitment periods in such a case. It means that a regulated WACC has not been calculated by the NRA for 2023. NL no longer regulates fixed market due to court decisions (see RA section) and therefore does not estimate WACC.

⁷ EE states that its final WACC value is obtained using a benchmark among other NRAs following BEREK benchmark activity, rather than applying a formula.

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 2023 report, in line with the 2022 version, also provides statistics on NGA/VHCN WACC where separately evaluated by NRAs.

Since the report focuses on the application of the WACC Notice, the current WACC in charge clearly 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 Notice came into force; ii) NRAs have made use of the transition period specified within the WACC Notice; iii) other reasons. Overall, the application of the WACC Notice promotes methodological convergence among NRAs, reducing differences in approaching single parameters' estimation.

In line with the 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. With longer time series a general reduction of the dispersion for all values may be observed: mainly for RFR and, to a lesser extent, ERP⁸, 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) as a year by year tool to better figure out the relevance of the parameters that explain differences between NRAs. The information is reported for all countries that have provided information and separately for EU member states.

⁸ For ERP a reduction of "outlier" values is more evident year by year.

Figure 1 - WACC database and frequency of update/calculation⁹

		Fixed Market (Year of adoption)															Frequency Update	
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022		2023
EU member state	AT		X			X			X					X	X			MA/RP
	BE	X		X					X				X					MA/RP
	BG						X			X								
	CY				X				X		X	X	X	X	X	X		MA/RP
	CZ									X			X			X	X	YEARLY
	DE				X						X	X	X	X	X	X	X	YEARLY
	DK								X	X	X	X	X	X				
	EE								X	X	X	X	X	X				
	EL						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		MA/RP
	HU								X	X	X	X	X	X	X	X	X	YEARLY
	IE		X						X					X		X	X	YEARLY
	IT			X					X					X			X	MA/RP
	LT								X			X	X	X	X	X	X	YEARLY
	LU									X					X			MA/RP
	LV														X	X	X	YEARLY
	MT						X							X				MA/RP
NL					X				X									
PL										X	X	X	X			X	YEARLY	
PT								X	X	X			X	X	X	X	YEARLY	
RO						X							X				MA/RP	
SE											X	X		X			MA/RP	
SI							X					X	X		X		MA/RP	
SK						X			X			X	X			X	YEARLY	
NO EU memembr	CH	X				X				X	X	X					YEARLY	
	IS										X					X		
	LI						X										X	MA/RP
	MK		X															
	ME													X	X			
	NO						X				X	X			X	X		MA/RP
	RS							X	X	X	X	X	X	X	X	X	X	YEARLY
	UK			X					X			X	X					MA/RP
	XK											X	X					
Number of	2	5	3	2	4	10	4	11	12	12	17	18	13	15	18	5		

X	New data reported with respect to 2022 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
	No Wacc in charge

Source: BEREC RA database 2023

Focus on the application of the WACC Notice

In line with the 2022 year report the present report provides also information about the application of the WACC Notice and on the use of the corresponding parameters estimated by BEREC Reports BoR (20) 116, BoR (21) 86, BoR (22) 70, BoR (23) 90.

⁹ 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 have 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 2023).

The WACC Notice was 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 2020 to 30 June 2021¹⁰.

The following table reports the main methodology for legacy WACC estimation available in the WACC Notice and the corresponding relevant values included in the BEREC WACC reports BoR (20) 116 BoR (21) 86 and BoR (22) 70 and BoR (23) 90¹¹.

Figure 1b - WACC Notice approach and WACC BEREC reports BoR (20) 116, BoR (21) 86, BoR (22) 70, BoR (23) 90 main values

	Commission Notice methodology (by points)	BEREC WACC BoR(20)116 (values)	BEREC WACC BoR(21)86 (values)	BEREC WACC BoR(22)70 (values)	BerEC WACC BoR(23)90 (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	Eurostat based calculation on monthly data for each country	Eurostat based calculation on monthly data for each country	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)	14 comparable companies: 1.15% (arithmetic average); 3.12%(max); 0.44% (min)	15 comparable companies: 1.31% (arithmetic average); 3.17%(max); 0.41%(min)	15 comparable companies: 1.48% (arithmetic average); 3.29%(max); 0.52%(min)
ERP	Single European Equity risk premium based on historical data (arithmetic average of historical equity premium)	Single EU ERP: 5.31%	Single EU ERP: 5.50%	Single EU ERP: 5.70%	Single EU ERP 5.92%
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.	14 comparable companies: 0.47 (arithmetic average) asset beta; 0.57 (max) asset beta; 0.33 (min) asset beta; 0.74 (arithmetic average) equity beta; 1.12 (maximum) equity beta; 0.42 (minimum) equity beta.	15 comparable companies: 0.41 (arithmetic average) asset beta; 0.5 (max) asset beta; 0.22 (min) asset beta; 0.67 (arithmetic average) equity beta; 1.02 (maximum) equity beta; 0.33 (minimum) equity beta.	15 comparable companies: 0.38 (arithmetic average) asset beta; 0.47 (max) asset beta; 0.22 (min) asset beta; 0.64 (arithmetic average) equity beta; 1.07 (maximum) equity beta; 0.31 (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).	14 comparable companies: 39.2% (arithmetic average); 63.24% (max); 13.61% (min).	15 comparable companies: 42.42% (arithmetic average); 70.52% (max); 13.28% (min).	15 comparable companies: 45.36% (arithmetic average); 75.02% (max); 13.04% (min).

Source: BEREC RA database 2023

¹⁰ Point 71 of the WACC 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”.

¹¹ This report refers refer also to the BEREC WACC report published in June 2023 as, even if published after the cut-off date of 1st of April 2023, several NRAs have adopted a WACC decision retroactively for 2022-2023, using the last available data reported in BoR (23) 90.

28 NRAs have provided information on their final fixed market WACC estimation in the 2023 survey, in which 18¹² NRAs have provided updated values, as shown in Table 1 (AT, CZ, DE, ES, HR, HU, IE, IT, LT, LV, PL, PT, SK, IS, LI, ME, NO, RS) updated values and reported in red, and then 15 NRAs (AT, CZ, DE, ES, HR, HU, IT, LV, PL, PT, SK, IS, LI, NO, RS) of those 18 NRAs that updated the value since last year report fully or almost completely apply the WACC Notice and calculate parameters according to the corresponding BEREC parameters report. DE, IT, ES apply the WACC Notice and the BEREC WACC parameters report with a country specific calculation of RFR in response to current macroeconomic issues. Including the NRAs that have applied the WACC Notice since last year, 15 NRAs fully apply the WACC Notice and the corresponding relevant BEREC parameters estimation (AT, CZ, FR, HR, HU, IS, LI, LU LV, NO, PL, PT, SE, SI, SK); six NRAs apply the WACC Notice partially or with some adaptation (CY, DE, ES, IT, RO, RS), the remainder do not apply the WACC Notice.

14 NRAs have notified the WACC to the Commission since the WACC Notice has been in charge and in 2021 one case (where the WACC Notice was only partially applied (DE)) the Commission has invited BNetzA to adjust the methodology to come in line with the five year averaging window for determining the risk free rate as early as possible. In ES (ES-2022-2419) and IT(IT-2023-2435) cases the Commission accepted NRA's country specific RFR calculation in light of current macroeconomic conditions but invited NRAs to contact the Commission before notifying thus enabling preliminary discussion and evaluation of eventual adjustments of parameters calculations with respect to the WACC Notice approach

In the case of DE the time window for averaging the RFR had been extended to 10 years, all other parameters being in line with the relevant BEREC parameters report. . In the ES case a weighted average between two time windows of the return of 10 years own country bonds has been considered (weighted average between the two time windows: the BEREC estimation and last six months after the first of April). In the IT case, the RFR has been adjusted to take into account a more "efficient" estimation of the implicit inflation rate included in the nominal risk free rate, i. e. an estimation of the real RFR in the same time windows (five years) used by BEREC has been used and the new nominal RFR has been derived using a more efficient value of the long run inflation rate than the one already included in nominal national bonds.

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. It should be pointed out that regulation in access markets has been removed in RO.

Three NRAs (ME, EL, LT) have not (yet) applied the WACC Notice even though their decision has been taken during 2020 or 2023 (at a time when the transition period still applied). In IE case the WACC has been updated in 2021 and 2022 following the methodology defined in a decision of 2020 before the Commission Notice and BEREC calculation entered in force. This methodology would be in charge for three-four years.¹³ In EL the fixed WACC has been notified and adopted in 2020, for LT the national law regulates the WACC calculation.

¹² LU is not included in the group of NRAs that have updated their WACC, as the nominal pre-tax WACC that is considered for benchmarking has not changed since last year's report, even though the inflation rate for the real WACC estimation has been updated.

¹³ <https://www.comreg.ie/publication/review-of-weighted-average-cost-of-capital>. In IE case the approach cannot be considered in line with the Commission Notice as it is based on a very wide sources of evidence where the Commission Notice approach and Berec calculations are only one, for some parameters. Moreover the estimation of the final WACC, on annual basis, is produced by IE adjusting the final cost of debt and cost of equity of the 2020 estimation. So in the present report in line with information provided, the values for each parameter of IE are reported in line with the one calculated for 2020 estimation, where adjustment on cost of debt and cost of equity, are also taken into account to produce the final value of the WACC.

SK, HU, LI used BoR(23)90 as the relevant BEREC WACC report for parameter estimation even if it was published later than the cut-off date of 1st of April 2023, but the WACC estimation is in charge for 2023.

To summarise: in the present survey, 21 NRAs have declared to “fully” or “partially” apply the WACC Notice and the corresponding BEREC WACC parameters report. In general when “fully” has been declared (18 NRAs: AT, CZ, DE, ES, FR, HR, IT, HU, IS, LI, LU, LV, NO, PL, PT, SE, SI, SK) it means that the WACC Notice has been followed at least for 4 of 5 five parameters (RFR, ERP, Beta, gearing and debt premium). In case “partially” has been declared the application of the WACC Notice and the corresponding BEREC WACC parameters report is generally not applied for more than one or two parameters (RS, CY) or a general compliance with the methodology prescribed in the WACC Notice for some parameters and transition period (RO).

In all other cases, as already reported, the motivation related not to apply the WACC Notice is generally due to the fact that the WACC had been estimated before the WACC Notice had come into charge.

The three NRAs that partially apply the WACC Notice are: CY: Beta and ERP are in line with the estimated parameters in the BoR (21) 86 but derived from another source; RS, for ERP and Beta a specific methodology and adjustments for national circumstance are considered; RO estimated the WACC parameters before the first relevant BEREC report was published.

18 NRAs are considered to apply the WACC Notice fully (AT, CZ, DE, ES, FR, HR, HU, IS, IT, LI, LU, LV, NO, PL, PT, SE, SI, SK) including countries that apply it using the appropriate flexibility considering also the fact that those cases have been commented and accepted by the Commission in the notification process according to art 32 of EEC.

The following table reports all NRAs that fully or partially apply the WACC Notice and the relevant BEREC WACC parameters report. Green highlights show when the WACC Notice is fully applied.

The following table summarises the situation before the 1st April 2023.

Figure 1c – Adoption of the WACC Notice¹⁴

Countries	Year of adoption	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	BEREC WACC report
CZ	2023	Yes completely		Yes	No		Bor(22)70
LI	2023	Yes completely		No			Bor(23)90
LV	2023	Yes completely		No			Bor(22)70
SK	2023	Yes completely		No			Bor(23)90
DE	2023	Yes Partially		Yes	Yes	To apply the Notice as soon as the macroeconomic condition become favorable	Bor(22)70
AT	2022	Yes completely		Yes	No		Bor(22)70
HR	2022	Yes completely		Yes	No		Bor(22)70
HU	2022	Yes completely		No			Bor(23)90
IS	2022	Yes completely		-			Bor(21)86
NO	2022	Yes completely		Yes	No		Bor(22)70
PL	2022	Yes completely		Yes	Yes	The comments concerned the lack of national consultations and the approach to determining the capital structure based on the gearing ratio	Bor(23)90
PT	2022	Yes completely		Yes	Yes	Not related to WACC	BoR (22) 70
ES	2022	Yes completely		Yes	Yes	Preferably to hold a meeting with EC before public consultation	Bor(22)70
IT	2022	Yes completely		Yes	Yes	Commission recognizes the impact of rapidly rising inflation and could consider issuing improved guidance for NRAs for calculating the WACC.	Bor(22)70
FR	2021	Yes completely		Yes	No		Bor(20)116
SE	2021	Yes completely		Yes	No		Bor(21)86
SI	2021	Yes completely		Yes	No		Bor(20)116
LU	2020	Yes completely		Yes	No		Bor(20)116
CY	2022	Yes Partially	Yes	No	0		Bor(21)86
RS	2022	Yes Partially	-	No	0	0	Bor(22)70
RO	2020	Yes Partially	Yes	Yes	Yes	EC considered ANCOM justification for non-application of the Notice	0
LT	2022	No	No	No	No	Calculations of WACC are based on legal basis of legislations in Lithuania	
ME	2022	No	No	No	No	0	NO
IE	2022	Value in charge before the issue of EC notice	No	No	0		
EL	2020	No	No	No	0		
BE	2019	Value in charge before the issue of EC notice	-	No	No		
MT	2019	Value in charge before the issue of EC notice	-	No	0		
FI	2018	Value in charge before the issue of EC notice	-	-	-		

Source: BEREC RA database 2023

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 2023 (28 NRAs¹⁵ for the fixed market) and, separately, for the EU members states (23

¹⁴ In red are those NRAs that fully apply the WACC Notice, in blue the NRAs that partially apply the WACC Notice in black the countries that do not apply the WACC Notice

¹⁵ AT, BE, CY, CZ, DE, EL, ES, FI, FR, HR, HU, IE, IT, LT, LV, LU, MT, PL, PT, RO, SE, SI, SK, NO, RS, IS, ME, LI.

NRAs for the fixed market) which are subject to the same Regulatory framework (including the WACC Notice). Main statistics are shown for the 18 NRAs that fully apply the WACC Notice and the corresponding BEREC WACC Report (AT, CZ, DE, ES, FR, HR, IT, HU, IS, LI, LU, LV, NO, PL, PT, SE, SI, SK).

Figure 2 - Main statistics nominal pre-tax WACC

	Average	Median	Standard Deviation	Relative Standard Deviation	Maximum	Minimum
WACC fixed Nominal Pre-tax 28 NRA;	5.82%	5.13%	1.79%	30.78%	9.98%	2.84%
(2022-27)	(5.82%)	(5.51%)	(1.62%)	(27.79%)	(9.73%)	(3.75%)
(2021-29)	(6.58%)	(6.51%)	(1.50%)	(22.82%)	(10.28%)	(4.04%)
(2020-31)	(7.22%)	(7.1%)	(2.06%)	(28.53%)	(13.40%)	(3.33%)
(2019-32)	(7.71%)	(7.28%)	(2.23%)	(28.87%)	(13.45%)	(4.04%)
(2018-32)	(7.96%)	(7.73%)	(2.34%)	(29.39%)	(14.30%)	(4.04%)
WACC fixed Nominal Pre-tax 23 EU NRAs	5.56%	5.01%	1.40%	25.23%	8.49%	3.63%
(2022-23)	(5.73%)	(5.51%)	(1.49%)	(26.02%)	(8.64%)	(3.75%)
(2021-25)	(6.47%)	(6.51%)	(1.28%)	(19.84%)	(8.64%)	(4.45%)
(2020-24)	(7.07%)	(7.13%)	(1.40%)	(19.81%)	(10.68%)	(4.54%)
(2019-26)	(7.60%)	(7.28%)	(1.87%)	(24.60%)	(13.45%)	(4.62%)
(2018-26)	(7.86%)	(7.73%)	(1.96%)	(25.00%)	(14.30%)	(14.30%)

Source: BEREC RA database 2023

The average WACC values currently in force for fixed markets have decreased in comparison to the previous year (values in brackets), specifically when considering EU NRAs.¹⁶ A dispersion diagram is reported in the box-plot in Figure 4.¹⁷

In Figure 3 WACC values for the fixed 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)¹⁸ are also shown. The eighteen NRAs that fully or partially apply the WACC Notice as well as the BEREC WACC parameters estimation in BoR (20) 116, BoR (21) 86, BoR (22) 70, BoR (23) 90 have been highlighted in green. 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 rates.¹⁹ Nevertheless, the RA survey included a question on other WACC values in charge for other services other than the legacy WACC and NGA premium. Only two NRAs replied that they evaluate a different WACC for other services (BE and ES): BE estimates a different WACC for cable and mobile services; ES estimates a different WACC for Broadcasting services (which is out of the scope of the fixed market). No NRA evaluates a different WACC for civil infrastructure access other than legacy and NGA premium.

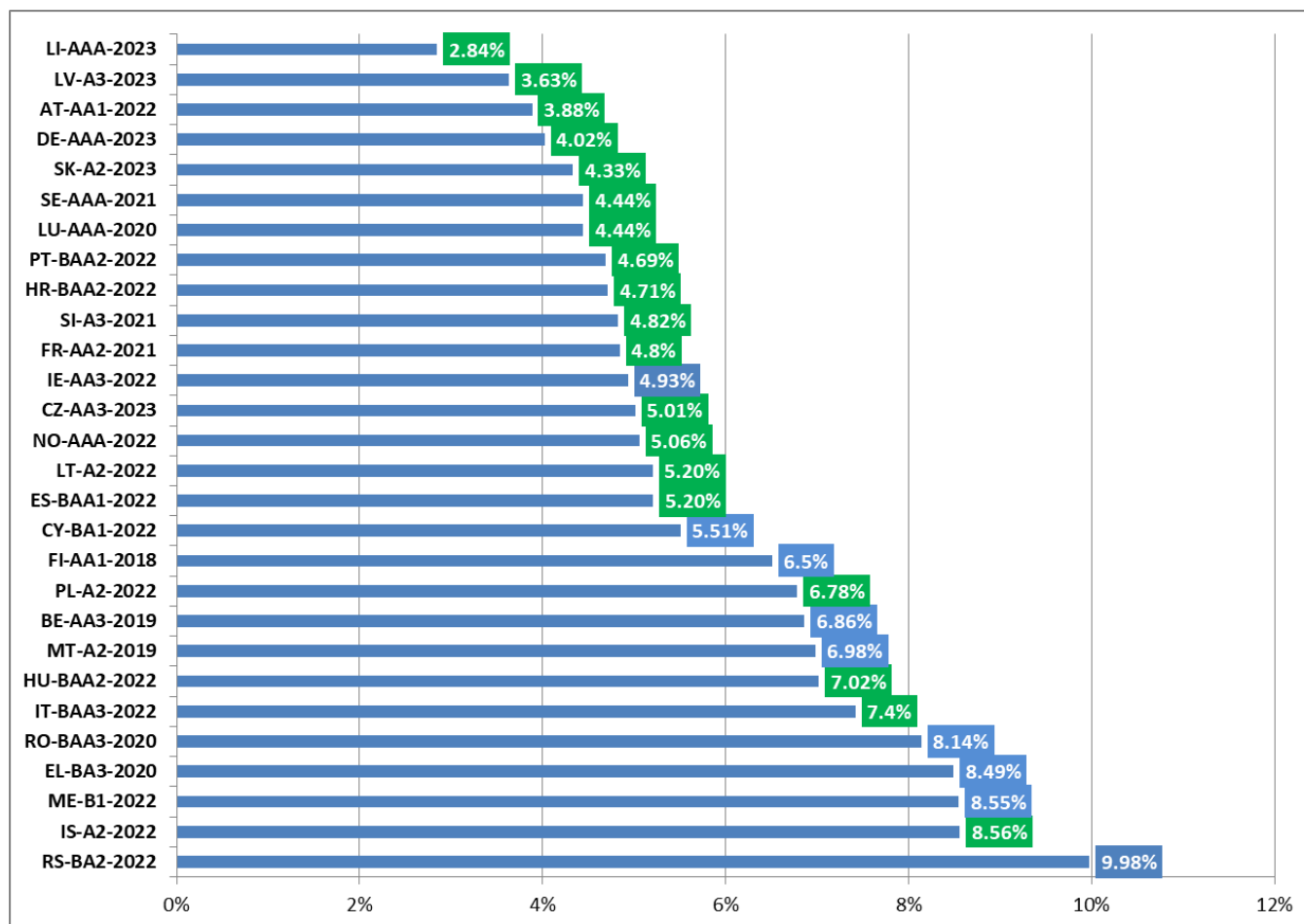
¹⁶ In the tables the information of previous year's statistics are also given providing the year of estimation and the corresponding number of countries included.

¹⁷ 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.

¹⁸ Figures on country credit rating are in line with the one reported in BoR (23) 90.

