Methodological review of the cost of capital estimation

Prepared for Autorità di Regolazione per Energia Reti e Ambiente (ARERA)

June 2021

www.oxera.com

compelling economics

Contents

Oxera Consulting LLP is a limited liability partnership registered in England no. OC392464, registered office: Park Central, 40/41 Park End Street, Oxford OX1 1JD, UK; in Belgium, no. 0651 990 151, branch office: Avenue Louise 81, 1050 Brussels, Belgium; and in Italy, REA no. RM - 1530473, branch office: Via delle Quattro Fontane 15, 00184 Rome, Italy. Oxera Consulting (France) LLP, a French branch, registered office: 60 Avenue Charles de Gaulle, CS 60016, 92573 Neuilly-sur-Seine, France and registered in Nanterre, RCS no. 844 900 407 00025. Oxera Consulting (Netherlands) LLP, a Dutch branch, registered office: Strawinskylaan 3051, 1077 ZX Amsterdam, The Netherlands and registered in Amsterdam, KvK no. 72446218. Oxera Consulting GmbH is registered in Germany, no. HRB 148781 B (Local Court of Charlottenburg), registered office: Rahel-Hirsch-Straße 10, Berlin 10557, Germany.

Figures and tables

Executive summary

In 2015 Oxera published a report, commissioned by ARERA, on best practice in estimating the weighted average cost of capital (WACC) in a regulatory context in Italy. The current report serves as an update to the 2015 report, and reflects on new evidence from capital markets and academia. It also provides updates based on, or in response to, further thinking and evidence presented by various parties during regulatory consultations and determinations in Europe, and in the UK more specifically.

The report takes into account a number of macroeconomic conditions and events that have characterised the last five years. On the one hand, empirical evidence shows that real yields in the eurozone have been negative for almost five years. Such evidence provides some challenges in assessing the expected return on an investment free of default and systematic risk—i.e. the risk-free rate (RfR). On the other hand, the macroeconomic outlook has been characterised by significant uncertainty in the last years, also due to recent developments in the COVID-19 crisis.

The following paragraphs detail our methodology and review the existing approach followed by ARERA in the context of the new market evidence.

Overall framework for the cost of equity

As in our 2015 report, and recognising the unusual macroeconomic developments in the eurozone, our proposed approach to estimating the cost of equity (CoE) for regulated utilities is based on the following pillars:

- the **real RfR**—estimating the real return expected on a risk-free asset. That is, benchmarking the RfR to a zero beta asset free of default risk;
- the **country risk premium (CRP)**—estimating the additional premium required by equity investors for investing in Italy;
- the **equity risk premium (ERP)**—estimating the additional level of compensation that investors require for investing in equity. The estimation takes into account the total market return (TMR) and the premium relative to the RfR;
- the **sector-specific risk premium (beta)**—estimating a sector-specific risk premium.

Risk-free rate

We have reviewed the contemporaneous evidence on how to estimate the RfR in light of the recent market and regulatory developments—notably, the redeterminations of the water PR19 price control by the UK Competition and Markets Authority (CMA) and the ongoing RIIO-2 energy appeals in the UK.

Empirical evidence shows that real yields in the eurozone have been negative for almost five years. Moreover, central banks have set policy rates that are negative in real terms, and in some cases also negative in nominal terms. As an example, the European Central Bank deposit rate is -0.5% in nominal terms, and the eurozone inflation forecast is +1.5%.

In this report, we have also reviewed whether sovereign yields are a good proxy for the expected rate of return on a zero-beta asset. The Capital Asset Pricing Model (CAPM) defines the RfR as the rate of return on a zero-beta asset, and assumes that there is a single RfR at which investors can undertake risk-free borrowing and lending. This assumption might be violated when considering an estimate of the RfR that is based on spot yields on government bonds. For example, we present evidence that demonstrates that even the safest corporate bonds trade at a yield that is significantly higher than that of government bonds. This phenomenon is described in academia as a convenience premium—i.e. the premium embedded in government bonds for their special liquidity and safety characteristics.