¹⁹ 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



Source: BEREC RA database 2023

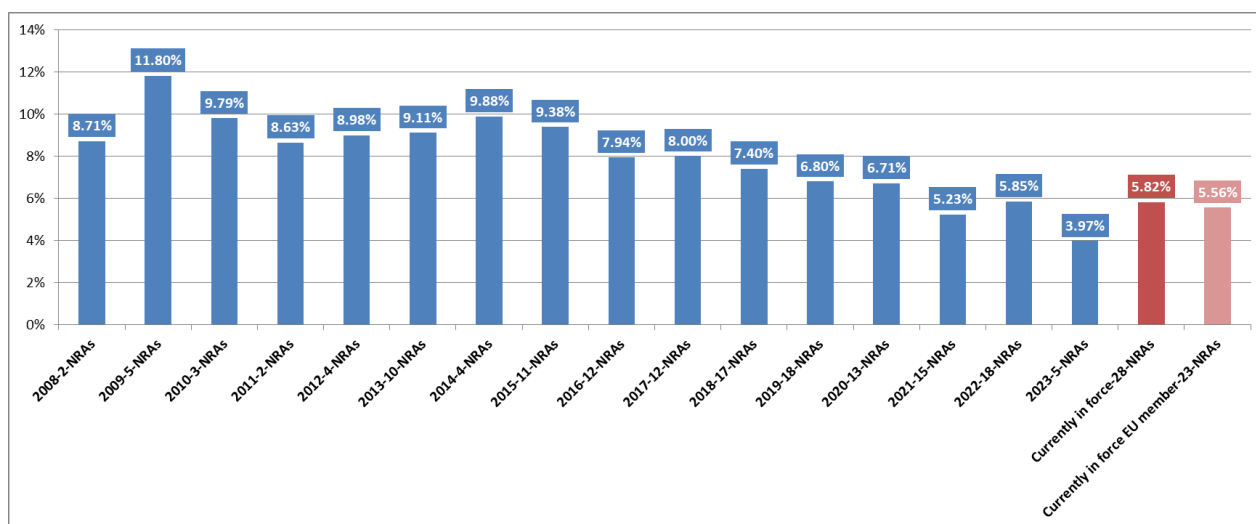
Figure 4 shows the average year-by-year values (NRAs that have calculated WACC in the corresponding year) and the resultant box plot of the nominal pre-tax WACC. The box plot in this figure only provides information about the dispersion between values while the average value is reported in figure 2. 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.²⁰

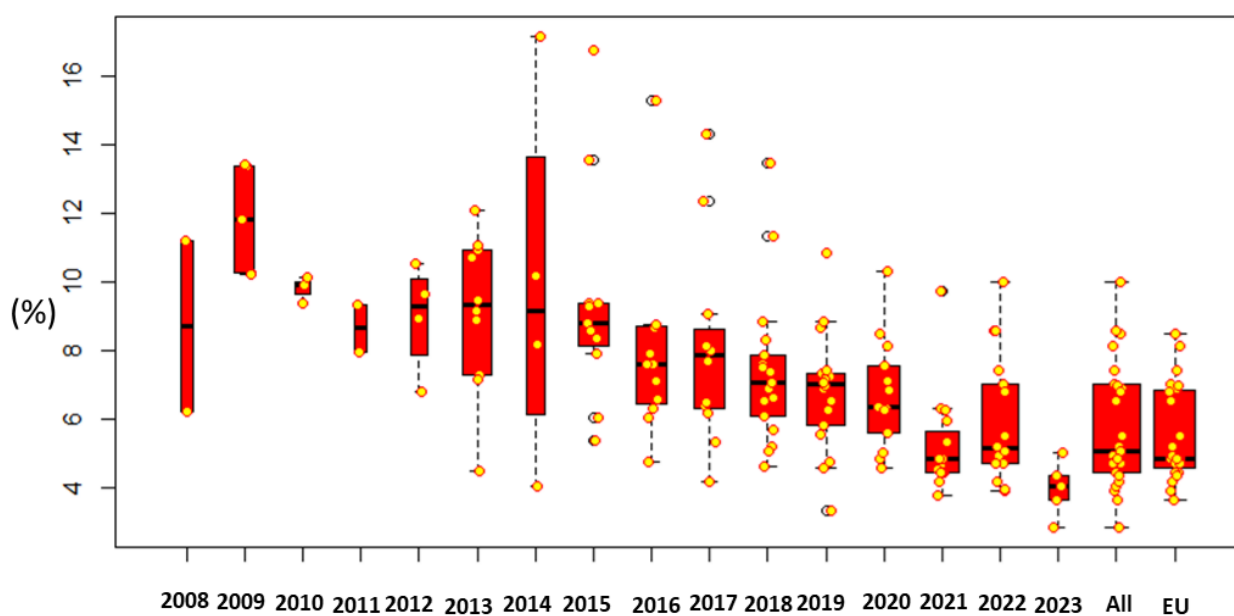
The average WACC has been decreasing since 2017.

Figure 4 - Nominal pre-tax WACC (fixed market 2008-2023)

²⁰ DE: the real pre-tax fixed WACC in force equals 3.2%.



WACC Nominal pre tax



Source: BEREC RA database 2023

In order to explore the WACC parameters’ weight with respect to the final WACC value, the regression presented in BoR (17) 169 and following Regulatory accounting reports 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 WACC Notice.

This year 17 NRAs have provided new WACC values, i.e. more than 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, which is the second most relevant parameter after RFR in explaining WACC differences including all observations from the beginning (2008), is becoming year by year less relevant than “Tax” parameters as specific country parameter in explaining the differences in final WACC values.²¹

This result is in line with the fact that the ERP estimation through a notional approach (following BERC calculation) by most NRAs (due to the application of the WACC Notice) leads to a reduction in its spread and differences. If we apply the same regression focusing only on recent time series panel data (2018 onwards) we can observe that the most relevant country specific parameters in explaining differences are RFR and Tax. Notional parameters Beta, gearing, ERP and debt premium, in this order of relevance, provide a less important contribution to explaining differences in final WACC values which shows that the application of the WACC Notice starts to have a visible effect in converging notional values. This is also consistent with the WACC Notice approach that provides some flexibility for NRAs to choose the peer group for the beta estimation and gearing estimation to better reflect national circumstances.

In each parameter section a specific analysis on how the WACC Notice has been addressed and applied by the NRAs, is provided in light of the flexibility given by the WACC Notice itself.

Considering specific statistics of the 18 NRAs that have applied the WACC Notice, in this year report, the impact in comparison to previous estimations is considered:

In 2021, the first year in which the RA report started to monitor the adoption of the WACC Notice, 6 NRAs applied the WACC Notice (DE, ES, FR, LV, PL, PT); in such case some adaptation and judgment has been effectively applied by DE on the RFR for stability and consistency reason when ES adjusted RFR for Quantitative Easing reason. In 2022 monitoring exercise another seven NRAs started to apply the WACC Notice (AT, CZ, HU, LU, SE, SI, SK) and three NRAs out of the first group updated their WACC using new data available from the BERC WACC report (DE, ES, LV). In 2023, a further four NRAs applied the WACC Notice (HR, IT, IS, LI) and ten NRAs of the fourteen NRAs that previously applied the WACC Notice updated their WACC by using the parameters of the new BERC WACC report (AT, CZ, DE, ES, HU, LV, PL, PT, SK, NO).

In the following table relevant BERC WACC reports used by NRAs for estimation are reported considering the NRAs that have applied the Notice since 2020; the year of adoption of the corresponding value in parentheses is reported in line with the year of adoption reported in figure 1.²²

²¹ 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).

²² Blue refers to the 2021 RA report; green to the 2022 RA report update, red to the current RA report 2023.

Figure 5 – WACC Notice adoption 2021-2023

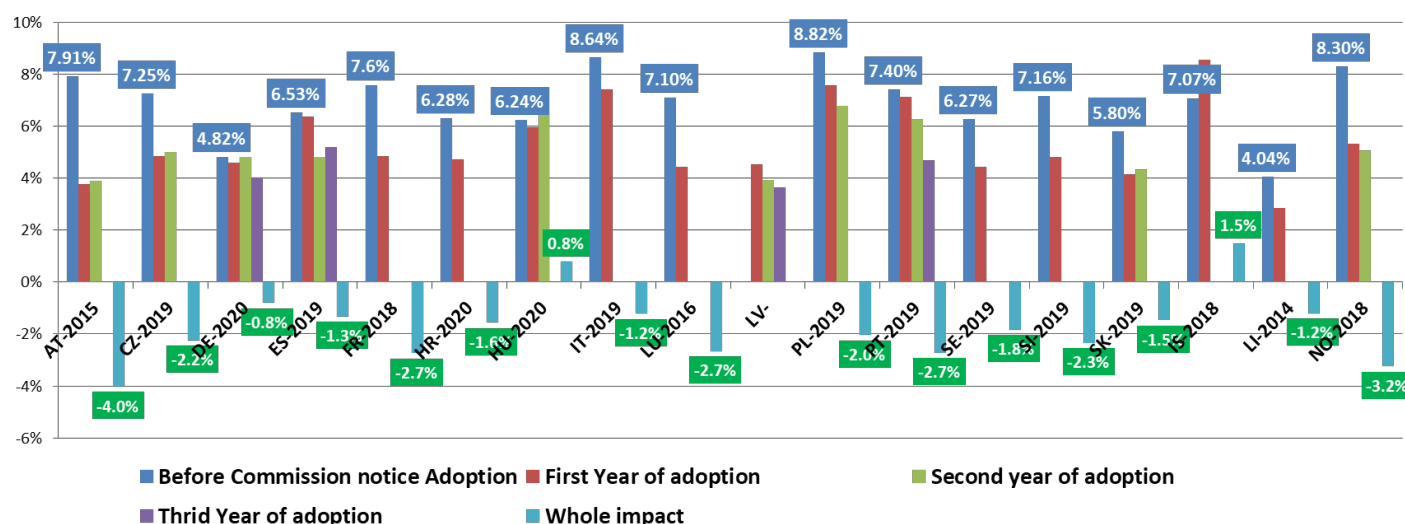
	Countries that applied the Notice since 2021 RA report	Countries that applied the Notice in 2022 RA report	Countries that applied the Notice in 2023 RA report
AT		Bor(21)86 (2021)	Bor(22)70 (2022)
BE			
CY			
CZ		Bor(21)86 (2022)	Bor(22)70 (2023)
DE	Bor(20)116 (2021)	Bor(21)86 (2022)	Bor(22)70 (2023)
EL			
ES	Bor(20)116 (2020)	Bor(21)86 (2021)	Bor(22)70 (2022)
FI			
FR	Bor(20)116 (2021)	Bor(20)116	Bor(20)116
HR			Bor(22)70 (2022)
HU		Bor(21)86 (2021)	Bor(23)90 (2022)
IE			
IT			Bor(22)70 (2022)
LT			
LU		Bor(20)116 (2021)	Bor(20)116
LV	Bor(20)116 (2021)	Bor(21)86 (2022)	Bor(22)70 (2023)
MT			
PL	Bor(20)116 (2020)	Bor(20)116	Bor(23)90 (2022)
PT	Bor(20)116 (2020)	Bor(21)86 (2021)	Bor(22)70 (2022)
RO			
SE		Bor(20)116 (2021)	Bor(20)116
SI		Bor(20)116 (2021)	Bor(20)116
SK		Bor(22)70 (2022)	Bor(23)90 (2023)
IS			Bor(21)86 (2022)
LI			Bor(23)90 (2023)
ME			
NO		Bor(21)86 (2021)	Bor(22)70 (2022)
RS			
Number of countries that have been updated through the notice	6	14	18

Source: BEREC RA database 2023

On the basis of the previous table, the following situation in term of WACC variations can be detected from the last estimation before the WACC Notice had been adopted by each NRA. The last value in charge before the WACC Notice was adopted is reported in blue; values updated after the adoption of the WACC Notice follow. For each country the year of estimation before the adoption of the WACC Notice approach is given. The final WACC value is generally decreasing, the variation being between

-0.8% and -3.2%. Only in two cases (HU, IS) the application of the WACC Notice resulted in a small increase of the final WACC value in comparison to the last one adopted before the adoption of the WACC Notice. This trend is a sum of effects related mainly to the market situation that changed over the years: i) reduction of the “systematic risk” of the Telecoms sector (affecting Beta); ii) low interest rate for a long time before the 2022 (affecting RFR); iii) substantial stable equity premium evaluated over a long-term historical basis (affecting ERP).²³

Figure 6 – WACC values and WACC Notice adoption 2021-2023



Source: BEREC RA database 2023

5.2.1 Risk Free Rate

see BoR (17) 169²⁴, BoR (18) 167²⁵ BoR(19)240²⁶, BoR (20) 116²⁷ BoR (21) 86²⁸ BoR (22) 70 BoR (23) 90²⁹ for definition and general financial theory

Main output from the survey.

Based on the replies provided in the 2023 survey the following statistics have been derived for all responding NRAs and for EU NRAs separately (2022-2018 values in brackets).³⁰

²³ The methodology proposed by the WACC Notice on the EU-ERP notional methodology based on historical data estimation reduced the possibility for NRAs to adapt the ERP methodology to maintain a more stable TMR (Total Market Return).

²⁴ <https://www.berec.europa.eu/en/document-categories/berec/reports/berec-report-regulatory-accounting-in-practice-2017>.

²⁵ <https://www.berec.europa.eu/en/document-categories/berec/reports/berec-report-regulatory-accounting-in-practice-2018>.

²⁶ <https://www.berec.europa.eu/en/document-categories/berec/reports/berec-report-regulatory-accounting-in-practice-2019-including-wacc-chapter>

²⁷ <https://www.berec.europa.eu/en/document-categories/berec/reports/berec-report-on-wacc-parameter-calculations-according-to-the-european-commissions-wacc-notice>.

²⁸ <https://www.berec.europa.eu/en/document-categories/berec/reports/berec-report-on-wacc-parameter-calculations-according-to-the-european-commissions-wacc-notice-of-6-november-2019>

²⁹ <https://www.berec.europa.eu/en/document-categories/berec/reports/berec-report-on-wacc-parameter-calculations-according-to-the-european-commissions-wacc-notice-of-6th-november-2019-wacc-parameters-report-2023>

³⁰ Data includes adjustments that can be attributed to RFR, as declared by NRAs, consistent with the final WACC estimation.

Figure 7 – Nominal Risk Free Rate

2021	Average	Median	Standard Deviation	Relative Standard Deviation	Maximum	Minimum
Nominal RFR-fixed market; Pre-tax 28 NRA;						
(2022-27)	1.80% (1.55%)	1.51% (1.39%)	1.43% (1.06%)	79.49% (68.27%)	5.78% (3.84%)	0.20% (0.25%)
(2021-29)	(1.96%)	(2.16%)	(1.07%)	(54.71%)	(4.62%)	(0.17%)
(2020-31)	(2.52%)	(2.30%)	(1.95%)	(77.28%)	(10.04%)	(0%)
(2019-32)	(2.70%)	(2.50%)	(1.90%)	(70.18%)	(10.04%)	(0.31%)
(2018-32)	(3.00%)	(2.59%)	(2.11%)	(70.54%)	(10.04%)	(-0.17%)
Nominal RFR-fixed market EU: Pre-tax 23 EU NRAs						
(23-2022)	1.48% (1.38%)	1.43% (1.01%)	1.02% (0.94%)	68.78% (68.05%)	3.97% (2.93%)	0.20% (0.25%)
(25-2021)	(1.76%)	(2.05%)	(0.89%)	(50.74%)	(3.01%)	(0.17%)
(24-2020)	(2.24%)	(2.27%)	(1.26%)	(56.34%)	(6.39%)	(0.27%)
(2019-26)	(2.34%)	(2.34%)	(1.32%)	(56.18%)	(6.39%)	(0.31%)
(2018-26)	(2.70%)	(2.59%)	(1.71%)	(63.30%)	(7.21%)	(-0.17%)

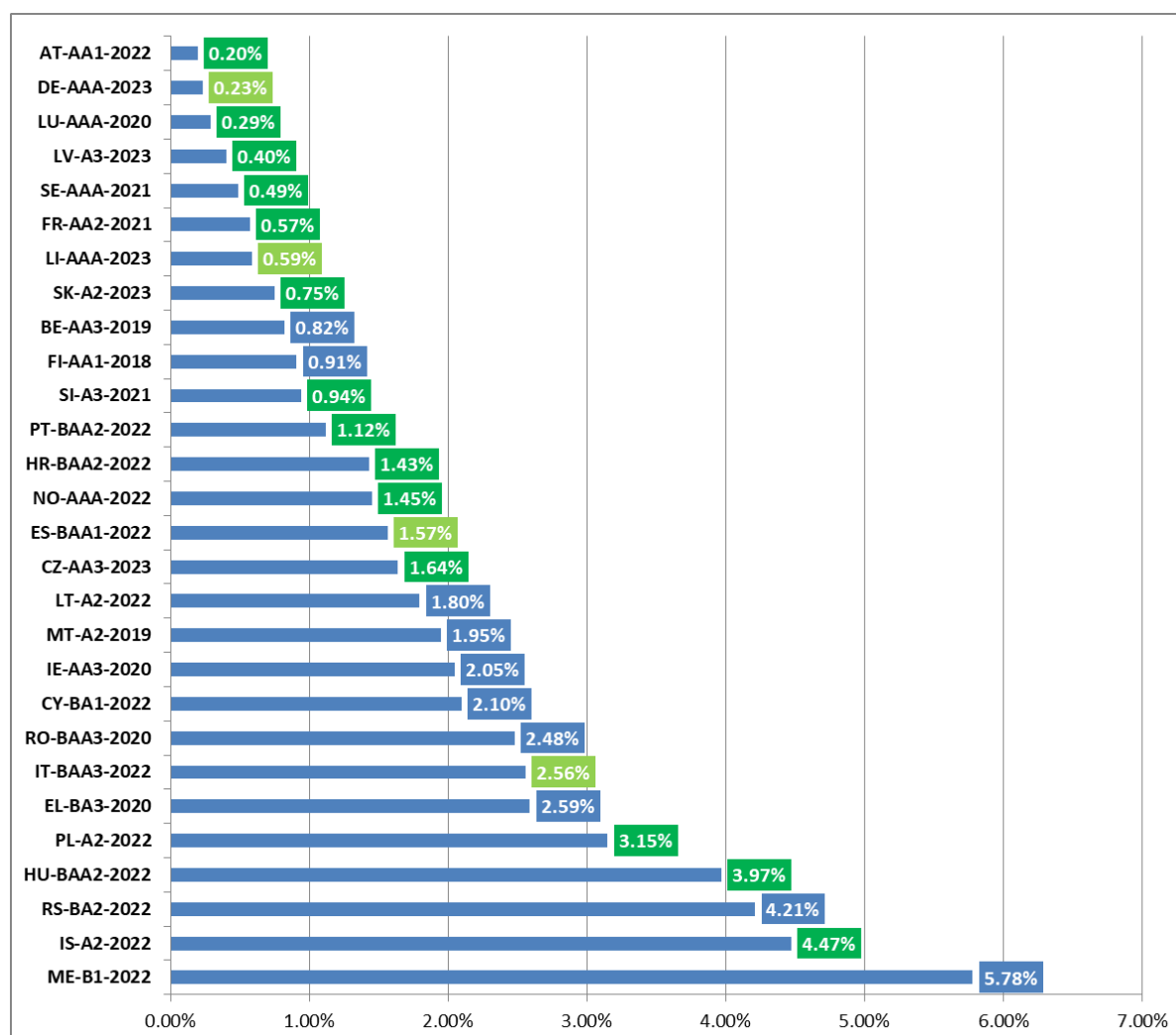
Source: BEREC RA database 2023

The decrease of the RFR shown past year reduced this year, following the international downward trend of interest rate evolution - even if the differences among countries remained relatively stable. It should be noted that differences are more pronounced when non-EU members are included in the sample.

Considering the 18 NRAs that have applied the WACC Notice and the corresponding BEREC WACC Report, 4 NRAs (DE, ES, IT, LI³¹) have adapted the corresponding values provided in the relevant BEREC WACC Report or the methodology defined by the Commission, all other 14 NRAs have used the values available in the corresponding BEREC WACC Report.

³¹ No values have been published for LI in the corresponding Report for RFR BoR (23) 90.

Figure 8 - Nominal Risk Free Rate



Source: BEREC RA database 2023

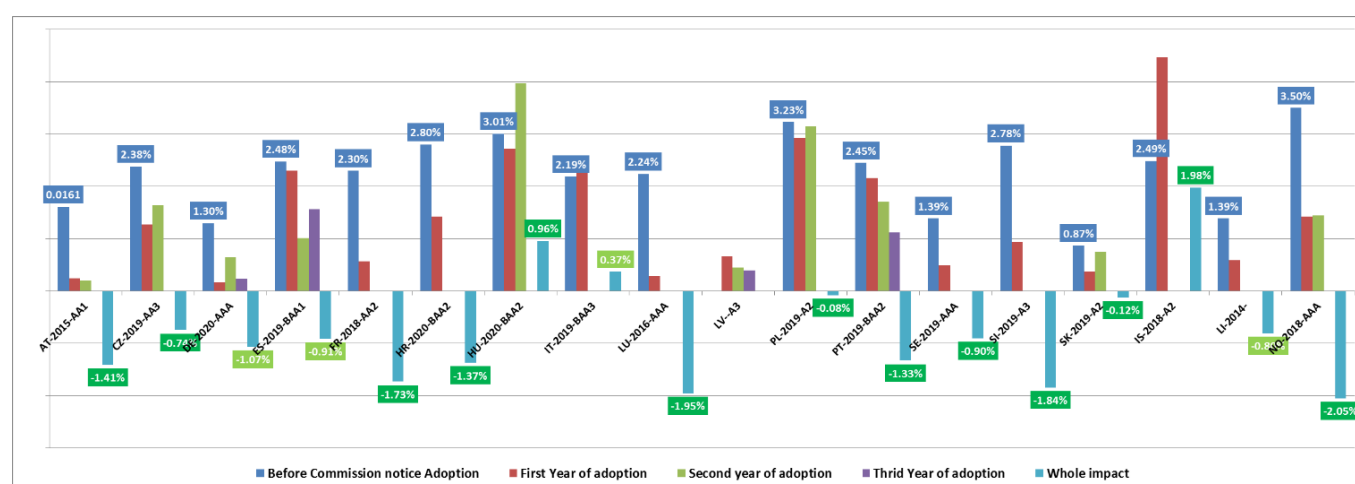
The four NRAs that adapted the WACC Notice methodology with respect to the values provided by BEREC in the relevant reports due to the macroeconomic conditions are NRAs that have estimated the WACC in the second half of 2022 or 2023, when inflation rates reflected major changes in financial outcomes (in figure are reported in light green). As anticipated ES address the rising interest rates using two time windows for estimating the RFR, one of five years and a shorter time window to better reflect the more recent increase of interest rates in 2022 and 2023. The same approach has been followed by LI, for this reason also highlighted in light green. In DE the time window for the average RFR has been extended to 10 years ; In IT the RFR has been adjusted to take into account a more “efficient” estimation of the implicit inflation rate included in the nominal risk free rate. More specifically, an estimation of the real RFR along the same time windows (five years) used by BEREC has been considered and the new nominal RFR has been derived using a more efficient, in line with a forward looking value, long-run inflation rate - a parameter better reflecting national specificity³². In IS the value adopted is very close to the one published in the relevant BEREC WACC Report, but as there is a

³² Cfr. point 63 of Commission notice “The Commission considers it appropriate to use a Eurozone-wide inflation estimate for Eurozone Member States; for non-Eurozone Member States national inflation estimates may be justified. In both cases, forward-looking estimates are more appropriate and ideally cover a period equal to the 10-year maturity of government bonds used to estimate the RFR. In practice 10-year inflation forecasts are rarely available, thus shorter term forecasts may be used (e.g. inflation forecast 5 year ahead by ECB).

relevant inflation linked market bond (for liquidity issue) in IS the NRA preferred to estimate first the real RFR and then to convert it into a nominal RFR in line with their past approach before the WACC Notice became available (the consistency between the BEREC estimation and the one adopted has been checked). HU, SK and PL preferred to use the last WACC Report by BEREC BoR (23) 90 also for 2022 (and 2023) as a basis for their WACC estimation even though the Report had been published later than the 1th of April, since it reports more recent data on the Risk Free Rate.

In Figure 9, for the 18 NRAs that have applied the WACC Notice, the evolution of RFR values is reported in relation to the last value in charge before the adoption (the year of estimation is reported as in Figure 1).³³ The dark-green highlight identifies NRAs that have fully adopted the WACC Notice, while the light-green highlight corresponds to the NRAs that have adjusted the BEREC values/methodology for this parameter. A rapid decrease of the nominal RFR for the NRAs that apply the WACC Notice occurs, specifically in countries with a higher country credit rating. This is in line with the fact that countries with a higher country credit rating were more likely to adjust –the averaging time window to more than five years in periods of low interest rates before the WACC Notice came into force. This approach was less evident for countries with a lower country credit rating. Adaptation of the WACC Notice, in general, reduces the differences with respect to pre-WACC-Notice estimation (DE, ES³⁴, IT, LI).

Figure 9 – WACC Notice adoption 2021-2023 (RFR)



Source: BEREC RA database 2023

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

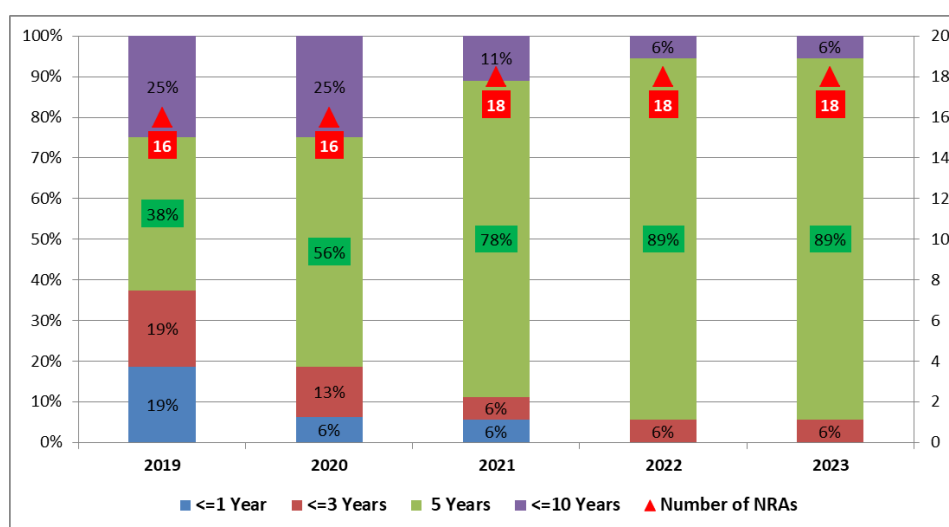
Comparing the distribution of the “time windows” used by the 18 NRAs (i) before the adoption of the WACC Notice, (ii) adopting the WACC Notice since 2020, and (iii) updating WACC along the years up to the last value in charge a relevant change in NRAs choices appears. Before the adoption of Com-

³³ In Figure 9 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).

³⁴ In 2020 – at the time of the first application of the WACC Notice - ES applied a Quantitative Easing adjustment (also considering the transition period) which was not included in the 2021 estimation.

mission WACC Notice 38% of NRAs have applied a 5 year time windows, while in 2023 - even considering the adaptation applied by ES, DE and LI - about 90% of NRAs have used a 5 year time windows for the estimation of the RFR consistent with the WACC Notice.³⁵ With respect to the other main elements of the methodology (e.g. geographical scope, bond length) the 18 NRAs that adopted the WACC Notice, had already considered their own country bond with ten years maturity (only AT before applying the WACC Notice used a different geographical scope) even before the WACC Notice came into force. Thus, methodological differences before and after the WACC Notice adoption, are mainly related to the averaging time windows applied. Such methodological differences are relevant when trying to explain different values before the WACC Notice came into force. In general it can be concluded that countries with lower credit rating were addressing the impact of higher interest rates, while countries with higher credit rating acted in an opposite direction to address the impact of lower interest rates.

Figure 10 - Distribution of time windows RFR (fixed market)



Source: BEREC RA database 2023

³⁵ DE has been classified as “<=10 Years” group, ES and LI for last updated in the <=3 Years considering the fact that for ES the average between 6 months and 5 years have been considered, for LI the approach is analogous as the one adopted by ES. For 2019 and 2020 (before the application of the WACC Notice) information on the averaging time windows applied were not available for LV and NO for this reason 16 NRAs have been considered instead of 18.

Figure 11 - Main methodology 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 2023

Figure 12 shows the summary of methodologies currently applied by NRAs for estimating the RFR. Marked in red are the most frequent approaches (in green the 18 NRAs that apply the WACC Notice). Most NRAs have taken into account the main elements of the methodology outlined in the WACC Notice.³⁶

Figure 12 - 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	4+2										Yes		
Nominal Risk Free Rate			domestic bond	7+18	1 year	0	Daily	3+1	Spot rate	0	Arithmetic average	7+18	Yes	1
			country specific bond	2	3 years	0	Weekly	3	3 months	0	Geometric Average	0		
			other	1	5 years	0	Monthly	2+17	6 months	0	Moving Average	0		
			benchmarking	0	10 years	6+18	Other	0	1 Year	5	Median	1		
					20 years	0			2 Years	0	Other	1		
					Other	2			3 Years	3				
									5 Years	2+15				
				10 Years	0									
				Others	3									

Source: BEREC RA database 2023

Almost all NRAs that updated the WACC in 2022-2023 applied the WACC Notice approach. The only EU country, LT and IE updated the WACC within a methodology established before the Notice would be in charge, as well as ME, RS updated the WACC without applying the WACC Notice.

³⁶ 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. Both CY and IE removed adjustments of the RFR evaluation since 2020 year's report.

Like in the 2022 report almost all NRAs have used a nominal estimation of the RFR without first evaluating a real RFR; in IT the real estimation has been chosen to address the issue of the inflation rate in the nominal estimation without modifying the BEREC time windows and the types of averages³⁷. A real RFR has been estimated for the fixed market by 4 NRAs (BE, CY, IE, MT).

A more consistent approach among NRAs in terms of the main methodologies used for estimating the RFR is evident, primarily for the use of the averaging window. In comparison to previous year, the number of NRAs that use a 5 years averaging windows has not decreased. RFR estimation can be significantly 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 (still the more differentiated parameters to estimate the RFR, even if tending towards homogeneity), the following statistics emerge (Figure 13).³⁸

Figure 13 - Main methodologies and time windows (frequency, number of NRAs)³⁹

RFR		Geographical scope			
		Domestic bond	Country specific	Others	Total
Time windows	≤1	5	0	0	5
	≤3	1+2	2	0	5
	≥5	1+ 16	0	1	18
Total		25	2	1	28

RFR		Geographical scope		
		Domestic bond	Country specific	Others
Time windows	≤1	CY,EL,FI,LT,MT		
	≤3	ME,ES,LI	BE,RO	
	≥5	AT,CZ, DE,FR,HU, HRLU,LV, NO,PL,PT, SE,SI,SK, IS IE,IT		RS

Source: BEREC RA database 2023

18 NRAs (they were 11 in 2020) have used domestic bonds and time windows that are greater than or equal to 5 years. 16 NRAs which are included in this category apply the WACC Notice. ES and LI, that also apply the WACC Notice, have been included in the category “<= 3 years” as explained at the beginning of the paragraph 5.2.1. DE has been included in the section “>=5 years” since different time windows (5 or more years) are applied.

³⁷ This has taken into account that a liquid market of inflation linked bonds with bond of 10 Years maturity and inflation swap with 10 years maturity are available in the IT capital market.

³⁸ NRAs that have a different approach in comparison to previous year’s report are shown in red.

³⁹ In the matrix the first figure indicates the frequency of the methodological mix, the second mentions NRAs. In green the NRAs that have adopted the WACC Notice.

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

Two NRAs have applied ex-post adjustments to the estimation of the RFR as reported in the following figure, where the year of update is provided. It should be pointed out that the number of NRAs that apply ex-post adjustment has been decreasing year by year, converging to a more consistent application of the overall methodology.

Figure 14 - Adjustments applied to RFR (fixed market)

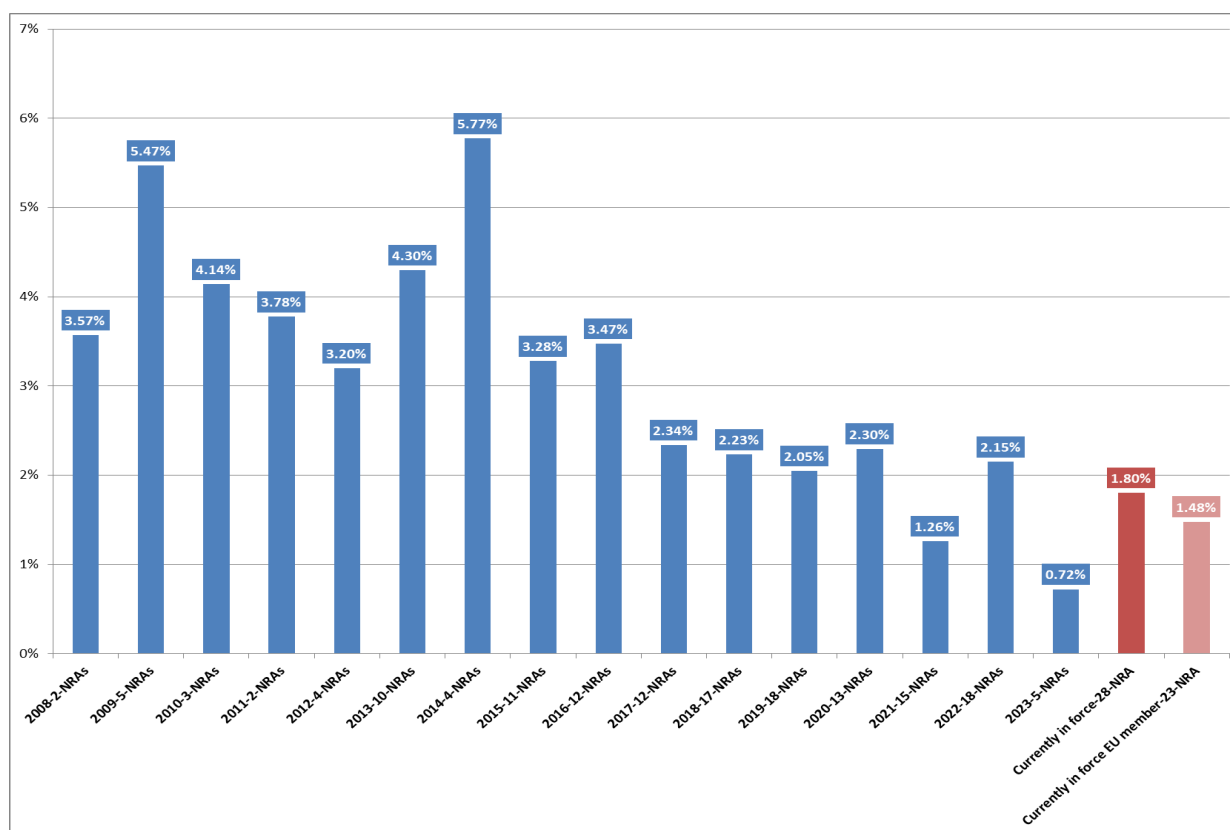
	Nominal RFR	Nominal risk free rate without adjustment	Country risk premium (%)	Size premium value (%)	Consistency with ERP estimation (hystorical data on ERP on different bond length)	Other adjustment: Size of adjustment (%)	Description of adjustment and how the adjustment was made
RO-2020	2.48% (6.39%)	0.31% (3.19%)	2.17% (3.20%)				Damodaran
RS-2022	4.21% (3.84%)	0.17% (0.01%)	4.04% (3.83%)				Damoradan

Source: BEREC RA database 2023

In Figure 15 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 all current values in line with the information provided in Figure 1.

In terms of value, RFR is still decreasing over the years even if in the current year, for the first time in this Report, the average started to increase in line with the market development (an increase in higher returns for domestic bonds).

Figure 15 - RFR evolution over time (fixed market)



Source: BEREC RA database 2023

Summing up, the current situation that has appeared during the last two years, namely a very quick and substantial increase of interest rates poses some questions about a too strict and narrow application of the WACC Notice. Efficiency reasons, specifically in case the WACC is estimated for more than one year in line with market reviews, can request a more careful approach due to the fact that updating year by year can reflect an easier way to consider current economic conditions⁴⁰. In every case stability and consistency reasons should also be taken into account: considering EU countries there are already three relevant markets where a broader way of following the Notice compared to a strict ("mechanical") application of the Notice has been considered, and accepted by the EU Commission when justified by national circumstances, e.g. for estimating the more country-specific parameters such as RFR. This is in line also with the fact that the WACC Notice has already provided NRAs with the flexibility to partially mitigate their provisions, when strictly justified by national circumstances.

5.2.2 Equity Risk Premium (ERP)

see BoR (17) 169, BoR (18) 167, BoR (19) 240, BoR (20) 116, BoR (21) 86, BoR (22) 70, BoR (23) 90 for definition and general financial theory

Main output from the survey.

Using the replies to the 2023 survey the following statistics have been derived for all responding NRAs and for EU NRAs separately (2022-2018 values in brackets).

⁴⁰ Cfr point 70 of the WACC Notice: "The Commission considers that updating the national WACC value at least once per year is appropriate to take account of recent economic conditions"

Figure 16 - ERP values

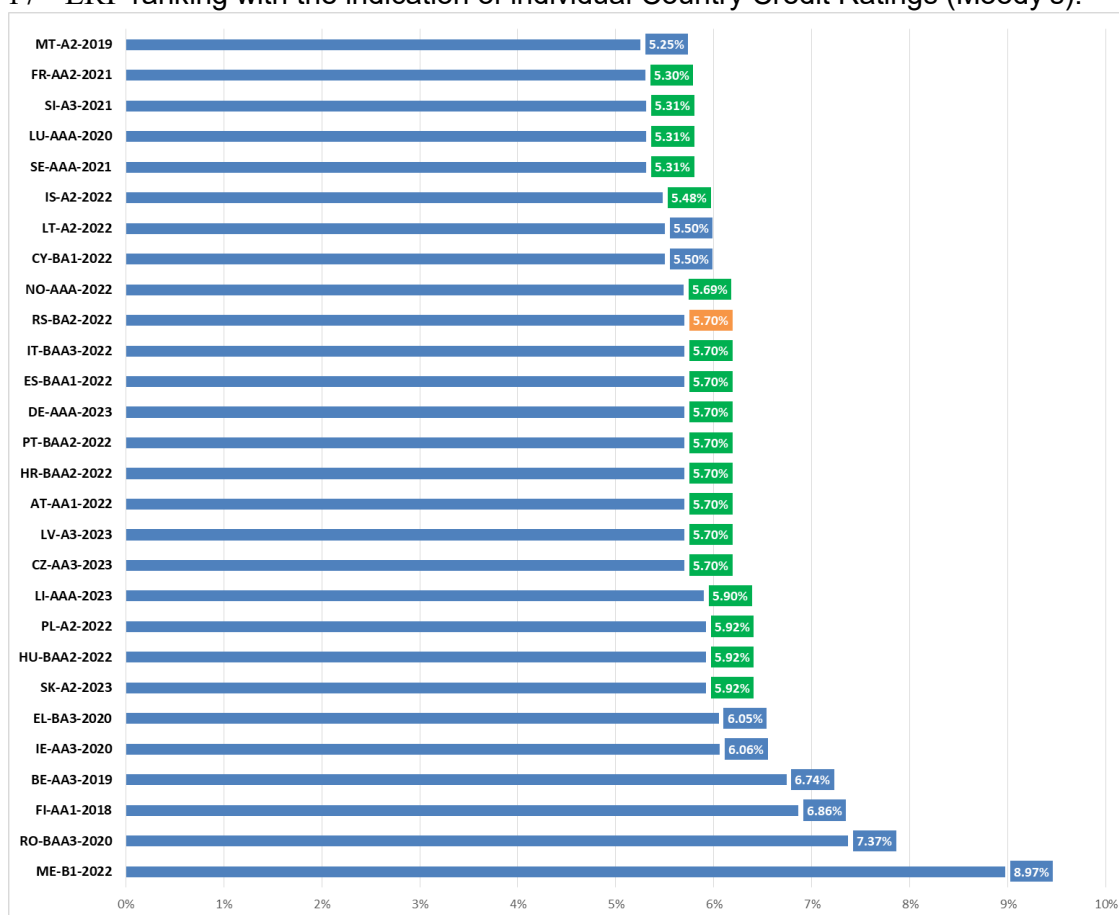
	Average	Median	Standard Deviation	Relative Standard Deviation	Maximum	Minimum
Equity Risk Premium (fixed);						
28-NRAs	5.92%	5.70%	0.77%	13.00%	8.97%	5.25%
(2022-27)	(5.65%)	(5.50%)	(0.58%)	(10.33%)	(7.37%)	(4.55%)
(2021-29)	(5.80%)	(5.71%)	(0.72%)	(12.43%)	(7.37%)	(4.55%)
(2020-31)	(5.76%)	(5.75%)	(0.77%)	(13.29%)	(7.25%)	(4.55%)
(2019-32)	(5.93%)	(5.63%)	(1.52%)	(25.57%)	(13.14%)	(4.55%)
(2018-32)	(5.90%)	(5.45%)	(1.90%)	(32.14%)	(14.46%)	(3.10%)
Equity Risk Premium EU 23-						
NRAs:	5.82%	5.70%	0.53%	9.09%	7.37%	5.25%
(2022-23)	(5.70%)	(5.50%)	(0.61%)	(10.77%)	(7.37%)	(4.55%)
(2021-25)	(5.81%)	(5.75%)	(0.72%)	(12.30%)	(7.37%)	(4.55%)
(2020-24)	(5.77%)	(5.85%)	(0.76%)	(13.18%)	(7.14%)	(4.55%)
(2019-26)	(6.05%)	(5.79%)	(1.65%)	(27.27%)	(13.14%)	(4.55%)
(2018-26)	(6.03%)	(5.60%)	(2.07%)	(34.42%)	(14.46%)	(3.10%)

Source: BEREC RA database 2023

The average and median 2023 values for ERP increased this year (in contrast to previous years) while their deviations are decreasing over time if EU countries only is considered. For this parameter it can be observed that all the first group of 18 NRAs that have applied the WACC Notice are using the single EU ERP value as calculated by BEREC in BoR (20) 116, BoR (21) 86, BoR (22) 70, and lastly BoR (23) 90, depending on the year of update. Outside the first group of 18 NRAs, BEREC calculation for EU-ERP has been used also by RS that has declared to partially adopt the WACC Notice. In two cases (LT and CY), the values estimated are country-specific but are in line with the ERP estimated in BoR (21) 86 (despite the fact that the two NRAs had not formerly applied the WACC Notice).

The green highlights mark the 18 NRAs that apply the WACC Notice, in orange RS which de facto applies the WACC Notice at least for this parameter.

Figure 17 - ERP ranking with the indication of individual Country Credit Ratings (Moody's).–

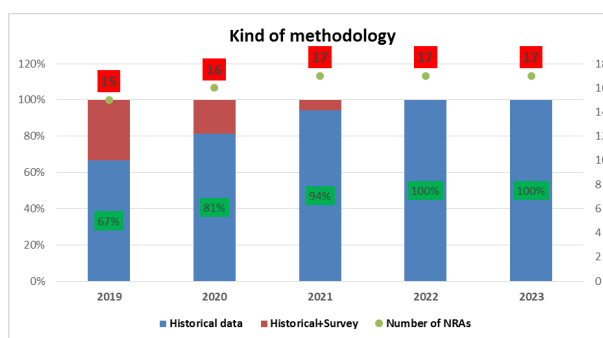
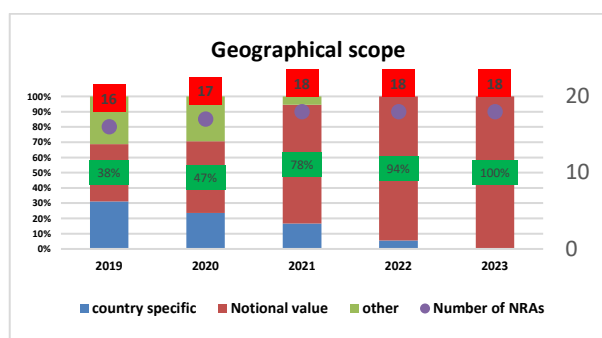
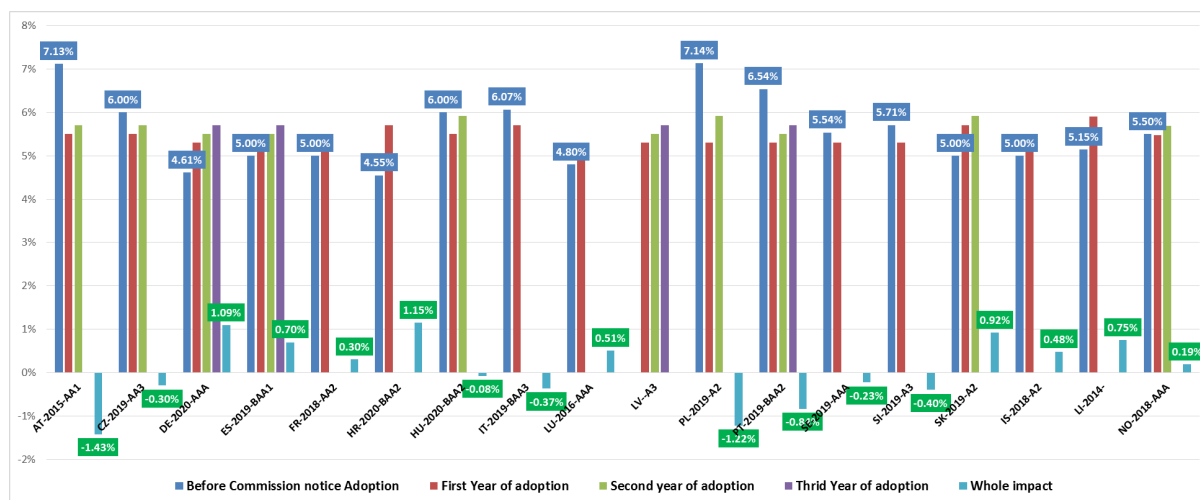


Source: BEREC RA database 2023

In Figure 18 the impact on the 18 NRAs that apply the WACC Notice is reported in line with the analysis already reported for RFR and WACC final values. The impact of ERP is on average less relevant for NRAs for the final average values with respect to RFR (where a clear reduction trend was already present for almost all NRAs that adopted the WACC Notice).

For ERP the inconsistency between methodologies was more relevant: Half of NRAs experience an increased value of the ERP, the other half a reduction. This situation is consistent with the evolution of the methodologies adopted by NRAs: before the adoption of the WACC Notice by 18 NRAs the geographical scope for calculating the ERP was about 1/3 own country specific, 1/3 notional, and 1/3 a mix of the approach. Looking at the methodologies in use before the adoption of the WACC Notice, more than 60% of NRAs already based the estimation on “historical data” and the remaining on “historical data + survey”. After the adoption of the WACC Notice, the methodologies applied by all compliant NRAs is “notional”, based on “historical data”.

Figure 17 – WACC Notice adoption 2021-2023 (ERP)



Source: BEREC RA database 2023

Figure 19 report the main approaches used by NRAs to estimate ERP, based on the questionnaire on a set of pre-defined alternatives. The 18 NRAs that apply the WACC Notice and BEREC calculation for this parameter are reported in green; RS that, for this parameter, refers to the WACC Notice is highlighted in orange.