Therefore, when estimating the RfR with reference to government bonds, it is important to account for the convenience premium and to uplift the benchmark on that basis.[1] Further, if the RfR is not indexed, it is important to consider the expected level of the future interest rate. To account for this, we recommend estimating a forward premium that can be added to the benchmark.[2]

We note that there is uncertainty associated with the development of interest rates, and that forward rates change on a daily basis. In other words, there is a risk that interest rates will rise faster than forward rates currently indicate, which would create a financeability problem. To account for this risk, an uncertainty premium can be added to the benchmark.

Country risk premium

We have reviewed the CRP with reference to the adjustment formula used by ARERA. We present evidence that the long-run average spread between Italian and a blend of AAA and AA eurozone government bonds is approximately 1%.

We note that the CRP adjustment formula follows the spread on Italian bonds with a three-year lag. The difference between the allowed CRP and actual spreads may be reduced by making incremental changes to the adjustment formula

Total Market Return

Consistent with the 2015 report, we consider it appropriate to rely on long-run historical evidence of equity market returns from Dimson, Marsh and Staunton (DMS) as the primary source of input, and to use the forward-looking evidence as a cross-check.

We note that the academic evidence suggests that arithmetic averaging of historical data produces an unbiased estimate of the discount rate for use in investment appraisal and valuation. We also attach some weight to the view that expected market returns may be below the long-run average as a consequence of the relatively low level of prevalent interest rates.

Issues in beta estimation

The methodology outlined in this report focuses on the selection of an appropriate comparator sample. In short, the comparator sample can be selected by:

- filtering to include those companies with the majority of revenues in the activity of interest;

[1] Evidence from academia suggests that the convenience premium on government bonds is approximately 50bp to 100bp.
[2] The estimated forward premium as of March 2021 is 24bp.

- filtering to include those companies with the majority of revenues in the geography of interest;
- applying liquidity filters (i.e. bid–ask spread and share turnover ratio) to remove illiquid stocks;
- selecting the appropriate data frequency and estimation window. The statistical robustness of the beta estimates is directly proportional to the number of observations used in the regression analysis, which would indicate the use of daily data. However, if systematic risk is changing over time, using a longer time period may be less relevant for assessing the current (or 'forward-looking') market risk exposure of a company;
- selecting the appropriate index. Assuming that investors will diversify their portfolios within the relevant currency zone, the use of a eurozone index to estimate the beta of eurozone companies is preferred.

Cost of debt (CoD) estimation

In setting the allowed CoD, it is important to consider the objectives of the regulator and the sector context. In general, there are two key principles to follow in setting the allowed CoD:

- cost recovery—that is, the regulator should aim to set the allowed CoD such as to ensure that the companies can recover the cost of efficiently incurred debt;
- incentives—a notional CoD that reflects the credit rating of an efficiently financed firm would incentivise companies to issue new debt at the lowest possible rates consistent with that credit rating.

There are two methods to estimate the CoD: using **market evidence** (e.g. estimating the CoD with reference to current yields on bonds matching the credit rating of the companies of interest); and using **company data** (e.g. with reference to the company's existing debt obligations).

Market evidence suggests that the difference between embedded debt costs and current market yields is approximately 1%. This difference arises due to the reduction in interest rates over time, since the cost of embedded debt includes bonds raised in the past, when yields were higher.

Gearing

We have analysed market data on publicly traded Italian utilities and observed that the level of gearing of those companies ranges from 40% to 50%.

We have also reviewed regulatory determinations more widely in Europe. The review of these determinations indicates that a range between 50% and 60% is adopted most often as a notional gearing level for energy utilities.

Treatment of tax

In the context of setting an allowance for the companies to meet their tax obligations, it is important to consider the differences between a pre-tax and a post-tax WACC and the advantages and disadvantages of each method.

We explain that the use of a pre-tax WACC mitigates the problems associated with the detailed modelling of tax liabilities, introducing simplicity and transparency to the regulatory price-setting formula. We also explain that, generally, the pre-tax WACC is estimated using the statutory tax rate.

In contrast, we explain that a post-tax WACC combined with a detailed modelling of the taxes can reduce the discrepancies between the implicit tax allowance and the effective tax.