Figure 18 – Methodologies for estimating ERP (fixed market)

	Methodology (General)		Specific Methodology		-If historical data Average methodology	
Equity risk premium	Notional value	1+1+18	Historical data	1+1+18	Arithmetic average	1+1+18
	country specific	4	Dividend grow model		Geometric Average	
	other	2	Historical+DGM		Moving Average	
	benchmarking	1	Historical+DGM+Suvey	1	Median	
			Survey	3	Other	1
			Historical+Survey		Arithmetic and Geometric	0

Source: BEREC RA database 2023

In terms of the geographical scope of the methodology, the adoption of the WACC Notice determines a clear preference for a notional EU ERP – evolving from the surveys reported in past RA reports – with 75 % of NRAs adopting a notional approach (roughly one third in 2020 and 66% in 2022). As last year, one NRA has adopted a benchmarking approach based on values from other NRAs (MT). “Country specific” methodology has been chosen by FI, IE, ME, RO. A mix of approach (“Other”) has been chosen by two NRAs (BE and EL). Considering the methodology applied, “historical data” is the most frequently used methodology (this was prevalent even before the adoption of the WACC Notice).

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

In Figure 20 the main indicators of the “geographical scope” (notional vs. country specific) and the kind of information used in terms of weight given to the past are compared.⁴¹ The situation is largely unchanged in comparison to last year, only one NRA has changed methodology.

NRAs that have only used historical data generally have taken into account long-time series.⁴² 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.

⁴¹ Note that not all NRAs have provided specific information on each methodological category.

⁴² 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.

Figure 19 - Methodologies used to determine ERP

43

	Historical data	Historical data + (DGM/Survey)	Survey	Total
Notional	1+18	0	0	19
Country specific	1	0	3	4
Other	0	1	0	1
Total	20	1	3	24

	Historical data	Historical data + (DGM/Survey)	Survey	Total
Notional	AT,CZ, DE,ES,FR,HU,IS, IT,HR,LU,LI,LV, NO,PL,PT, SE,SI,SK + RS			19
Country specific	IE		FI,ME,RO	4
Other		BE		1
Total	20	1	3	24

Source: BEREC RA database 2023

The clear preference for a combination of notional with historical data can be seen (promoted by the WACC Notice) and was also frequent before the WACC Notice was adopted.

Relatively weak correlations, in terms of the main motivations behind NRAs methodological choices in defining ERP, may be observed from the data collected⁴⁴. 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 willingness 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 (e.g. macroeconomic conditions).

Figure 21 crosses and compares the updated choice of methodologies for parameters that contribute to the cost of equity (ERP and RFR).

⁴³ In green the 16 NRAs that have fully applied the WACC Notice. The first table indicates the frequency of the methodological mix the second shows NRAs.

⁴⁴ 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.

Figure 20- Methodologies used to determine ERP and RFR

45

ERP					
		Notional value	country specific	other	benchmarking
RFR	domestic bond	1+18	2	1	1
	country specific bond		2	1	
	other	2			

ERP					
		Notional value	country specific	other	benchmarking
RFR	domestic bond	AT,CZ, DE,ES,FR,H U,IS, IT,HR,LU,LI, LV, NO,PL,PT, SE,SI,SK LT	FI,IE	EL	MT
	country specific bond		ME,RO	BE	
	other	RS			

Source: BEREC RA database 2023

Two NRAs use their own country specific ERP and also estimate RFR with domestic bonds, providing the same geographical scope for the equity component RFR and ERP, while 19 NRAs have used domestic bonds and a notional approach for estimating ERP.

Another relevant aspect 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 the consistency in the application of the WACC Notice based on historical data for ERP with longer time windows for RFR; nevertheless there are also NRAs that still maintain a preference for a more forward-looking approach for RFR and ERP: shorter averaging windows for the RFR (to a limit spot rate) and a survey approach for the ERP.

⁴⁵ In green the 18 NRAs that have applied the WACC Notice for the two parameters. The first table indicates the frequency of the methodological mix the second shows NRAs.

Figure 21 - Time windows used for ERP/RFR

ERP					
		Historical data	Historical data + other	Survey	Total
RFR	≤ 1 year	0	0	1	1
	≤ 3 year	2	1	2	5
	≥ 5 years	2+ 16	0	0	18
	Total	20	1	3	24

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

Source: BEREC RA database 2023

5.2.3 Beta

see BoR (17) 169, BoR (18) 167, BoR(19) 240, BoR (20) 116, BoR (21) 86, BoR (22) 70, BoR (23) 90 for definition and general financial theory

Main results of the survey

Using the replies provided for the 2023 survey the following statistics have been derived for all responding NRAs and for EU NRAs separately (2022-2018 values in brackets).⁴⁶

⁴⁶ Asset betas/Equity betas are calculated with reference to different market indexes, thus comparison should be considered in the light of this fact.

Figure 22 - Equity and Asset Beta values (fixed market)

2021 Data		Average	Median	Standard Deviation	Relative Standard Deviation	Maximum	Minimum	
Fixed Market	Equity beta 28- NRAs (2022-27) (2021-29) (2020-31) (2019-32) (2018-32)	0.71 (0.77) (0.79) (0.83) (0.84) (0.83)	0.67 (0.77) (0.79) (0.83) (0.85) (0.82)	0.13 (0.12) (0.14) (0.13) (0.13) (0.14)	18.96% (15.37%) (17.13%) (15.36%) (15.51%) (15.53%)	1.09 (1.09) (1.09) (1.11) (1.11) (1.11)	0.41 (0.49) (0.45) (0.5) (0.5) (0.5)	
	Asset beta – 15-NRAs (2022-17) (2021-16) (2020-18) (2019-18) (2018-18)	0.46 (0.51) (0.53) (0.55) (0.54) (0.53)	0.43 (0.48) (0.53) (0.54) (0.55) (0.54)	0.10 (0.07) (0.08) (0.06) (0.04) (0.06)	22.32% (14%) (14.73%) (11.18%) (7.55%) (12.06%)	0.71 (0.71) (0.71) (0.71) (0.62) (0.64)	0.31 (0.40) (0.43) (0.46) (0.43) (0.43)	
	Beta debt – 13- NRAs (2022-8) (2021-5) (2020-4) (2019-3) (2018-3)	0.10 (0.11) (0.11) (0.11) (0.14) (0.14)	0.1 (0.1) (0.1) (0.1) (0.1) (0.1)	0.01 (0.01) (0.02) (0.02) (0.07) (0.07)	10.76% (13.47%) (15.31%) (18.18%) (49.49%) (49.49%)	0.14 (0.14) (0.14) (0.14) (0.22) (0.22)	0.1 (0.1) (0.1) (0.1) (0.1) (0.1)	
	Fixed Market EU NRAs	Equity beta 23 -NRAs (2022-23) (2021-25) (2020-24) (2019-26) (2018-26)	0.74 (0.78) (0.81) (0.85) (0.85) (0.84)	0.72 (0.78) (0.79) (0.85) (0.86) (0.84)	0.13 (0.11) (0.13) (0.14) (0.14) (0.13)	17.52% (14.40%) (16.16%) (16.18%) (16.04%) (16.02%)	1.09 (1.09) (1.09) (1.11) (1.11) (1.11)	0.49 (0.49) (0.45) (0.50) (0.50) (0.50)
		Asset beta – 12 NRAs (2022-14) (2021-12) (2020-12) (2019-14) (2018-14)	0.48 (0.51) (0.54) (0.56) (0.55) (0.54)	0.43 (0.50) (0.53) (0.55) (0.55) (0.55)	0.10 (0.08) (0.08) (0.07) (0.06) (0.07)	21.11% (14.78%) (14.73%) (12.78%) (10.28%) (13.40%)	0.71 (0.71) (0.71) (0.71) (0.64) (0.64)	0.38 (0.40) (0.43) (0.46) (0.45) (0.43)
		Beta debt – 10 NRAs (2022-7) (2021-4) (2020-1) (2019-2) (2018-2)	0.10 (0.11) (0.11) (0.14) (0.16) (0.16)	0.1 (0.1) (0.10) (0.14) (0.16) (0.16)	0.01 (0.02) (0.02) (0) (0.08) (0.08)	12.16% (14.30%) (18.18%) (0) (53.03%) (53.03%)	0.14 (0.14) (0.14) (0.14) (0.22) (0.22)	0.1 (0.1) (0.1) (0.14) (0.1) (0.1)

Source: BEREC RA database 2023

Average values for 2023 are lower compared to the previous years, showing a progressive reduction of the perceived systematic risk of the Telecom sector, also the speed of reduction is increasing.

The WACC Notice asks for calculating the relevant equity beta for evaluating the corresponding cost of equity basing the estimation on a peer group of values or at least verifying that the own country SMP operator parameters are in an efficiency close range of the BEREC estimation. The WACC Notice, in fact, doesn't prescribe a specific approach for estimating the beta from the peer group and also allows the direct use of the "own" SMP operator's parameter if within an efficient range. However, the WACC Notice states (point 48-50) that 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 (being represented by the peers). Nevertheless, considering the equity beta of a peer group 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.

The equity beta can thus be derived from the notional asset beta estimation with the following formula including a figure of beta debt of 0.1 as a general reasonable value for the beta debt estimation used also by BEREC to derive the asset beta of each peer and the corresponding gearing.

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

The WACC Notice moreover allows to exclude some peers if they clearly do not fit national conditions⁴⁷. The annual BEREC report provides guidance on this aspect in chapter three.

Looking at the 18 NRAs that fully applied the WACC Notice 4 main groups emerge that differentiate the approach in the WACC Notice application: i) type of beta (SMP vs Notional); ii) if notional, applying the AM (Arithmetic Mean) of the equity betas of BEREC peers; iii) if notional, the AM (Arithmetic Mean) of the asset beta peers is first evaluated and the Miller formula (previously described) is applied to estimate the relevant equity beta choosing a relevant gearing value; iv) if notional the WA (weighted average over market cap) of the asset beta peers is first evaluated and the Miller formula (previously described) is applied to estimate the relevant equity beta choosing a relevant gearing value.

More specifically, the following four main approaches are applied:

- One NRA (AT) uses the equity beta of its own SMP, which means no need to lever and re-lever the beta as no notional asset beta is derived.
- Some NRAs do not estimate the notional asset beta, even if a peer group is considered for the relevant notional equity beta estimation: in such cases the estimated BEREC arithmetic mean of the equity beta of the peers is directly used (LU, PL, PT, SI, NO). One NRA (SK) excludes two peers (Telecom Austria and NOS) from the arithmetic mean estimated by BEREC due to the fact that no debt premium could be derived for these two peers in the last BEREC report BoR (23) 90.
- Seven NRAs (CZ, ES, FR, HR, HU, LV, IS) use the arithmetic mean (AM) of the asset beta of the full group of peers for the notional asset beta estimation as evaluated by BEREC and the Miller formula (previously described) is applied to derive the corresponding equity beta using the arithmetic mean (AM) of the gearing of the full group of peers as derived by BEREC in combination with a beta debt of 0.1. One NRA (SE) used the gearing of its own SMP instead of the notional gearing to derive the equity beta through the Miller formula in combination with the AM of the full peer group asset beta and a beta debt of 0.1. One NRA (IT) derived the equity beta through the Miller formula using the arithmetic mean of the notional asset beta and notional gearing excluding three peers from the full BEREC peer group (Telenor, Telnet and Digi)⁴⁸ and including a beta debt of 0.1.

⁴⁷ Cfr. p. 20 BoR (23) 90: “According to para. 67 and in order to avoid “arbitrary” choices BEREC considers it justified to remove peer group members from the list primarily for the following reasons:

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

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

(c) The share of regulated vs non-regulated revenues of peer group members may vary. Indeed, as mentioned by the Brattle report⁴⁶, regulated telecommunication activities could be seen to be less sensitive to changes in the economy than those of an average firm with non-regulated activities;

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

⁴⁸ Main reasons: i) Digi is a very small MVNO in Italy with its business focused on countries where competition is at a more advanced stage (RO) and where SMP regulatory pressure is lower in comparison to the Italian market; ii) Telenor is an EEA operator and in the BEREC peer group the specificities of Northern European countries are already represented by three EU operators (Telia, Tele2, and Elisa) that experience a similar structural market situation in term demand and end-user income that can affect the corresponding systematic risk in a comparable way (no need to “polarize” the estimation); iii) Telenet is a

- One NRAs (DE) used the weighted average (WA) of the asset beta of the full group of peers for the notional asset beta as evaluated by BERC in relevant WACC BERC report and the Miller formula (previously described) is applied to derive the corresponding equity beta using the Weighted Average (WA) of the gearing of the full group of peers as derived by BERC in combination with a beta debt of 0.1. In case of LI the weighted average of the notional asset beta is derived using only SMP operators in the BERC peer group (DT, Elisa, KPN, Orange, Proximus, TI, Telefonica, TA, Telenor, Telia) excluding OAO operators; the Miller formula (previously described) is applied to derive the corresponding equity beta using the gearing of the own SMP operator including a beta debt of 0.1.

In the following table a synthesis of different situations in WACC Notice adoptions is reported (18 NRAs). The relevant values for equity beta are given and, where relevant, also the corresponding asset beta, gearing and beta debt in use. The NRAs that estimate the notional asset beta using arithmetic mean of the peers relevant parameters⁴⁹ are reported in green. The NRAs that estimate a notional asset beta using the weighted average of the BERC peer group are reported in red. The NRAs that instead derive directly the equity beta without the need of the corresponding asset beta are reported in blue. All the NRAs that have already updated the WACC in line with the WACC Notice in the present report did not modify the approach in comparison to the first application of the WACC Notice for the beta parameter, differently from what happened for the RFR (e.g. ES).

cable operator that has a different level of risk in comparison to “no cable” operators (in relation to the investment needed to deliver a VHCN), whereas, where in Italy no cable is present.

⁴⁹ No bold in case some differences have been applied with respect to the most common approach of each group.

Figure 23 – WACC Notice adoption beta

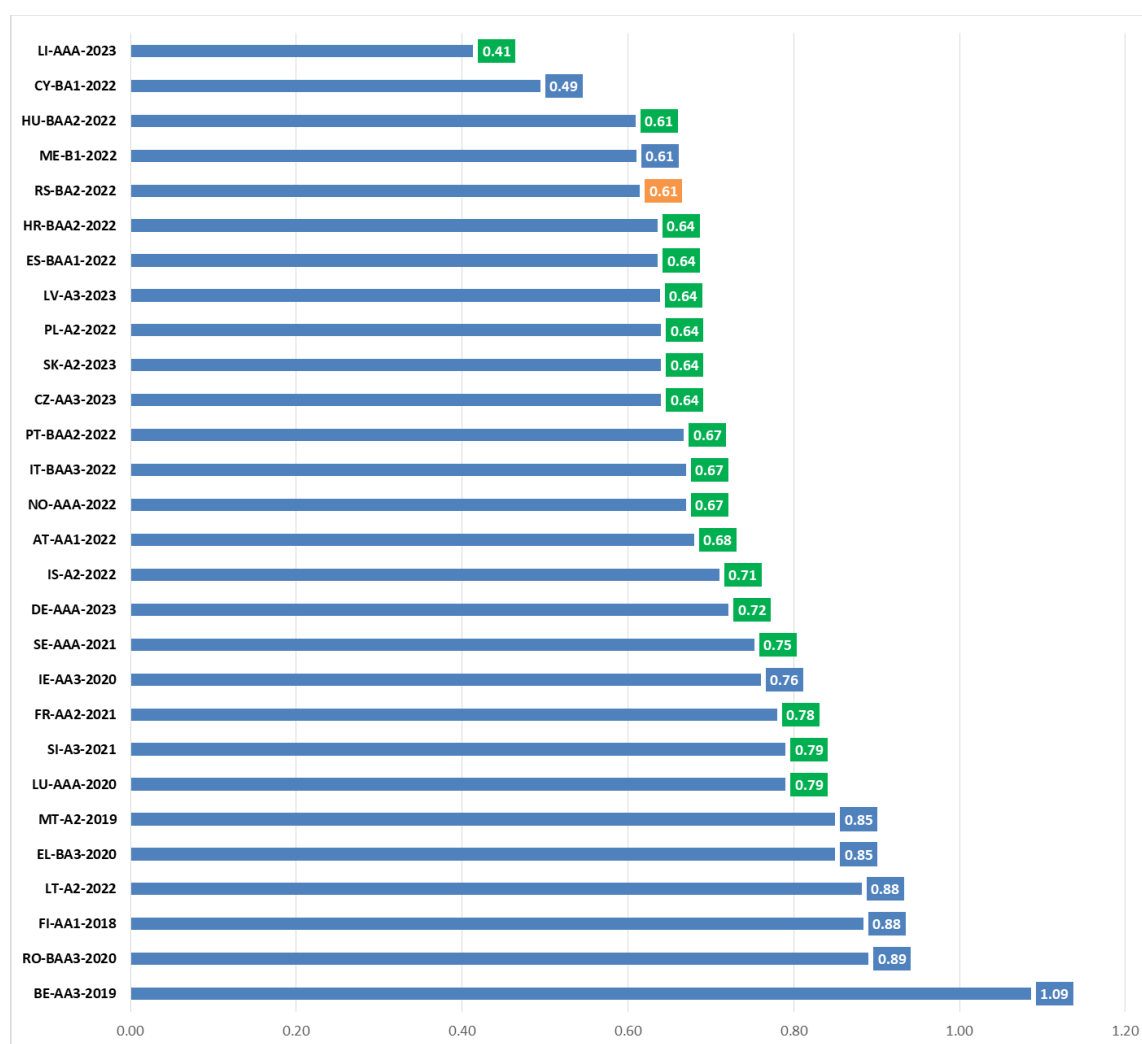
Country	Relevant report	Methodology	Beta asset	Beta equity	gearing for relever the beta	beta debt
AT	Bor(22)70	Own country SMP value of equity beta as estimated by Berec		0.68		
CZ	Bor(22)70	AM of asset beta of the full peer group and AM of the gearing peer group to relever the beta	0.41	0.64	42.42%	0.1
DE	Bor(22)70	Berec estimation of the Weighted average of full Berec peer group asset beta and weighted average of the gearing to re-levering the asset beta	0.43	0.72	47.07%	0.1
ES	Bor(22)70	AM of asset beta of the full peer group and AM of the gearing peer group to relever the beta	0.41	0.64	42.42%	0.1
FR	Bor(20)116	AM of asset beta of the full peer group and AM of the gearing peer group to relever the beta	0.53	0.78	37.00%	0.1
HR	Bor(22)70	AAM of asset beta of the full peer group and AM of the gearing peer group to relever the beta	0.41	0.64	42.42%	0.1
HU	Bor(23)90	AAM of asset beta of the full peer group and AM of the gearing peer group to relever the beta	0.37	0.61	45.36%	0.1
IT	Bor(22)70	AM of asset beta with three peers not included in the relevant Berec peer group (Telnor, Digi, Telnet) and AM of gearing Berec peer group not including (Telnor, Digi, Telnet)	0.44	0.67	40.73%	0.1
LU	Bor(20)116	Directly the AM Equity beta of the full Berec peer group estimated by Berec		0.79		
LV	Bor(22)70	AM of asset beta of the full peer group and AM of the gearing peer group to relever the beta	0.41	0.64	42.42%	0.1
PL	Bor(23)90	Directly the AM Equity beta of the full Berec peer group estimated by Berec		0.64		
PT	BoR (22) 70	Directly the AM Equity beta of the full Berec peer group estimated by Berec		0.67		
SE	Bor(20)116	AM of asset beta of the full peer group and gearing of own country SMP operator to relever the beta	0.53	0.75	34.10%	0.1
SI	Bor(20)116	Directly the AM Equity beta of the full Berec peer group estimated by Berec		0.79		
SK	Bor(23)90	Directly average of the equity beta excluding from the peers NOS and Telecom austria		0.64		
IS	Bor(21)86	AM of asset beta of the full peer group and AM of the gearing peer group to relever the beta	0.47	0.71	39.22%	0.1
LI	Bor(23)90	WA of asset beta of the full peer group and gearing of own country SMP operator to lever and relever the beta	0.37	0.41	13.47%	0.1
NO	Bor(22)70	Directly the AM Equity beta of the full Berec peer group estimated by Berec		0.67		

Source: BEREC RA database 2023

Figure 25 reports Equity Beta values estimated by each NRA ranging from lower to higher values. The values for NRAs that apply the WACC Notice are reported in green; RS is in orange, since for this parameter the estimation is in line with the WACC Notice using the BEREC report BoR (22) 70, adapted to national circumstances.⁵⁰

⁵⁰ RS selected a group from the 15 peers defined by BEREC taking into account comparable industry, relatively similar products/services and geographical location of own country situation.

Figure 24 – Equity Beta values and distribution



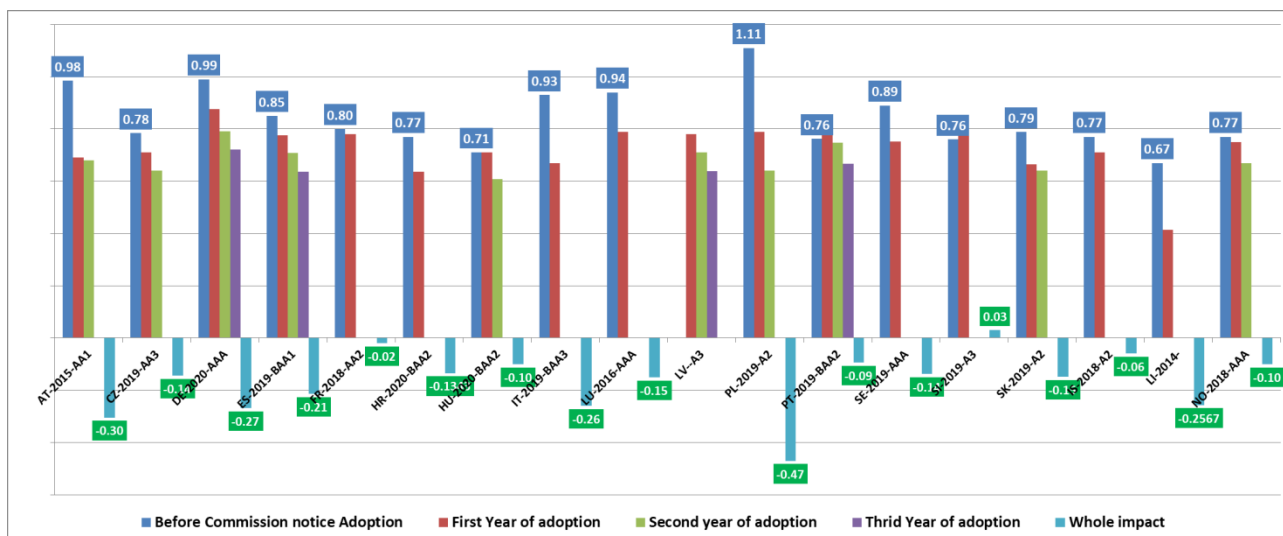
Source: BEREC RA database 2023

In the following picture in line with the analysis carried out for the other parameters the impact of the application of the WACC Notice in term of values and methodologies is reported. For almost all NRAs the application of the WACC Notice resulted in a reduction of the equity beta (between -0.02 and -0.47). Only in one case a small increase of the equity beta has been detected after the last application of the WACC Notice. This trend is mainly driven by the market conditions of the perceived risk in the Telecom sector (eventual changes in methodologies play a less relevant role).

In figure 26 the evolution of the main elements of the methodologies are monitored, specifically (i) which kind of beta is estimated (notional if a peer group is in use; an SMP beta; Other); (ii) the time windows used (5 years; 3 years; 12 months; or other); (iii) if an adjustment is applied (Blume, Bayesian). According to information provided, even before the WACC Notice came into force, among the 18 NRAs that currently adopt the WACC Notice, about 80% already used a notional approach for the beta estimation,⁵¹ 60% used a time window of five years and more that 40% don't apply any adjustment (keeping in mind that, only 12 of 18 NRAs provided information on the adjustment at that time).

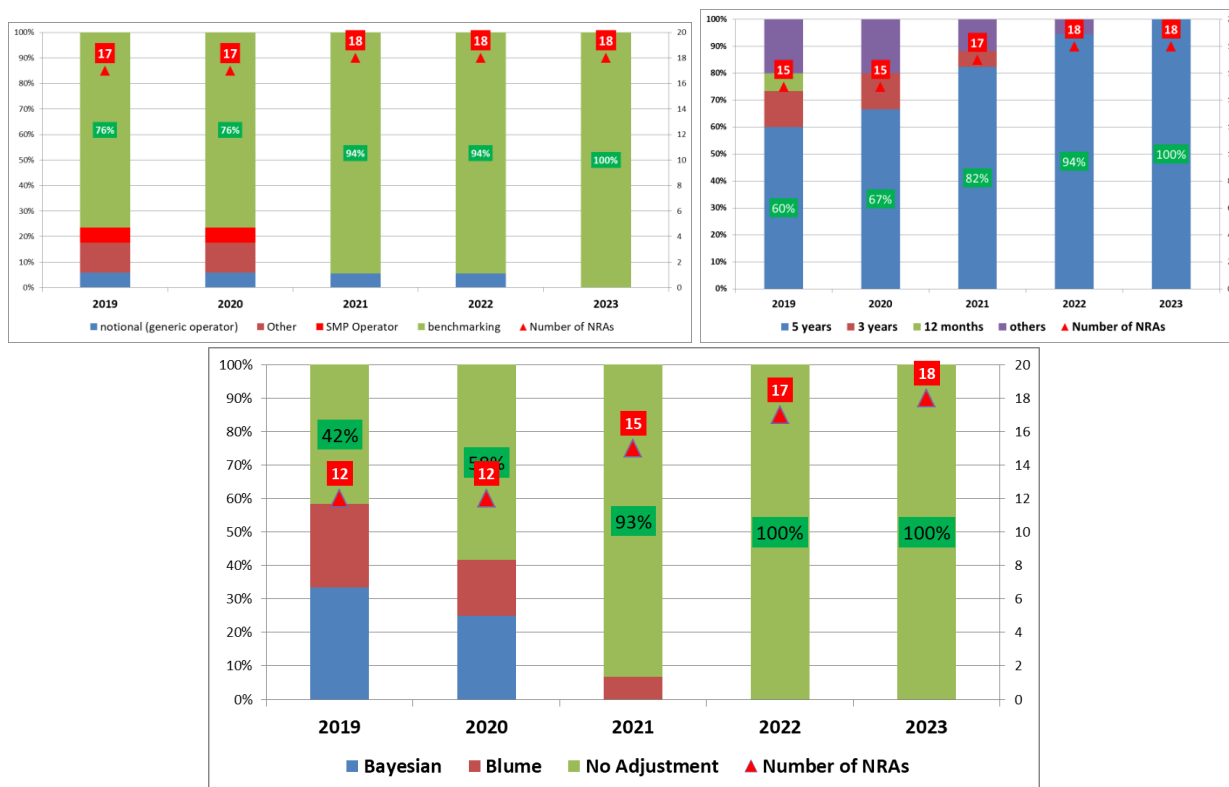
⁵¹ For AT, that use directly the SMP equity beta as estimated by BEREC, the methodology after the adoption of the WACC Notice has been classified as "Notional approach", due to the fact that the SMP value is well inside the efficient range and not far from the AM mean estimated by BEREC. So the approach cannot be considered a deviation from the main "WACC Notice approach": "notional approach", 5 years average for the time windows estimation; "No adjustment" to the equity beta estimated.

Figure 25 – Before and after WACC Notice adoption 2021-2023 (beta)



Source: BEREC RA database 2023

Figure 26 – WACC Notice adoption 2021-2023 (beta) (methodologies evolution)



Source: BEREC RA database 2023

The following figures summarises the different approaches used by NRAs to estimate the beta; in green the 18 NRAs that fully apply the WACC Notice.

Figure 27 – Methodologies for estimating Beta

	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)	7+17	Arithmetic average	15	daily	1	1 week	0	Dimson	1	Own Country	0	yes	5+11	Modigliani-Miller	3+11	Arithmetic average	1
	SMP Operator	1+1	Weighted Average	2	weekly	4+18	1 month	0	Bayesian	0	European	6+18	no	1+6	Miles & Ezzell	0	Geometric Average	0
	Other	0	Median	1	monthly	2	3 month	0	Blume	1	World	0			Hamada	1	Moving Average	0
	benchmarking	2	Other	-	other	0	6 months	0	Vasicek	0					Other	1	Median	0
							12 months	1	others	1							Other	1
						2 years	1	No Adjustment	3+18									
						3 years	1											
						5 years	3+18											
						10 years	0											
						others	0											

Source: BEREC RA database 2023

The most frequent methodology used by NRAs to estimate a notional beta is based on a peer group of telecom operators (24 NRAs, increasing since the past year). In line with previous year’s reports, the number of peers are given for the NRAs that apply a notional approach for beta estimation and that have provided information, but don’t fully apply the WACC Notice. The number of comparable operators varies between 9 and 15, mainly European. The way the average beta is estimated from the peer group may differ according to the different kinds of averaging methods chosen.

Figure 28 - NRAs not applying the WACC Notice: Beta notional methodology

52

Countries	Methodology	Number of peers	Average used
BE	notional (generic operator)	SMP + 8 EU peers	Other
FI	notional (generic operator)	15 telecom companies	Median
IE	notional (generic operator)	12, European operator	Other
RS	notional (generic operator)	15 European SMP operators as the one reported in the Berec report Bor(22)70	Other

Source: BEREC RA database 2023

Concerning the sampling period, daily and weekly sampling are the most frequent approaches used by NRAs that had not yet applied the WACC Notice. In general, the choice of the sampling period does

⁵² NRAs that have provided information on all elements are shown. All NRAs that fully apply the WACC Notice are not reported separately due to the fact that the approach has been already described.

not seem to be correlated with the time window used as reported in Figure 30 (2019-2022 figures in brackets).

Figure 29 – NRAs not applying the WACC Notice: Beta methodology for sampling period and time windows⁵³

Fixed					
		Time windows			
		≤2 Years	≤3 Years	≥5 Years	Total
Sampling period	daily	1(1)(1)(2)(1)	(0)(1)(2)(4)	(0)(2)(2)(2)	1(1)(4)(6)(7)
	weekly	(0)(0)(0)(1)	1(1)(2)(3)(2)	2+18(17)(11)(5) (5)	21(18)(13)(8)(8)
	monthly	1(0)(0)(0)(0)	(0)(0)(0)(0)	1(1)(3)(5)(5)	2(1)(3)(5)(5)
	Others	(0)(0)(0)(0)	(1)(1)(1)(1)	(0)(0)(0)(0)	0(1)(1)(1)(1)
	Total	2(1)(1)(2)(2)	1(2)(4)(6)(7)	21(18)(16) (12)(12)	23(21)(21) (20)(21)

	Fixed market		
	Methodology	Sampling period	Time windows
BE	notional (generic operator)	daily	2 years
FI	notional (generic operator)	weekly	3 years
IE	notional (generic operator)	weekly	5 years
ME	notional (generic operator)	monthly	12 month
LT	SMP Operator	monthly	5 years
RS	notional (generic operator)	weekly	5 years

Source: BEREC RA database 2023

The motivation behind the choice of time windows and sampling period are 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 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 most cases since the WACC Notice has been adopted increasingly over time (Figure 31).

⁵³ NRAs that have provided information on all elements are shown. The 14 NRAs that fully apply the WACC Notice are not reported separately.

Figure 30 - Beta/RFR time windows⁵⁴

		Beta (Time windows)		
		≤2 Years	≤3 Years	≥5 Years
RFR (time windows)	≤1 Year	0(0)(0) (1) (2)	1(1)(1) (2) (2)	1(1)(2) (3) (4)
	≤3 Years	2(1)(1) (2) (1)	(1)(1) (2) (3)	2(0)(0) (1) (1)
	≥ 5 Years	0(0)(0) (0) (0)	0(0)(2)(2) (2)	2+16(17)(14)(8) (7)

		Beta (Time windows)			
		≤2 Years	≤3 Years	≥5 Years	Total
RFR (time windows)	≤1 Year		FI	LT	2
	≤3 Years	BE, ME		ES, LI	4
	≥ 5 Years			AT, CZ, DE, FR, HU, IS, IT, HR, LU, LV, NO, PL, PT, SE, SI, SK IE, RS	18
	Total	2	1	21	24

Source: BEREC RA database 2022

Since the adoption of the WACC Notice there has been a clear convergence in the choice of the averaging time window.

Concerning the adjustment used for estimating the equity beta of SMP operators or comparable companies (Figure 32), there is a clear tendency, since the adoption of the WACC Notice, not to use adjustments. Only few NRAs still apply adjustments to the standard OLS estimation for the Equity beta due to the fact that the estimation has been done before the WACC Notice was applicable⁵⁵. The application of the WACC Notice has thus increased the consistency of NRAs in not applying any adjustment.

⁵⁴ NRAs that have provided information on all parameters are shown. The NRAs that apply the WACC Notice are highlighted in green.

⁵⁵ 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 31 - Time window adjustments to Equity Beta⁵⁶

	Time Windows		
	<=2 Years	<=3 Years	>=5 Years
No Adjustment	(0)(1)(2)	(0)(1)(2)(1)	2+18(17)(11)(5)(5)
Blume	(0)(1)(1)	1(1)(1)(1)(1)	(1)(2)(2)(2)
Vasiecek		(0)(0)(1)(1)	
Bayesian		(0)(1)(1)(2)	(1)(2)(2)
Dimson	1(1)(1)(1)(0)		
Others	(0)(1)(0)	(1)(1)(0)(1)	(1)(1)(1)

Source: BEREC RA database 2022

Most NRAs apply an unlevered beta before estimating the final equity beta (16 NRAs) including NRAs that apply the WACC Notice, it should be said that in such case there is a group of countries that still prefer to use the arithmetic mean of the estimated equity beta (6 NRAs). Concerning the unlevering formula the most widely used is the Modigliani-Miller formula (Miller being the same formula without tax⁵⁷).

Concerning the market index, all NRAs use a European index (STOXX Europe TMI Telecommunications; STOXX Europe TMI, MSCI Europe Index) which is a trend that has increased year by year.

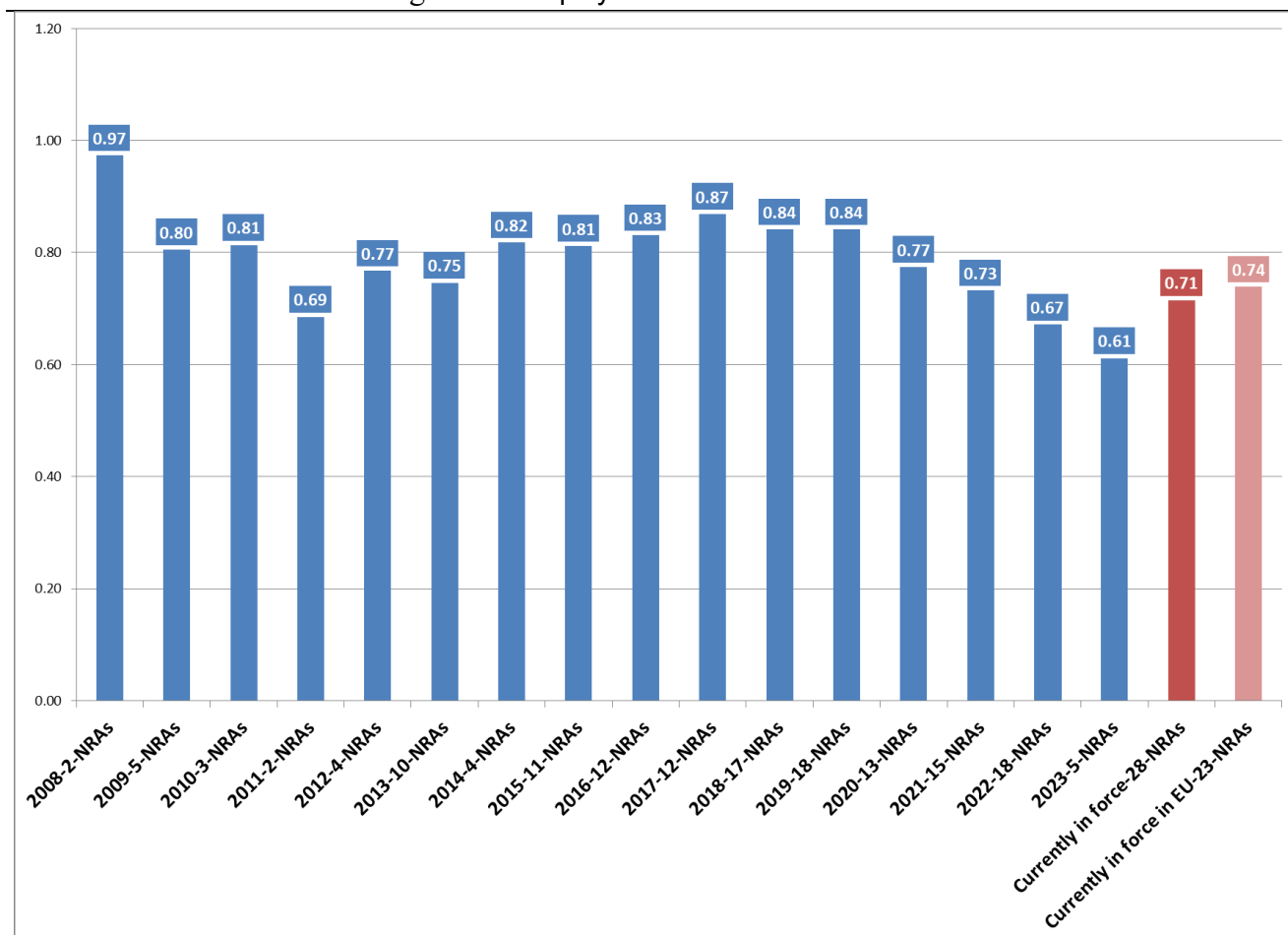
Sensitivity analysis on the time windows, adjustments and the choice of market index shows a relevant variability of the estimation (see annex 1 of BoR (17) 169). A notional approach can reduce a certain level of variability.

Overall, in the period 2008-2023, estimated beta values show a first increase between 2014-2019 followed by a significant reduction in the last years.

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

⁵⁷ Sometimes the same formula is referred to as "Hamada formula".

Figure 32 - Equity Beta evolution over time



Source: BEREC RA database 2023

5.2.4 The cost of debt

see BoR (17) 169, BoR (18) 167, BoR(19)240, BoR (20) 116, BoR (21) 86, BoR (22) 70, BoR (23) 90 for definition and general financial theory

Main output from the survey.

Using the replies provided for the 2023 survey the following statistics have been derived for all responding NRAs and for EU NRAs separately (2022-2018 values in brackets).

Figure 33 – Cost of debt values

	Average	Median	Standard Deviation	Relative Standard Deviation	Maximum	Minimum
Cost of debt fixed market 28-NRAs	3.02%	2.67%	1.86%	61.47%	8.71%	0.00%
(2022-27)	(2.71%)	(2.40%)	(1.55%)	(57.08%)	(7.69%)	(0.00%)
(2021-29)	(3.22%)	(3.44%)	(1.56%)	(48.44%)	(7.67%)	(0.00%)
(2020-31)	(3.81%)	(3.90%)	(2.03%)	(53.33%)	(8.58%)	(0.00%)
(2019-32)	(4.00%)	(3.98%)	(2.03%)	(50.89%)	(8.58%)	(0.00%)
(2018-32)	(4.30%)	(4.43%)	(2.08%)	(48.31%)	(8.77%)	(0.00%)
Cost of debt fixed market 23-EU NRAs	2.58%	2.43%	1.28%	49.53%	5.45%	0.00%
(2022-23)	(2.49%)	(2.25%)	(1.19%)	(47.69%)	(4.23%)	(0.00%)
(2021- 25)	(3.00%)	(3.29%)	(1.26%)	(42.05%)	(5.83%)	(0.00%)
(2020-24)	(3.55%)	(3.59%)	(1.67%)	(47.11%)	(7.84%)	(0.00%)
(2019-26)	(3.79%)	(3.81%)	(1.74%)	(45.92%)	(7.84%)	(0.00%)
(2018-26)	(4.12%)	(4.39%)	(1.74%)	(42.14%)	(7.84%)	(0.00%)

Source: BEREC RA database 2023

For 2018-2022 a continuous decrease in the level of the averages is seen mainly due to the corresponding decrease of the RFR that is included in the corresponding cost of debt. For 2023 a small increase can be detected, due to the evolution of capital market in the Telecom sector where higher interest rates can affect the level of operators' debt (on the increase, as highlighted in BEREC WACC Report BoR(23)90).

Considering the 18 NRAs that apply the WACC Notice, with reference to the parameter in this section:

- 13 NRAs (CZ, ES, FR, HR, HU, IT, LU, LV, PL, PT, SI, IS, NO) apply the relevant arithmetic mean estimated by BEREC in the relevant WACC Report;
- 2 NRAs (AT, SE) use the debt premium of the SMP operator estimated by BEREC in the relevant WACC Report;
- two NRAs use the weighted average (DE, LI): DE applies the WA of debt premium evaluated in the relevant BEREC report; LI evaluates the WA of debt premium considering only SMP operators (DT, Elisa, KPN, Orange, Proximus, TI, Telefonica, TA, Telenor, Telia) in the peer group using as weight the data included in the BEREC WACC Report BoR (23) 90 for market capitalisation;
- one NRA (SK) does not include NOS and Telekom Austria in the peer group as not all parameters were available for them (e.g. debt premium) and also evaluates the arithmetic mean of the cost of debt reported in table 4 of BoR (23) 90 instead of using the debt premium, adding +0.10% as adjustment this year (different from the past year application of the WACC Notice) to better reflect a country specific situation.

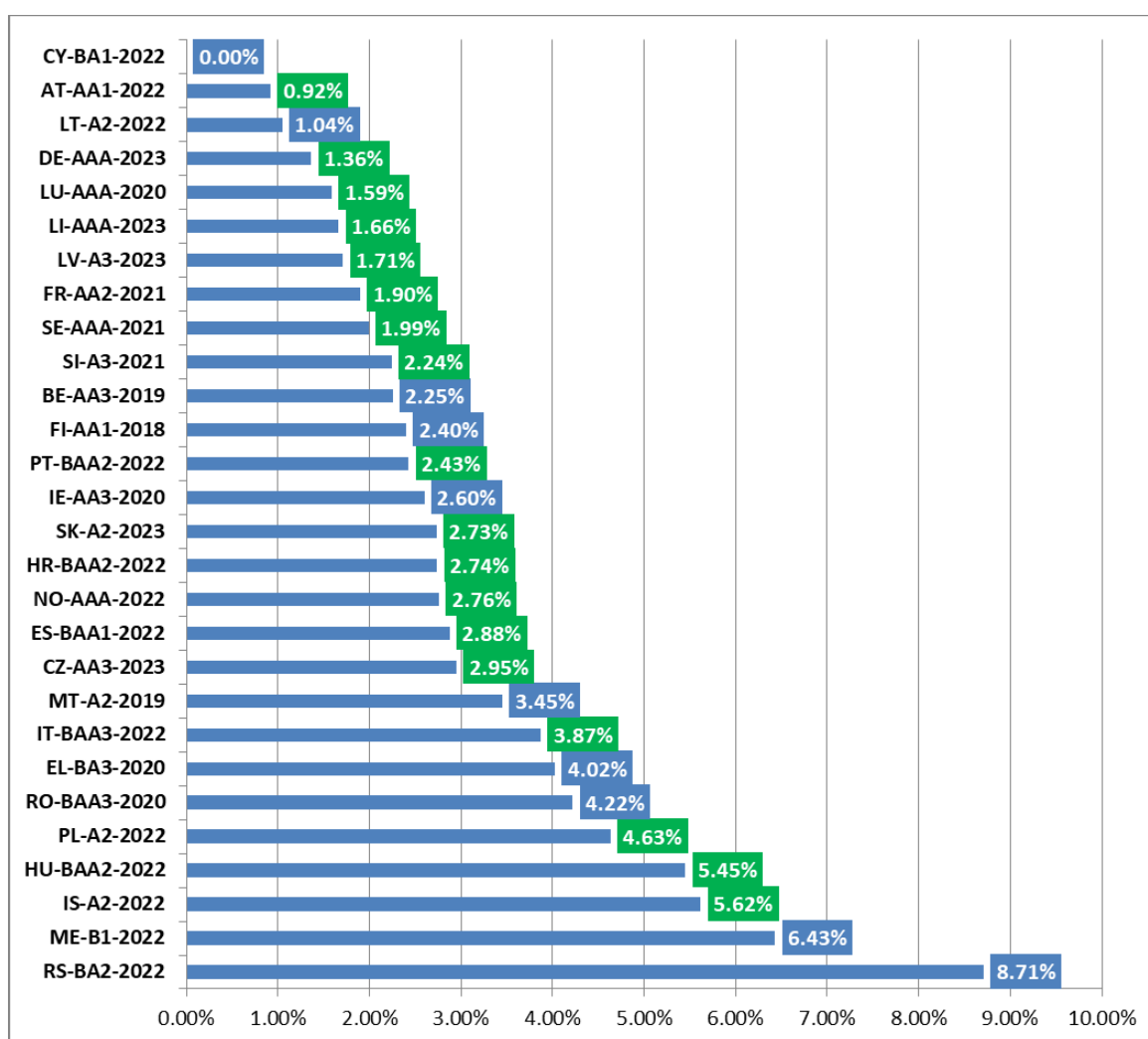
Figure 34 – NRAs that adopt the WACC Notice approach (debt premium)

Country	Relevant report	Methodology	Debt premium
AT	Bor(22)70	Own country SMP debt premium	0.72%
CZ	Bor(22)70	AM debt premium	1.31%
DE	Bor(22)70	WA debt premium	1.13%
ES	Bor(22)70	AM debt premium	1.31%
FR	Bor(20)116	AM debt premium	1.30%
HR	Bor(22)70	AM debt premium	1.31%
HU	Bor(23)90	AM debt premium	1.48%
IT	Bor(22)70	AM debt premium	1.31%
LU	Bor(20)116	AM debt premium	1.30%
LV	Bor(22)70	AM debt premium	1.31%
PL	Bor(23)90	AM debt premium	1.48%
PT	BoR (22) 70	AM debt premium	1.31%
SE	Bor(20)116	Own country SMP debt premium	1.50%
SI	Bor(20)116	AM debt premium	1.30%
SK	Bor(23)90	AM cost of debt + adjustment	1.98% (2.73% cost of debt)
IS	Bor(21)86	AM debt premium	1.15%
LI	Bor(23)90	WA debt premium (using only SMP operators)	1.07%
NO	Bor(22)70	AM debt premium	1.31%

Source: BEREC RA database 2023

In Figure 34 the currently estimated cost of debt is shown. The respective Credit Rating and its year of estimation is also reported.