Managing uncertainty

We present the options available to a regulator to deal with the uncertainty of the cost of capital parameters. In principle, especially at times of market uncertainty, a mechanism to account for unexpected changes in specific cost of capital parameters may be needed. Given the recent developments in the COVID-19 crisis, ARERA may wish to consider a different approach in terms of the frequency of its review of parameters. In summary, we explain that the options available to a regulator are:

- a trigger mechanism;
- a re-opener;
- indexation;
- pass-through.

In addition, we present a qualitative assessment of the practical issues related to the implementation of each model in the context of the current WACC framework, including the timing of updates and the choice of relevant benchmarks and thresholds.

1 Introduction

1.1 Context for the current methodological review

With decision 380/2020/R/com, ARERA has launched proceedings for updating the criteria for the determination of the allowed rate of return in the electricity and gas sectors for the regulatory period (PWACC) that starts on 1 January 2022.

In setting the allowed rate of return, the Authority is guided by the following objectives:

- stability and certainty of the regulatory framework;
- adequacy of the level of remuneration, taking into account the risk profiles of the sector;
- protection of service users.[3]

In this context, this methodological review aims to improve the framework used to estimate specific parameters of the WACC.

1.2 Current WACC framework

The document setting out the methodology and criteria for calculating the rate of return on invested capital for infrastructure services in the electricity and gas sectors for the period 2016–21 is the TIWACC (TIWACC 2016–21).

The TIWACC was approved with resolution 583/2015/R/COM.[4] The regulated services to which the TIWACC methodology applies are:

- electricity transmission;
- electricity distribution and metering;
- gas transport;
- gas distribution;
- gas metering;
- gas storage;
- regasification of liquefied natural gas (LNG).

The methodology used to estimate the WACC is based on the CAPM, which is most commonly used by regulators and practitioners to estimate the CoE component of the WACC.

Under TIWACC 2016–21, the regulatory period was set for six years, with two sub-periods of three years.

The TIWACC methodology is used to estimate market parameters that are common across the sectors, as well as sector-specific parameters. The cross-sector parameters are:

[3] ARERA (2018), 'Aggiornamento del tasso di remunerazione del capitale investito per i servizi infrastrutturali dei settori elettrico e gas, per il periodo 2019-2021', Documento per la consultazione 557/2018/R/com.
[4] ARERA (2015), 'Tasso di remunerazione del capitale investito per i servizi infrastrutturali dei settori elettrico e gas: criteri per la determinazione e l'aggiornamento', Delibera 02 dicembre 2015 583/2015/R/com.

- the RfR;[5]
- the CRP;
- the TMR;
- the CoD;
- the inflation rate;
- tax parameters.

Cross-sector WACC parameters are set by ARERA at the end of each sub-period. The sector-specific parameters are the β and the gearing.

The allowed rate of return is calculated as real and pre-tax:

$$WACC_{pre-tax,p,s}^{real} = Ke_{p,s}^{real} * \frac{(1 - g_{p,s})}{(1 - T_p)} + Kd_p^{real} * \frac{g_{p,s}(1 - tc_p)}{(1 - T_p)} + F_{p,s}$$

where, for each service s and for each sub-period p:

- $Ke_{p,s}^{real}$ is the real post-tax CoE;
- $Kd_p^{real}$is the real post-tax CoD;
- $g_{p,s}$ is the gearing ratio defined as $\frac{debt}{debt+equity}$;
- T_p is the corporate tax rate;
- tc_p is the tax shield;
- $F_{p,s}$ is the tax adjustment factor.

The tax adjustment factor is a corrective factor that adjusts the real pre-tax WACC allowance to cover taxes paid on nominal profits. This adjustment is needed because the tax term is applied to the real CoE and the real CoD in the WACC formula, while in reality companies pay taxes on nominal profits. ARERA has specified the following formula for the F factor:

$$F_{p,\,s} = \frac{ia_p}{1 + ia_p} \times \left(\frac{T_p - tc_p \times g_{p,\,s}}{1 + T_p} \right)$$

ARERA uses a real WACC in the regulatory formula by deflating the nominal pre-tax WACC with a measure of expected inflation (expressed by the ia_p term).