Figure 35 - Cost of debt value and distribution



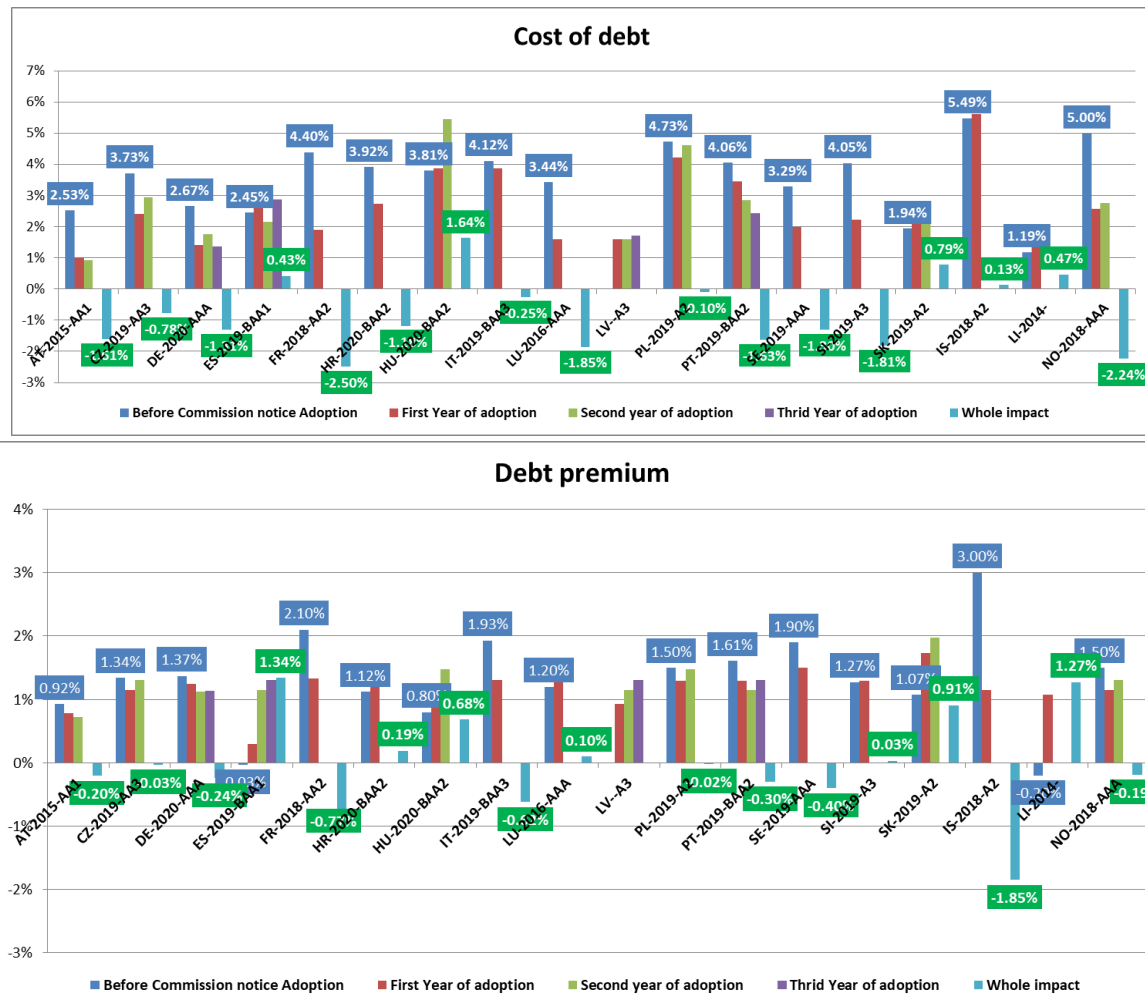
Source: BEREC RA database 2023

The following Figure reports the evolution of cost of debt and debt premium⁵⁸ for the 18 NRAs that applied the WACC Notice. The last value before the adoption of the WACC Notice serves as reference (the year of last estimation before the WACC Notice is reported in the label of each country). The whole impact is estimated as the difference between the last value estimated before the adoption of the WACC Notice and the last value adopted following the WACC Notice. A decrease of the parameter value after the application of the WACC Notice is observed, mainly due to the RFR component included. With reference to the debt premium, the overall decrease is less evident - some countries experience an increase of the debt premium (the reduction is generally limited and in most of the cases lower than -0.40%).

Looking at the evolution of the methodologies, the geographical scope of the estimation (SMP vs notional) as well as the “time windows” used for estimating the debt premium/cost of debt changed over the years causing a different impact. Therefore, for this parameter, the trend is not only influenced by the evolution of the capital market in the Telecom sector, but also by the methodological changes.

⁵⁸ The debt premium has been estimated as the difference between cost of debt and RFR.

Figure 36 - Before and after WACC Notice adoption 2021-2023 (Debt premium/Cost of debt)



Source: BEREC RA database 2023

Figure 37 – Methodologies evolution of cost of debt over time (2019-2023) for the 18 NRAs that applied the WACC Notice



Source: BEREC RA database 2023

The following figures summarise the different approaches used by NRAs to estimate the cost of debt for fixed markets. The approach outlined in the WACC Notice is the most frequent one; the effort by BEREC in publishing an evaluation of the debt premium from the secondary traded market data (not freely available) played a role in favouring the convergence towards the most frequent approach by NRAs.

Figure 38 - Methodology used for estimating cost of debt

	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)	5+16	Debt premium	4+17	Book value	1	Secondary traded market	17	1 year	0	Spot rate	1	Arithmetic average	4+18	Arithmetic	14
	SMP Operator	1+2	Cost of Debt	4+1	Market Value (Company bond)	5+18	Nominal bond yield	3	3 years	0	3 months	0	Geometric Average	0	Median	0
	Other	2			Other	0	Other	1	5 years	0	6 months	0	Moving Average	0	Weighted Average	2
	benchmarking	1							10 years	3+18	1 Year	0	Median	0	Other	0
									20 years	0	2 Years	0	Other	1		
									Hybrid	0	3 Years	1				
									Other	0	5 Years	1+18				
											10 Years	0				
											Others	2				

Source: BEREC RA database 2023

The most frequent approach used by NRAs is a notional one (21 NRAs, 19 last year); the category "Other" which reflects a mix of approaches (SMP and notional, benchmarking) is now chosen by only 2 NRAs; the SMP cost of debt is considered by 3 NRAs including 2 that apply the WACC Notice as reported before. It should be highlighted that that the WACC Notice allows the use of the SMP value directly if this value is considered as efficient and in any case in the range of the values estimated for the peer group. The majority of NRAs apply the arithmetic mean and weighted average is used only for some country specificities (DE-LI).

The application of the WACC Notice has considerably increased the consistency of the corresponding methodological approach applied by NRAs.

Almost all NRAs estimate a debt premium instead of estimating the cost of debt directly, mostly when using a notional approach (see Figure 40). in this case, NRAs generally use the same peer group used for estimating beta and gearing; in one case (IT) the BEREC Arithmetic Mean is used as it was very close to the debt premium of the SMP operator (that sometimes is considered more relevant for estimating the cost of debt condition), in comparison to a pure notional approach considering specific national conditions (in this case the peer group used for the debt premium is different with respect to the one chosen for asset beta and gearing). One NRA (IE) uses a very detailed approach that considers many source of evidence *inter alia*: i) the approach of the WACC Notice (five years average of the debt premium of a peer group of companies with credit rating at least BBB); ii) spot rate of the same debt premium estimation; iii) actual coupon bond emission of own incumbent operator.⁵⁹

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

Most NRAs use averaging windows for bonds or time to maturity in line with those used for RFR (generally 10 year average).

⁵⁹ <https://www.comreg.ie/media/2020/10/ComReg-2096.pdf> paragraph (5.1). In the annual update an adjustment to the cost of debt estimated in 2020 equal to 2.6% is applied: the adjustment takes into account the fact that the difference between the cost of debt estimated by ComReg with the proposed methodology and the one based on the Commission notice as estimated by ComReg was 116 point basis in 2020; this difference was expected to remain constant over time. Thus the cost of debt is going to be updated annually considering an estimation of the cost of debt using the «Commission Notice approach and adding to this the 116 point basis. In practice it is a correction of the value of the cost of debt estimated in 2020.

Figure 39 - Cost of debt calculated through debt premium⁶⁰

	Cost of debt calculated through debt premium	Cost of Debt
Notional (generic operator)	17+3(17)(16)(14)(12)	1+2(2)(1)(0)(1)
SMP operator	0(1)(1)(1)(1)	1 (2)(3)(3)(4)
Other	1 (1)(1)(7)(7)	(0)(3)(3)(3)
Benchmarking	0 (0)(0)(0)(1)	1 (1) (1)(0)(0)

	Cost of debt calculated through debt premium	Cost of Debt
Notional (generic operator)	AT,CZ,DE,ES,FR,HR,HU,IS,IT,LI,LU,LV,N O,PL,PT,SE,SI BE,FI,IE	SK,ME,RS
SMP operator		LT
Other	MT	
Benchmarking		RO

Source: BEREC RA database 2023

With reference to the data source used, most NRAs use the market value of peer group companies. 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 corporate bond of 10 year residual maturity, in line with the bond length used to estimate RFR (21 NRAs).

Figure 40 - Bond lengths used for estimating cost of debt/RFR

		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)	3+18(17)(11)(9)(8)	(1)(1)(1)	1(1)(2)(2)(1)	2(2)(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 2023

NRAs generally choose averaging windows in accordance with averaging windows used for the RFR. The category “Other” is chosen only by 2 NRAs where the cost of debt is estimated based on the nominal coupon bond yield and not when the secondary traded market is used as data source.⁶¹

⁶⁰ NRAs that have provided information on all elements are shown. The NRAs that apply the WACC Notice are not reported separately.

⁶¹ 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 to the time windows used for the RFR estimation.

The results of the methodological survey are in line with the general principle expressed in BoR (18) 167 where BEREC understands the need for consistency in the averaging windows used for the cost of debt and RFR, but recognises also the necessity for NRAs to be flexible due to the fact that it is not easy to have perfect matching between the ten years bond maturity of the companies with corresponding time to maturity of country bonds for the five year averaging windows (i.e. point 98 BoR (18) 167). This is in line also with the approach adopted by BEREC in the debt premium estimation done in the annual WACC report: a specific criterion has been selected to trade off expected outcomes due to methodological provisions of the WACC Notice and the availability of the data for the parameter estimation (paragraph 4.3 BoR (23) 90).

Figure 41 - RFR/cost of debt time windows

62

		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(1)(1)(2)(1)	1 (1)(1)(2)(2)	2 (2)(2)(5)(4)
	>= 5 Years	1(1)(3)(3)(2)	(0)(2)(2)(2)	17+1 (16)(9)(4)(4)	19(17)(14)(9)(8)
Total		1 (1)(4)(6)(5)	1 (1)(3)(4)(3)	19 (17)(10)(7)(7)	21 (19)(17)(17)(15)

		Cost of debts		
		<=1 Year	<=3 years	>= 5 Years
RFR	<=1 Year			
	<=3 Years		BE	ES
	>= 5 Years	RS		IE, AT,CZ,DE,FR,H R,HU,IS,IT,LI,LU ,LV,NO,PL,PT,S E,SI, SK

Source: BEREC RA database 2023

Two NRAs applied specific adjustments to the cost of debt.

⁶² NRAs that have provided information on all parameters are shown. The NRAs that fully apply the WACC Notice are not reported separately.

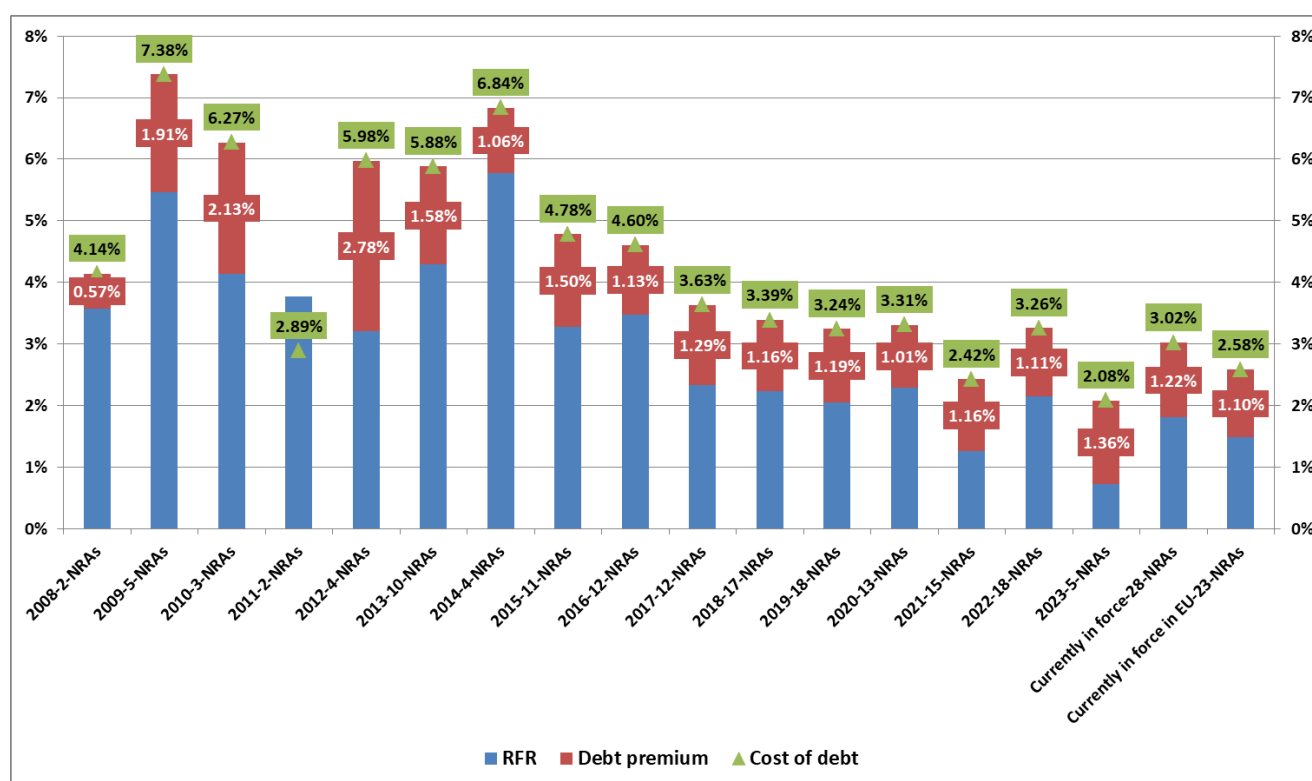
Figure 42 - Adjustments to cost of debt

	Cost of debt	Cost of debt without adjustment	Adjustment (%)	Motivation
IE	2.67%	2.6%	0.07%	New estimation of the cost of debt by a modified «Commission Notice methodology» done by ComReg + 116 point basis , that over all determine the new cost of debt with respect to the value estimated in 2020 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)
RS	8.71% (7.69%) (7.67%) (7.86%) (7.61%) (8.77%)	6.03% (5.64%) (6.27%) (6.85%) (6.48%) (7.23%)	2.68% (2.05%) (1.65%) (1.02%) (1.13%) (1.54%)	

Source: BEREC RA database 2023

The next figure shows the evolution over time of the cost of debt (as the sum of RFR and debt premium).

Figure 43 - Evolution of cost of debt over time



Source: BEREC RA database 2023

5.2.5 Gearing Ratio

see BoR (17) 169, BoR (18) 167, BoR (19) 240, BoR (20) 116, BoR (21) 86, BoR (22) 70, BoR (23) 90 for definition and general financial theory

Main results of the survey.

The outcome of the 2023 survey is reported in the following figure for all responding NRAs and EU NRAs separately (2022-2018 values in brackets).

Figure 44 - Gearing ratio

	Average	Median	Standard Deviation	Relative Standard Deviation	Maximum	Minimum
Gearing fixed market --						
28-NRAs	39.59%	41.56%	11.87%	29.99%	64.30%	0.00%
(2022-27)	(37.16%)	(39.22%)	(9.23%)	(24.83%)	(49.89%)	(0.00%)
(2021-29)	(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)	(37.70%)	(39.93%)	(9.71%)	(26.76%)	(54.79%)	(0.00%)
(2018-32)	(37.28%)	(39.85%)	(10.04%)	(26.93%)	(55.62%)	(0.00%)
Gearing fixed market-EU						
23-NRAs	38.67%	40.73%	9.75%	25.20%	47.07%	0.00%
(2022-23)	(37.24%)	(39.22%)	(9.08%)	(24.39%)	(46.46%)	(0.00%)
(2021-25)	(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)	(37.24%)	(40%)	(10.61%)	(28.48%)	(55.62%)	(0.00%)
(2018-26)	(37.27%)	(40%)	(10.65%)	(28.58%)	(55.62%)	(0.00%)

Source: BEREC RA database 2023

The overall situation is quite stable over time but the last year registers a small increase in the level of gearing in line with the evolution of market data on the level of debt of telecom operators, as highlighted in BEREC's WACC report BoR (23) 90.

Results for the 18 NRAs that fully apply the WACC Notice and the corresponding relevant BEREC reports can be summarised as follows:

- 13 NRAs (CZ, ES, FR, HU, IT, LU, LV, HR, PL, PT, SI, SK, NO) apply the arithmetic average from the relevant BEREC WACC Reports; 11 NRAs (CZ, ES, FR, HU, LU, LV, HR, PL, PT, SI, NO) use the calculated BEREC AM average using the full peer group; IT has deleted three operators from the peer group (Digi, Telenor and Telenet) as for the asset beta for the same reasons (the same gearing has been used to re-lever the asset betas as well as for estimating the weighted average of the cost of equity and cost of debt in the WACC formula); SK, NOS and TA have not been considered in the peer group and in the corresponding AM of the gearing due to the missing data on debt premium for those operators.
- 2 NRAs (AT, SE) use the gearing of their national SMP operator;
- 1 NRA (DE) used the weighted average for capitalisation as indicated by BEREC in the relevant report;
- 1 NRA (LI) estimated gearing using both equity and debt components from the book values included in the financial statement of the national SMP operator (no traded debt) and national fiscal regime (deductions for equity, not debt);

The following table shows the relevant BEREC WACC parameters Reports used by the 18 NRAs compliant with the WACC Notice: NRAs that use AM from the BEREC peer group are in green, NRAs that apply the WA of the peer group are in red, the NRAs that used the SMP operator values are in black.

Figure 45 - NRAs that adopted the WACC Notice approach (gearing)

Country	Relevant report	Methodology	Debt premium
AT	Bor(22)70	Berec estimation own country SMP gearing	34.35%
CZ	Bor(22)70	AM full peer group gearing	42.42%
DE	Bor(22)70	WA full peer group gearing	47.07%
ES	Bor(22)70	AM full peer group gearing	42.42%
FR	Bor(20)116	AM full peer group gearing	37.00%
HR	Bor(22)70	AM full peer group gearing	42.38%
HU	Bor(23)90	AM full peer group gearing	45.37%
IT	Bor(22)70	AM Berec peer group gearing not including DIGI, Telnor, Telnet	40.73%
LU	Bor(20)116	AM full peer group gearing	37.00%
LV	Bor(22)70	AM full peer group gearing	42.42%
PL	Bor(23)90	AM full peer group gearing	45.36%
PT	BoR (22) 70	AM full peer group gearing	42.42%
SE	Bor(20)116	Berec estimation own country SMP gearing	34.10%
SI	Bor(20)116	AM full peer group gearing	36.95%
SK	Bor(23)90	AM Berec peer group gearing not including TA, NOS	46.86%
IS	Bor(21)86	AM full peer group gearing	39.22%
LI	Bor(23)90	SMP operator gearing due to specific national condition no Berec peer group	13.47%
NO	Bor(22)70	AM full peer group gearing	42.42%

Source: BEREC RA database 2023

In Figure 47 the currently estimated cost of debt is reported for each NRA, with the indication for the year of estimation and the relative Credit Rating.