The CoE is calculated by adding a specific term reflecting the CRP to the traditional CAPM formulation:

$$Ke_{p,s}^{real} = max\left(\frac{RF_p^{nominal} - isr_p}{1 + isr_p}; 0.005\right) + \beta_s^{asset} \cdot \left[1 + (1 - tc_p) \cdot \frac{g_{p,s}}{1 - g_{p,s}}\right] \cdot ERP_p + CRP_p$$

where:

- $RF_p^{nominal}$ is the RfR in nominal terms;

[5] The updated RfR also feeds into the calculation of the CoD.

- isr_p is the expected inflation rate, estimated as the ten-year average in inflation-linked swaps in the eurozone for the period from 1 October 2017 to 30 September 2018;
- β_s^{asset} reflects the systematic risk of the asset, which is re-geared to derive an equity beta to use within the CAPM (the de- and re-gearing formula used is the Hamada equation—see section 2.5.5);[6]
- ERP is the equity risk premium.

The introduction of CRP means that the premium required by investors to invest in Italy can be captured explicitly.

The CAPM relates the CoE of a particular activity to its exposure to systematic or non-diversifiable equity market risk. The return required by equity investors consists of the return on a risk-free investment and a risk premium that reflects how correlated the returns on the particular investment in question are with the market overall. Non-systematic risk, according to the CAPM, can be diversified away by holding a portfolio of assets.

This exposure to systematic risk is measured by the equity beta (i.e. the term obtained by gearing the asset beta in the equation above). An investment with no systematic risk (i.e. with no correlation with returns on the market) would have an equity beta of zero. An investment in the equity of a company of average risk would have an equity beta of 1. In other words, the premium over the RfR that equity investors expect to earn on such an investment would be the same as the average for the overall market (equal to the ERP).

The post-tax CoD is calculated as follows:

$$Kd_p^{real} = max\left(\frac{RF_p^{nominal} - isr_p}{1 + isr_p}; 0.005\right) + CRP_p + DRP$$

where DRP is the debt risk premium required by debt issuers above the RfR.

1.3 Structure of the report

The remainder of this report is structured as follows:

- section 2 looks at CoE estimation, with a focus on methodological issues in estimating the RfR, the CRP, betas and TMRs;
- section 3 focuses on CoD estimation;
- section 4 focuses on gearing estimation;
- section 5 provides a review of the pros and cons of setting returns on a pre- and post-tax basis;
- section 6 shows evidence on the impact of the COVID-19 crisis, and provides some options for managing uncertainty.

Appendix A1 provides an overview of recent regulatory precedents across Europe, which informs the rest of the document.

[6] ARERA (2015), 'Criteri per la Determinazione e l'aggiornamento del tasso di remunerazione del capitale investito per i servizi infrastrutturali dei settori elettrico e gas per il periodo 2016-2021 (TIWACC 2016-2021)', Allegato A.

2 Cost of equity

2.1 CAPM framework

The CoE is the rate of return required by equity investors in order to invest in a particular company or project.

In the context of setting the allowed revenues for regulated companies, the CAPM is the most common method used by practitioners, regulators and academics. Other methods—such as dividend discount models (DDMs), multifactor regressions and asset risk premium—are generally used as cross-checks to the CAPM framework.

The CAPM framework computes the CoE as the sum of the RfR and a risk premium in addition to the RfR that investors require as compensation for systematic risk.[7] The risk premium is based on the ERP and the equity beta, which is a parameter that captures a company's exposure to systematic risk.

Mathematically, a simple CAPM representation of the CoE is as follows.

$$CoE = RFR + \beta_e * (ERP)$$

2.2 Risk-free rate

The RfR measures the expected return on an investment free of default and systematic risk—i.e. where the realised return on the investment will be equal to the expected return. It reflects the time value of money, as it represents the compensation that investors require in order to forgo current consumption in favour of future consumption. If the RfR is not updated regularly (e.g. through indexation), a forward rate adjustment is required to match investors' expectations of future yields. An additional uncertainty premium can also be added to account for the risk that spot rates will rise faster than forward rates, causing a financeability problem.

In economies with low sovereign default risk, the RfR is typically estimated with reference to the yield to maturity on government-issued bonds. These bonds are assumed to be notionally free of default and systematic risk. We note that, in the past, regulators have typically followed this approach while allowing for a certain amount of additional headroom.[8] We also note that there are several challenges with the use of government bonds to estimate the RfR, particularly in the current market environment, where yields are typically below zero.

First, the CAPM framework requires only that the RfR be the expected return on a zero-beta asset, and does not specify that this asset must be a government bond.[9] Indeed, the academic literature suggests that unadjusted spot yields on government bonds cannot always be used as a proxy for the RfR in the CAPM framework.[10]

Second, an implicit assumption of the CAPM framework is that investors are able to borrow and lend at the RfR. However, this assumption does not hold in practice. Even investors with a high credit rating and/or who are undertaking collateralised borrowing are not able to borrow at the rate at which the

[7] Risk that cannot be diversified away by holding a portfolio of assets.
[8] For example, in the UK, Ofgem, Ofwat and Ofcom set the RfR above the yield on government bonds in past determinations.
[9] Brennan, M. (1971), 'Capital Market Equilibrium with Divergent Borrowing and Lending Rates', *The Journal of Quantitative and Financial Analysis*, **6**:5, December, p. 1204.
[10] Krishnamurthy, A. and Vissing-Jorgensen, A. (2012), 'The Aggregate Demand for Treasury Debt', *Journal of Political Economy*, **120**:2, April, pp. 233–67.

government finances itself. Table 2.1 summarises the key considerations for the RfR.

Table 2.1 Summary of key issues in the RfR

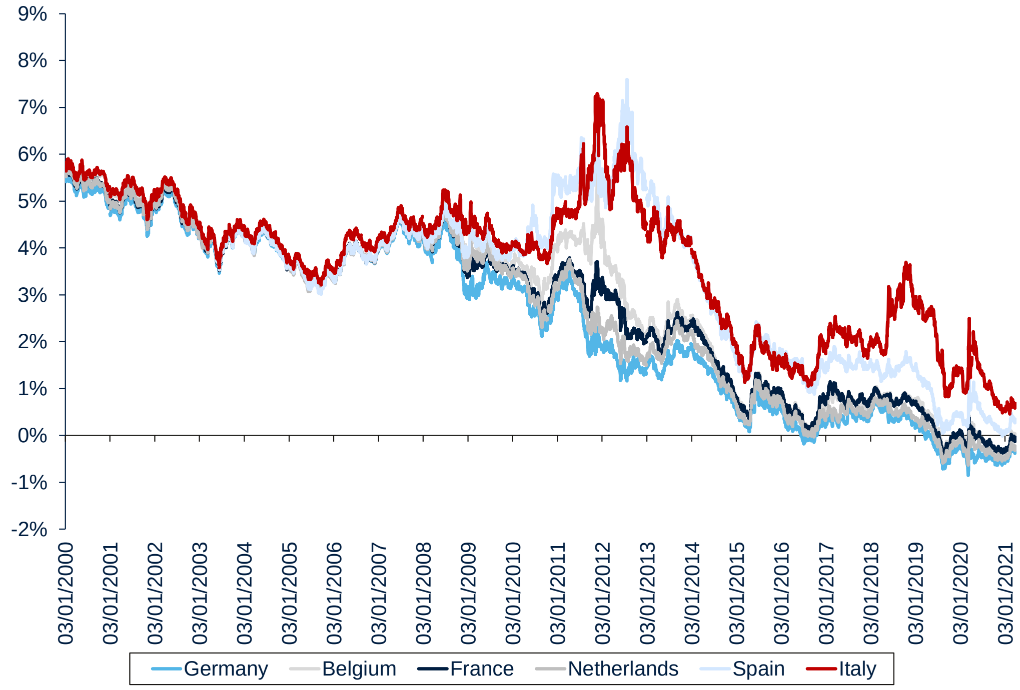
Area	Key considerations
Benchmark instrument	Selection of instruments that would be characterised as riskless: • high-rated government bonds • high-rated corporate bonds
Maturity	It is important to ensure consistency among the CAPM parameters. Hence, the selection of the RfR instruments should consider the appropriate investment horizon
Adjustments to the benchmark index	The RfR might not be proxied with reference to the benchmark only. In that case, it is important to adjust the benchmark of choice for convenience premium, liquidity premium, default risk and others
Forward premium	It is important to consider the value of expected future yields. The expected value of future yields can be captured by the forward curve An additional uncertainty premium can be added to the benchmark to account for the risk that spot rates will rise faster than the forward rates, which would create a financeability problem

Source: Oxera.