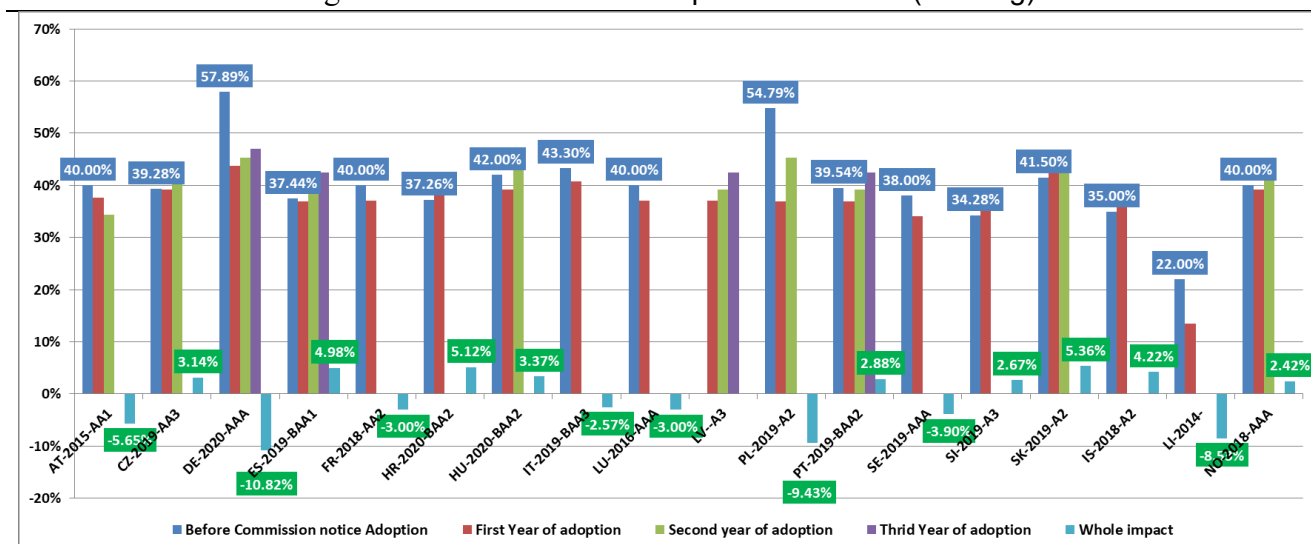
Figure 46 - Gearing values



Source: BEREC RA database 2023

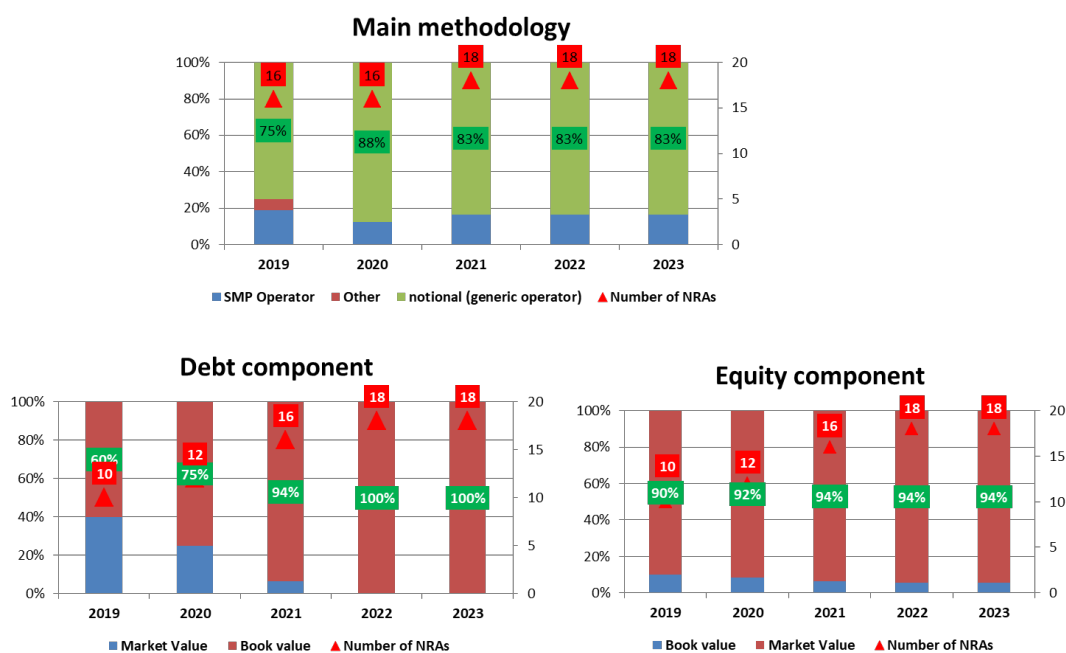
In the following Figure 48 the evolution of gearing is considered for the 18 NRAs that applied the WACC Notice. The last value before the adoption of the WACC Notice is the starting point (the year of last estimation before the WACC Notice adoption is reported in the label of each country). The whole impact is estimated as the difference between the last value estimated before the Notice and the most recent value adopted compliant with the WACC Notice. For the gearing the impact in absolute term is quite limited for the most NRAs (max 10% of difference in 4 years); this can be partially explained by the fact that the methodology used was already quite homogeneous. In fact, the geographical scope of the estimation was already focused on a notional approach; significant differences were only seen for NRAs that adjusted the methodology according to national circumstances (e. g. DE, PL) when adopting the WACC Notice. The other main elements of the methodology (data source for the estimation, i.e. market value vs book value) were already substantially in line with the approach of the WACC Notice for most NRAs.

Figure 47 – WACC Notice adoption 2021-2023 (Gearing)



Source: BEREC RA database 2023

Figure 48 - Methodologies evolution of gearing over time (2019-2023) for the 18 NRAs that adopted the WACC Notice



Source: BEREC RA database 2023

The following figures summarise the different approaches used by NRAs to estimate the gearing parameters. The adoption of the WACC Notice contributes to increase the incidence for the most frequent approaches.

Figure 49 - Gearing methodology

	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)	4+15	Book value	18	Book value	1	Arithmetic	2+14	Arithmetic average	1
	SMP Operator	1+3	Market Value	1	Market Value	1+17	Median	2		
	Other	2	Other	0	Other	0	Weighted Average	1		
	benchmarking	1					Other	2		

Source: BEREC RA database 2023

The large majority of NRAs used a "notional" approach, and, in general, do not adjust the gearing according to national circumstances. Moreover, when an unlevered beta is estimated the gearing used to unlever the beta is the same which is used for the weighted average of the cost of equity and debt in the WACC formula (there is no case of different gearing estimation). The gearing is generally estimated using the same averaging window for beta estimation. In line with last year's report, most NRAs used a notional approach consistent with their approach for estimating the beta, (3 exceptions from the notional approach are reported, AT, SE, LI, where the SMP gearing has been used).

Figure 50 - Gearing methodology

63

	Debt component			Equity component		
	Book value	Market value	Other	Book value	Market value	Other
notional (generic operator)	15,(13) (11)(4) (4)	1 (1) (4)(4) (3)	(0)(2) (2)	(0) (0)	16(15)(15)(8) (7)	(0)(2) (2)
SMP Operator	3 (3)(1)(2) (2)	(1)(1) (0)	(0)(0) (0)	1(1) (1)(1) (1)	2(2)(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	18(16)(12)(8) (8)	1(1)(5)(6) (4)	(0)(2) (2)	1(1)(1)(1) (1)	18 (17)(16)(13) (11)	(1)(2)(2)

	Debt Component			Equity component		
	Book value	Market value	Other	Book value	Market value	Other
notional (generic operator)	CZ,DE,ES,FR,HR,HU, IS,IT,LU,LV,NO,PL, PT,SI, SK	BE			CZ,DE,ES,FR, HR,HU,IS,IT, LU,LV,NO,PL, PT,SI, SK, BE	
SMP Operator	AT,SE,LI			LI	AT,SE	
Other						
benchmarking						

Source: BEREC RA database 2022

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

Considering the methodologies used by all NRAs for estimating the cost of debt, gearing and beta (company/industry specific parameters) it should be highlighted that the gearing estimation plays a significant role in the WACC formula since it affects several parameters: (i) it determines the weights for the cost of equity and cost of debt, (ii) it is used to unlever 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 resulting in a reduction in the spread of the methodologies in accordance with a notional approach based on a peer group.

⁶³ NRAs that have provided information on all parameters are shown. The NRAs that apply the WACC Notice are reported in green.

Figure 51 - Methodology gearing and cost of debt estimation

64

		Cost of debt				
		notional (generic operator)	SMP Operator	Other	Benchmarking	Total
Gearing	notional (generic operator)	15+4(17) (15) (12) (12)	(1)(2)(2) (2)	(2)(4)(4)	0(0)(0)(0)	19(18)(19) (18)(18)
	SMP Operator	1(2)(2)(2)(1)	2+1(2)(2)(2)(3)	(1)(2)(3)	(0)(0)(0)	4 (4)(5)(6) (7)
	Other	(0)(0)(0)	(0)(0)(0)	2(1)(1)(3)(2)	(0)(0)(1)	2(1)(1)(3)(3)
	Benchmarking	(0)(0)(0)	(0)(0)(0)	(0)(0)(0)	1(1)(1)(0)(0)	1(1)(1)(0)(0)
Total		20(19)(17)(14) (14)	3 (3)(4)(4)(5)	2 (1)(4)(9)(9)	1(1)(1)(0)(1)	26(24)(26)(27) (28)

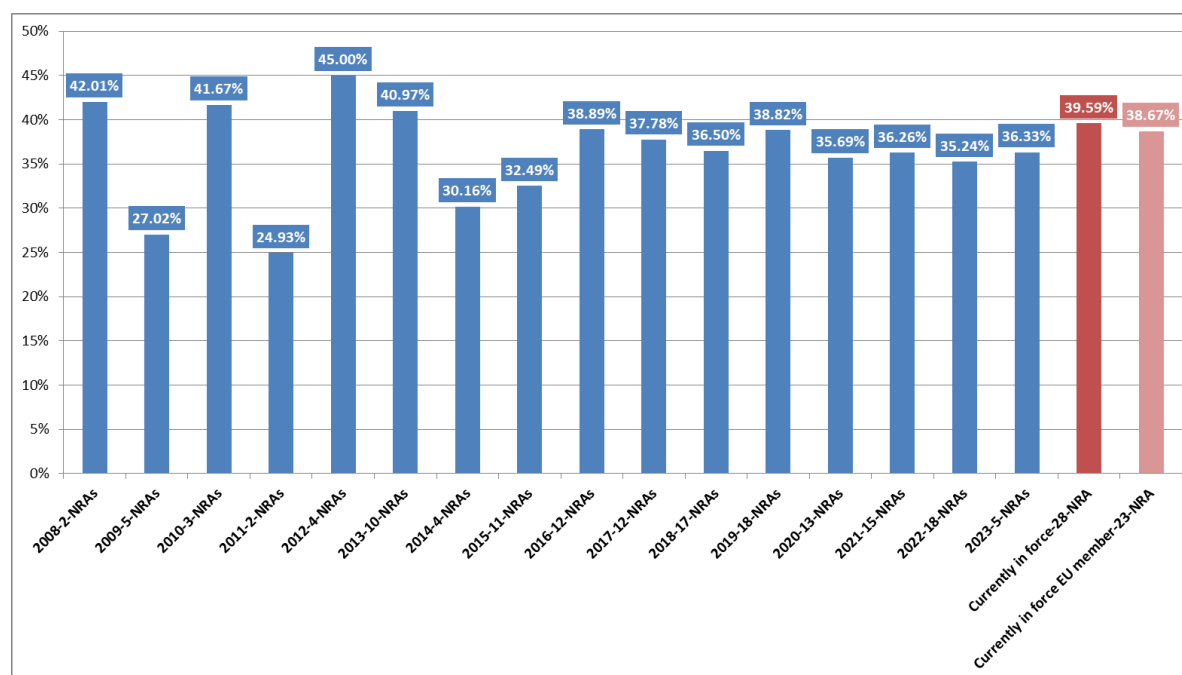
		Cost of debt			
		notional (generic operator)	SMP Operator	Other	Benchmarking
Gearing	notional (generic operator)	CZ,DE,ES,FR,HR,HU,I S,IT,LU,LV,NO,PL,PT, SI, SK, BE,FI,IE,RS			
	SMP Operator	LI	AT,SE,LT		
	Other			EL,MT	
	Benchmarking				RO

Source: BEREC RA database 2023

The evolution over time of the gearing estimation is reported in Figure 53, with a small increase of the parameter in the last year.

⁶⁴ NRAs that have provided information on all parameters are shown. The NRAs that apply the WACC Notice are reported separately in green.

Figure 52 – Evolution of gearing over time



Source: BEREC RA database 2023

5.2.6 Tax rate

Concerning the corporate tax rate in use in 2023 the following statistics emerge (2018-2022 figures in brackets):

Figure 53 - Corporate tax rate⁶⁵

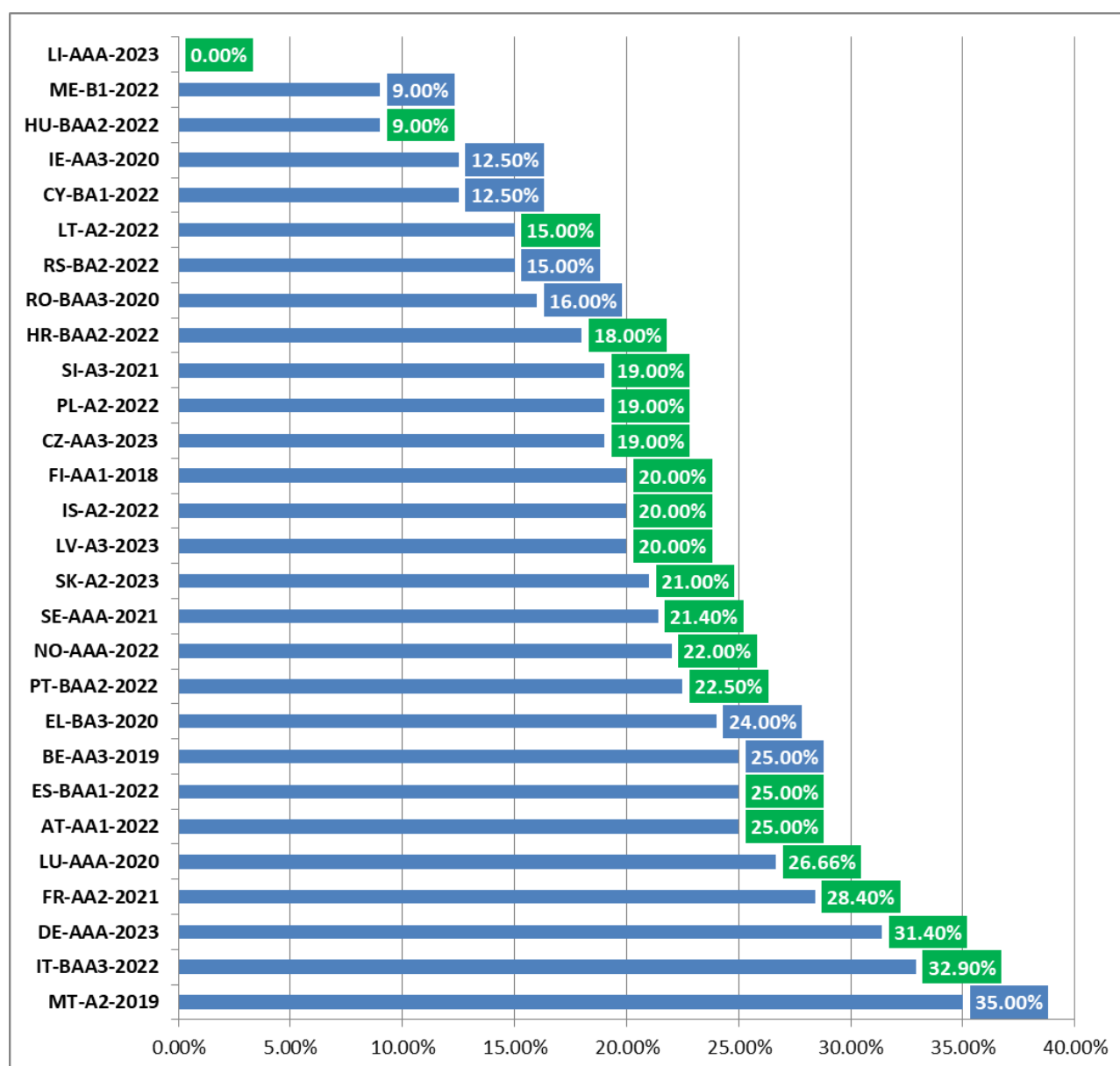
	Average	Median	Standard Deviation	Relative Standard Deviation	Maximum	Minimum
Tax rate fixed market 28-NRAs						
(2022-27)	20.15%	20.00%	7.62%	37.81%	35.00%	0.00%
(2021-29)	(20.48%)	(20.00%)	(8.04%)	(39.25%)	(35.00%)	(0.00%)
(2020-31)	(20.31%)	(20.00%)	(8.09%)	(39.85%)	(35.00%)	(0.00%)
(2019-32)	(20.02%)	(20.00%)	(7.75%)	(38.72%)	(35.00%)	(0.00%)
(2018-32)	(21.07%)	(20.45%)	(8.34%)	(39.57%)	(35.00%)	(0.00%)
	(21.09%)	(20.45%)	(8.48%)	(40.19%)	(36.00%)	(0.00%)
Tax rate fixed market 23-EU NRAs						
(2022-23)	21.66%	21.00%	6.59%	30.40%	35.00%	9.00%
(2021-25)	(22.04%)	(21.00%)	(6.88%)	(31.20%)	(35.00%)	(9.00%)
(2020-24)	(21.68%)	(21.00%)	(7.11%)	(32.77%)	(35.00%)	(9.00%)
(2019-26)	(21.57%)	(21.50%)	(7.21%)	(33.43%)	(35.00%)	(9.00%)
(2018-26)	(22.51%)	(21.50%)	(7.73%)	(34.33%)	(35.00%)	(9.00%)
	(22.54%)	(22.00%)	(7.91%)	(35.08%)	(36.00%)	(9.00%)

Source: BEREC RA database 2023

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.

⁶⁵ Null tax rate is related to the fact that in LI specific deductions for equity are present.

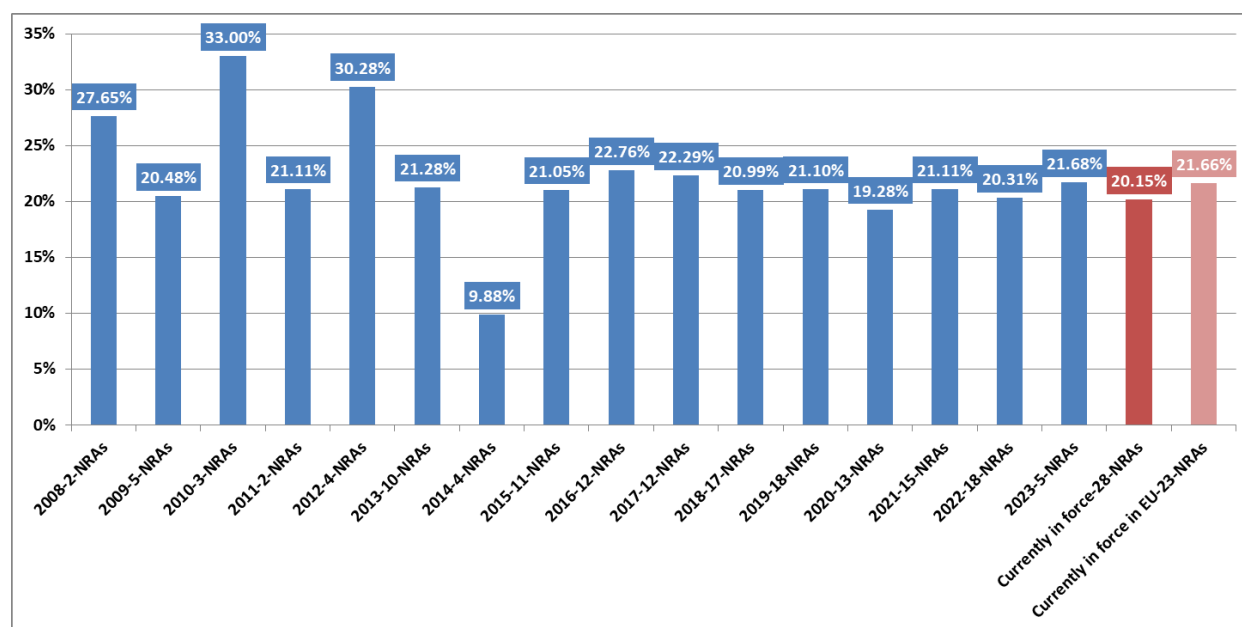
Figure 54 - Tax rate currently in use



Source: BEREC RA database 2023

The time series of the arithmetic average tax rate adopted is reported in Figure 56.

Figure 55 - Evolution of average tax rate over time (fixed market 2008-2023)



Source: BEREC RA database 2023

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 evaluation process by the European Commission.

Today, only one NRA still applies an adjustment to the cost of equity in fixed markets (see Figure 20 - Adjustments to cost of debt, in bracket the adjustment applied in 2018-2022).

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.⁶⁶

In comparison to the previous years the practice of using adjustments is decreasing over time with some NRAs (CZ, DE, NO, SK) having removed the adjustments. One NRA (IE) updated annually the cost of equity through a specific adjustment applied to the 2020 estimation.⁶⁷ This tendency has been also confirmed with the application of the WACC Notice.

⁶⁶ The adjustment reported is derived in comparable way between NRAs for the purpose of the present report, with the objective to derive through the standard formula of the CAPM model the final WACC considering all the information provided on all the other parameters.

⁶⁷ In the IE case the methodology for cost of equity calculation has been established in 2020, based on a mix of approaches that take into account both 2014 methodology as well as the methodology reported in the Commission Notice for the estimation of some parameters, providing an estimation called "Equilibrium approach". The final cost of equity in 2020 has been found within a range of values from those two methodologies: i) 2014 methodology ii) modified Commission Notice approach. In the annual update only a "modified Commission Notice" approach has been applied to update the cost of equity parameters (risk free rate, equity beta, and equity risk premium). In calculating the parameters ComReg will also refer to the value proposed by BEREC as well to ensure consistency and in case variance arise to understand the reasons for same. So the ranges of values include BEREC estimation, but are derived through a more wide level of information supported by a consultant. Using the updated parameters ComReg calculates a new range of cost of equity under the modified Commission Notice approach. 64% of the difference between the lower bound and the upper bounds is considered and added to the lower bound already calculated, producing the new updated post tax cost of equity. The 64% is based on the evidence that in the

Figure 56 - Adjustments to the cost of equity

	Adjustmet for cost of equity	Motivation
IE	-1.03%	An annual calculation of the parameters that compose the cost of equity (RFR, Equity beta and ERP) is done in line with a modified Commission notice approach. From this calculation a range of values for the post-tax cost of equity are derived and the 64% of the differences between the upper bound and lower bound is considered, this value (64° percentile approach) is added to the lower bound of the estimation of the post tax cost of equity that is the new value that substitute the one derived in 2020 decision.
RS	2.34% (1.81%) (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.

Source: BEREC RA database 2023

The motivation for technical adjustments is generally to take into account national specificities with the main motivation being stability considerations.

5.3 NGA Risk premium

In this section an overview of NGA WACC estimation is provided (no cross-relationship with price control applied to the NGA wholesale regulated product for which the information is available in the RA section of the report).

The following emerges from the survey: 10 NRAs estimate a risk premium for FTTH networks currently in force, 1 NRAs still apply a risk premium to the FTTC services without differentiating it from the one applied to FTTH (SI). In the last year 2 NRAs have updated the risk premium (CZ, SI).

It is not possible to obtain a clear view of the corresponding systematic or non-systematic risk taken into account in NGA risk premium estimation. Uncertainty of demand is the main source of risk.⁶⁸ The risk is generally applied to all the kinds of infrastructure, both active and passive.

estimation done in 2020 the mid-point of estimation of the post-tax cost of equity derived thorough the “Equilibrium approach”, was in the 64th percentile of the “Modified Commission Notice approach” derived at that time. So on annual basis the new calculation based only on the “Modified Commission Notice Approach” that produces a range of values of the cost of equity is considered, and the 64th percentile of the range is taken as new final cost of equity.

⁶⁸ 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.

Figure 57 - 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	0.97%	Yes	0.97%	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.		The NGA risk premium was calculated as a difference between the WACC for legacy network and WACC for NGA network.
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	1.55% (1.97%)	Yes	1.55% (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). Furthermore, the lower risk premium is justified given that other operators are willing to invest in fiber optic access	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	

								networks, as evidenced by the significant increase in announcements of intentions to set up fiber optic distribution networks of alternative operators in the last two years. Furthermore, the lower risk premium is justified given that other operators are willing 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	1.92% (3.20%)	Mainly systematic risk (as it is estimated not for a specific project or geographical area).	Passive and Active	<p>Agcom evaluated the risk premium through an option pricing model (mainly based on a DCF approach) in a way to include two main risk factors: a) the "wait and see" option to postpone the investment when new information about demand/cost will be available; b) the risk to open the network to third parties without having any first mover advantage.</p> <p>The evaluation of the risk premium in 2015 was based on the quantification of the wait and see option using a Montecarlo method for estimating the variance of the investment in FTTH, considering uncertainty on: demand (take up), Arpu, and capex cost, including the flexibility option given by third party that can have access to the infrastructure without sustaining any sunk cost. Applying the theory provided in the paper J.C Cox S.A.Ross, M. Rubestain, Option pricing: A simplified approach, (1979), the corresponding risk premium on the top of legacy Wacc have been determined from the variance of the IRR FTTH business case considered. The two sources of risk have been justified until 2022, due to the specific conditions experienced in the market review 2015-2018 and 2019-2021, that showed: i) a national coverage with FTTC solution, achieved between 2015-2018 by the incumbent operator, in combination with a low coverage of FTTH with no incremental investments; ii) the investments in FTTH have been taken until 2021 at national level only by an alternative operator with a wholesale only model. The investment in FTTH solution in this context was not an independent choice by the SMP operator, but a reply to the competitive context. 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> <p>Since 2022 investment plans for FTTH materialized, in term of commercial availability of the network, also by the incumbent operator, the "wait</p>	<p>The premium is applied to all VHCN wholesale services including the duct access that in every case have a pricing form of IRU with multiple years where the cost of capital are discounted in the final price. The premium is summed up with respect to the nominal legacy WACC.</p>	<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.</p>

										and see" option is going to decrease along the years. Agcom, for 2022-2023 pricing (decision 132/23/CONS2), has reduced the risk premium value with respect to the previous market review considering that in area where commercial available FTTH network was present the "wait and see option" is not anymore relevant (weighted average between the previous risk premium 3.2% and 0%).		
PL	Yes	No		No		Yes	1.51% (2.05%)			The premium is determined on the basis of the arithmetic mean of the NGA risk premium from countries that apply such a premium. Currently, apart from Poland, there are 5 EU countries that apply the NGA risk premium.	The NA risk premium is only included for fiber when it comes to cabling or copper infrastructure is out of service	
SI	Yes	Yes	1.50%	Yes	1.50%	Yes	1.50%	Demand risk	Passive and Active	benchmarking	For all NGN network components	

Source: BEREC RA database 2023

Appendix I - WACC parameter quantitative analysis

Carried out since BoR(17)169, as new observations on WACC estimation become available (new 17 observations since last year are 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 parameter. 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 2023):⁶⁹

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

(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 predict⁷⁰. 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

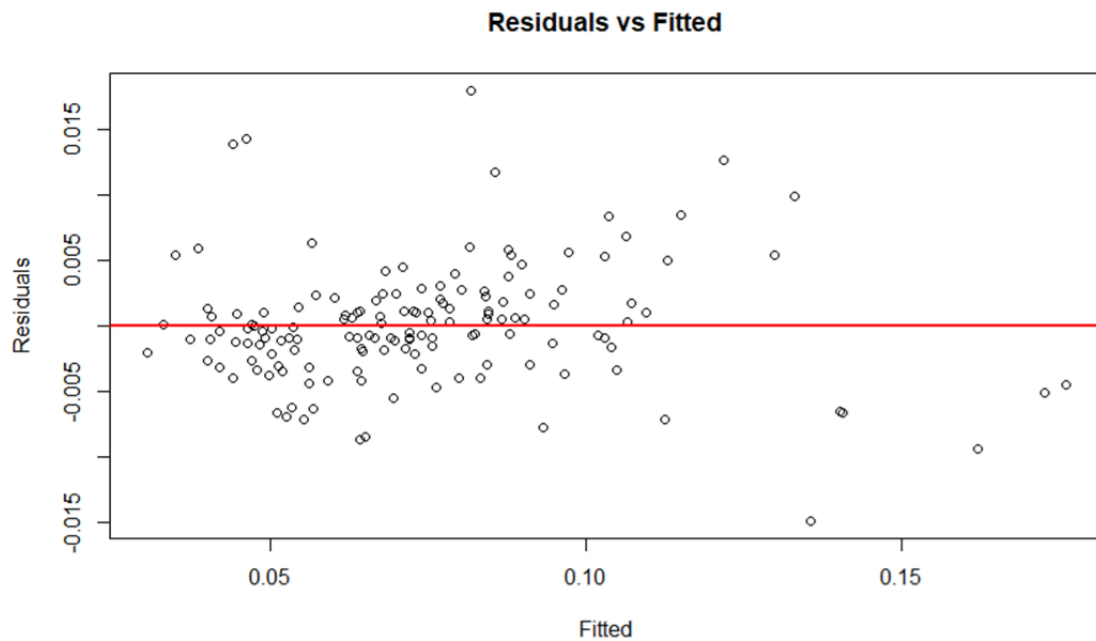
A first verification of the validity of the linear approximation is to detect if some path can be identified in the residual plot (y-axis) with respect to the expected values (x-axis). Points should be distributed symmetrically around a horizontal line in relation to an intercept

⁶⁹ The parameters have been analysed not including adjustment not attributed to single parameters.

⁷⁰ “Statistics for business and economics” Heinz Kohler 1994.

equal to zero. Different trends indicate at first point the presence of some non-linearity in the model (Figure 59)⁷¹. 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 58 - Linear approximation

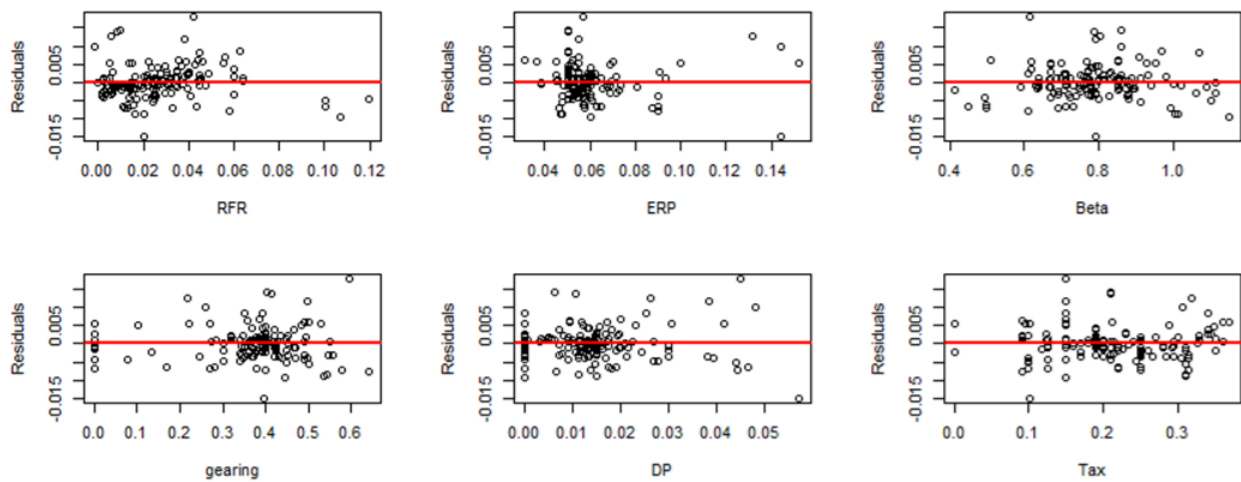


Source: BERECA database 2023

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).

⁷¹ The residual of an observed value is the difference between the observed value and the estimated value of the quantity of interest.

Figure 59 - Non-linear effects



Source: BEREC RA database 2023

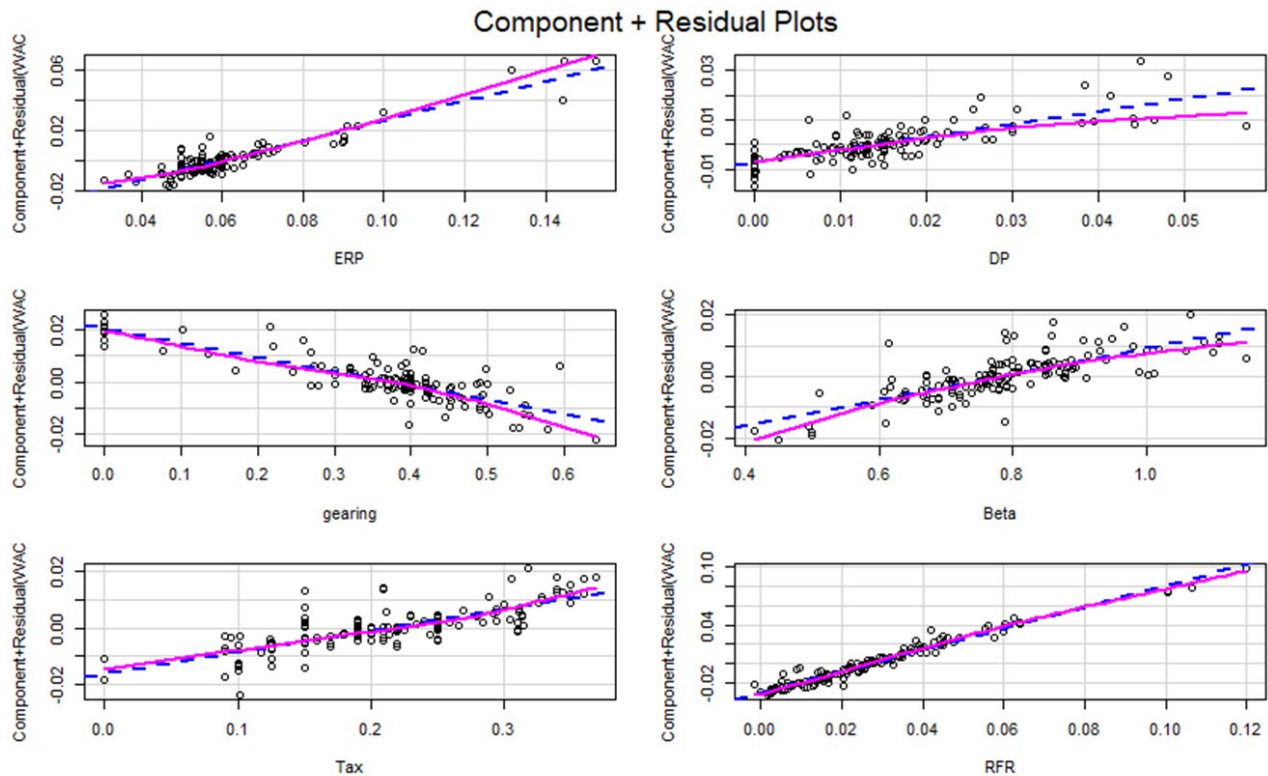
Another relevant measure to detect non-linearity in the model is provided through the use of the partial residual plot⁷² (Figure 61), which, in case of multiple regression, shows the relationship between a given independent variable and the response variable, given that other independent variables are 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 plots⁷³ (correlation measure).

In Figure 59 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.

⁷² 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..

⁷³ Regressing each independent variable with the dependent variable like a bi-variate model.

Figure 60 - Nonparametric fitting

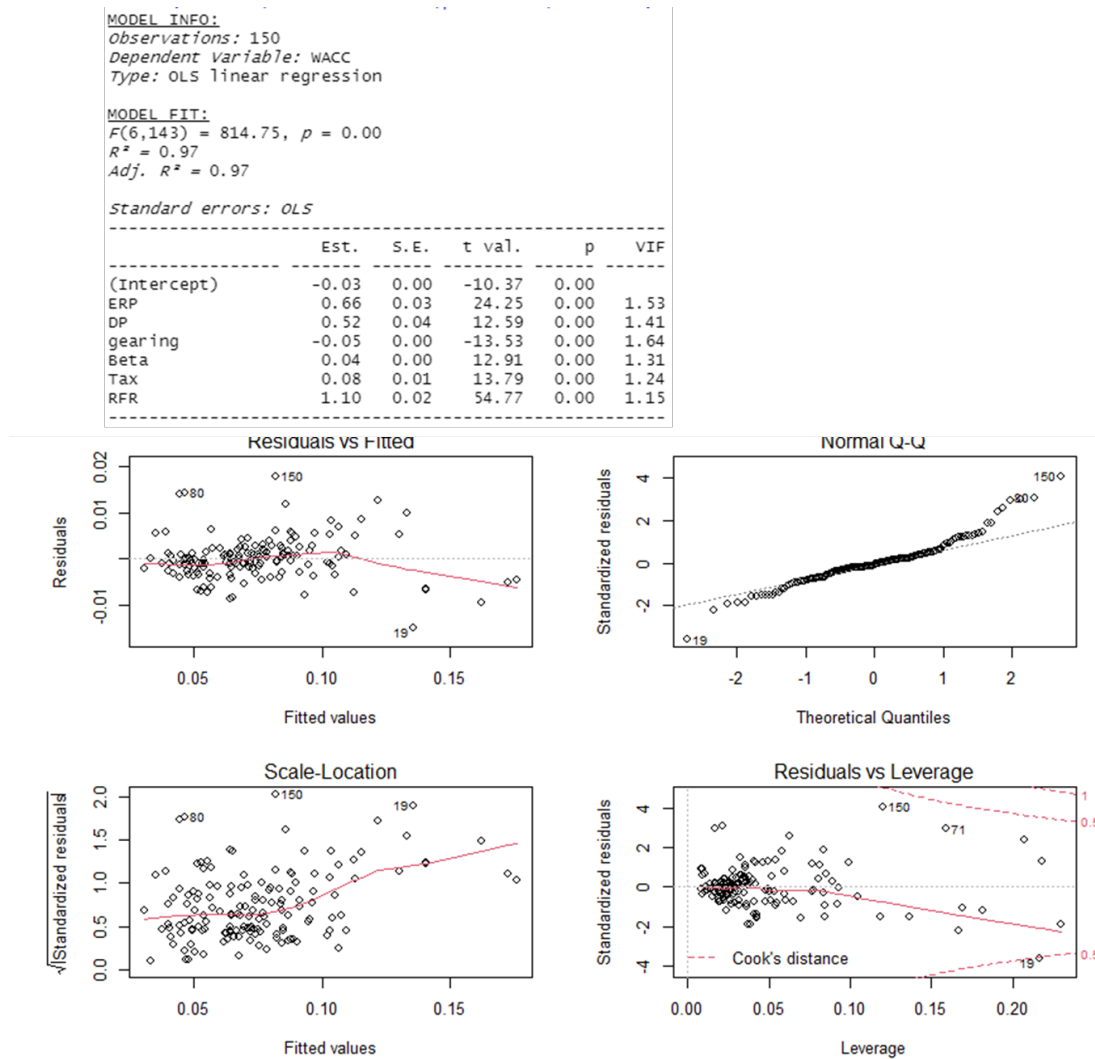


Source: BEREC RA database 2023

Normality, multicollinearity, homoscedasticity

In Figure 62 summarised statistics are provided showing that all regressors are statistically significant with an adjusted R squared of 0.97. 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 59); (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 61 - Nominal panel data statistics

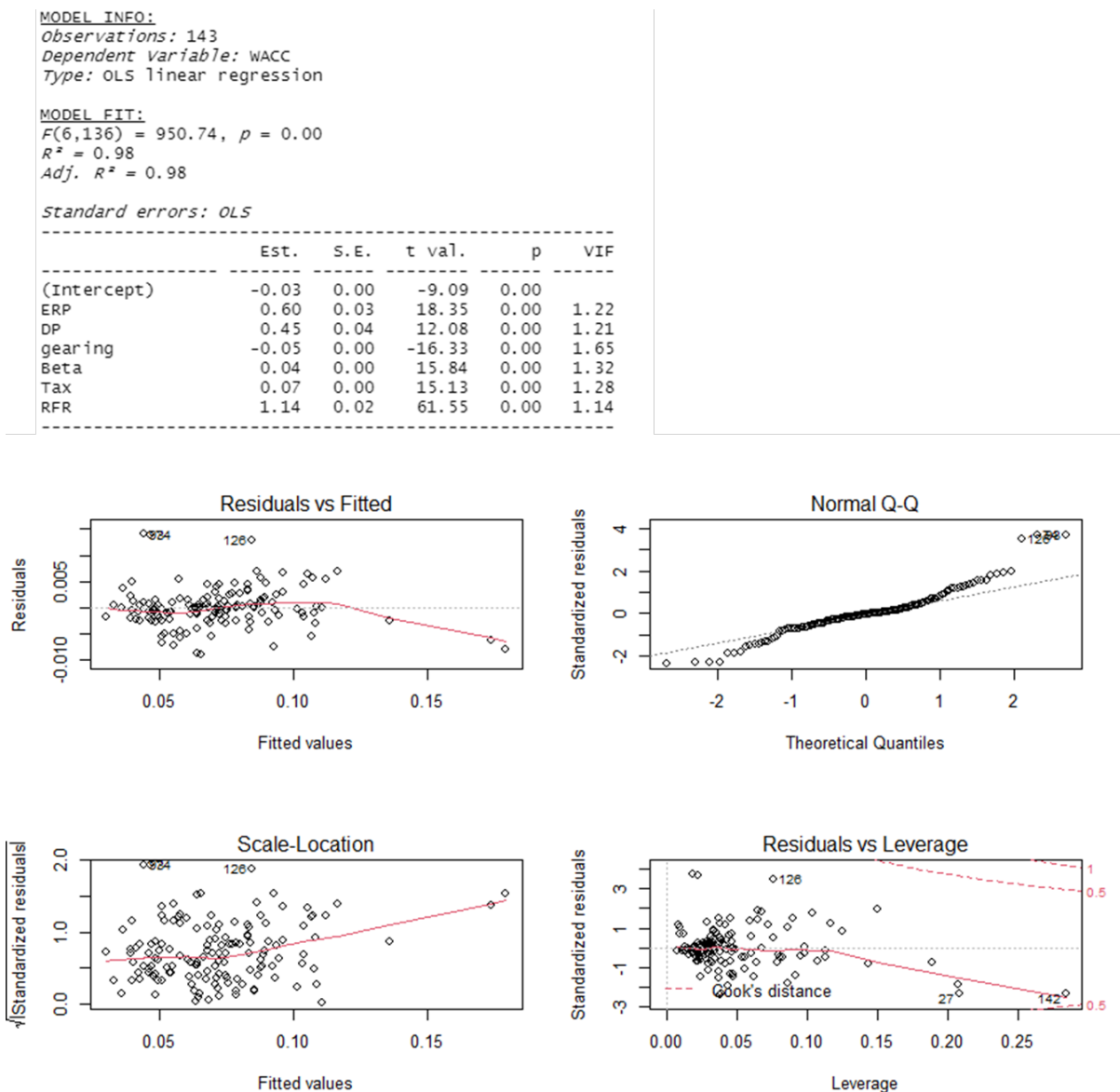


Source: BEREC RA database 2023

We hence show the same model without seven possible outlier observations, by still finding similar results, as shown in Figure 63, where the quality of fitting and the correlation between variable are reduced.⁷⁴

⁷⁴ 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 62 - Nominal panel data statistics without outliers



Source: BERE RA database 2023

Figure 64 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,⁷⁵ 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 62 we report statistics from the three analysis done, when all the observations are taken into account (n=150),⁷⁶ when possible 7 “outliers” have been deleted (n=143), when only EU members are included (n=116).

Figure 63 - WACC Nominal pre-tax R² adjusted variations / AIC variations (full time series analysis)

Number of observation: 150	Total	RFR	ERP	Tax	gearing	beta	CD
R ² Adj	97.04%	61.66%	12.07%	3.89%	3.74%	3.41%	3.24%
AIC	-1603.05	-461.49	-242.75	-124.9	-121.59	-113.93	-109.89
Number of observation: 143	Total	RFR	ERP	Tax	gearing	beta	CD
R ² Adj	97.57%	67.21%	5.96%	4.05%	4.72%	4.44%	2.57%
AIC	-1587.03	-478.81	-176.12	-139.13	-153.22	-147.52	-102.18
Number of observation EU NRAs: 116	Total	RFR	ERP	Tax	gearing	beta	CD
R ² Adj	97.19%	71.59%	8.82%	5.80%	5.40%	5.87%	2.19%
AIC	-1308.97	-379.14	-163.89	-129.05	-123.51	-129.92	-66.05

Source: BEREC RA database 2023

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, beta is becoming more relevant with the new introduced observation; this can be seen by the fact that contrary to the past the new updated values are going to be different from the past, due to increased differences in the level of risk in the telecom sector with respect to the other sectors as already discussed in previous chapter.

⁷⁵ 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.

⁷⁶ The RA database benefit of 151 observations (Table 1). The last value for 2022 of IE has not been included as it is not derived by a formula, but from an adjustment to the cost of equity and debt on the one in 2020 estimation that has been already included..

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 bias⁷⁷). 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. At the same time beta is becoming more relevant for explaining the difference in WACC values between NRAs due to asynchronous update of the parameter and due to the fact that contrary to the past the variation of this parameter is more relevant than before this element in this year data is still more relevant than past years.

Figure 64 - WACC Nominal pre-tax R² adjusted variations / AIC variations (reduced time series analysis)

Number of observation: 89 observations	Total	RFR	ERP	Tax	gearing	beta	CD
R ² Adj	97.21%	74.18%	3.28%	4.95%	4.37%	8.00%	4.72%
AIC	-1015.59	-294.44	-68.35	-90.05	-83.09	-119.6	-87.3
Number of observation EU NRAs: 71	Total	RFR	ERP	Tax	gearing	beta	CD
R ² Adj	97.68%	74.97%	3.39%	6.71%	3.45%	8.57%	2.29%
AIC	-831.54	-248.01	-63.09	-95.57	-63.71	-108.88	-47.81

Source: BEREC RA database 2023

⁷⁷ 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.