2.2.1 Yields on government bonds

Since the introduction of the euro, government bond yields in the eurozone economies have generally been traded at similar levels to each other. From the perspective of the marginal investor, most of these bonds could have been considered risk-free until late 2008. However, as shown in the figure below, since the onset of the financial crisis in late 2008, government bond yields in some jurisdictions (including Italy) have been unusually volatile and have sometimes traded at much higher yields.

Figure 2.1 Government bond yields (nominal)



Note: The bonds issued by Germany and the Netherlands are rated AAA. The bonds issued by France and Belgium are rated AA. The bonds issued by Spain and Italy are rated A and BBB respectively.

Source: Oxera analysis, based on Thomson Reuters data. The cut-off date is March 2021.

The average nominal spot yields on highly rated government bonds (i.e. AAA and AA rated bonds) are -0.13%. Combined with any reasonable measure of expected inflation, the implied ten-year real yield would be negative.

A negative real interest rate implies that investors will receive less money in real terms in the future than they invest today. In the 2015 report, we explain that negative interest rates are not consistent with economic theory, which predicts that negative real interest rates will not persist because consumers have incentives to bring forward their consumption.[11]

However, empirical evidence shows that real yields in the eurozone have been negative for almost five years. Moreover, central banks appear to be setting their policy rates at negative in both nominal and real terms. As an example, the European Central Bank deposit rate is -0.5% in nominal terms, and the eurozone inflation forecast is approximately 1.5%.[12]

Further, the persistence of negative rates can be explained by the following economic theories.

- The theory of the evolution of the marginal utility of income through time explains that, for a growing economy where income is expected to be higher in the future, individuals will choose to borrow now and repay the funds in the future—out of their (higher) income. However, for a shrinking economy, the theory states that individuals will choose to save now in order to have

[11] Oxera (2015), 'Estimating the cost of capital for Italian electricity and gas networks', June, p. 11.
[12] European Central Bank, 'Key ECB interest rates', https://www.ecb.europa.eu/stats/policy_and_exchange_rates/key_ecb_interest_rates/html/index.en.html, https://www.ecb.europa.eu/stats/ecb_surveys/survey_of_professional_forecasters/html/table_hist_hicp.en.html, accessed 29 May 2021.

more funds available in the future, to smooth consumption. If this were the case, the economy would suffer from a lack of borrowers, and interest rates would decrease.

- Another theory states that there is a possibility of financial frictions. According to this view, some individuals are unable to borrow at the optimal level, so there is a suboptimal level of borrowers in the economy, which causes rates to fall and stagnate.
- Finally, the view that nominal interest rates cannot go below zero because individuals would just opt to hold cash (at zero return) implicitly assumes that the cash supply in the economy would meet the demand requirements. The theory does not consider that the stock of cash is limited and that switching to cash is neither costless nor straightforward. For example, investors who hold millions to billions in debt markets would have difficulty in closing positions and switching to cash, and would also face costs and security risks in storing large amounts of cash.

There is then a question of whether it is appropriate to read across the current market evidence on government bond yields directly into the WACC used in a regulatory context. For instance, there is a question of whether investors can borrow and lend at the rate of government bonds—which is often used as a proxy for the RfR. It might therefore be reasonable to use a real RfR that is above the current yields on high-rated government bonds. This would also be consistent with regulatory precedent in Europe.[13]

Specifically, the academic literature explains that government bonds possess special safety, collateral, hedging and liquidity characteristics relative to other securities. The demand for government bonds is also increased by regulatory requirements for banks and other financial institutions to hold such assets. These features give rise to a convenience premium.[14] This pushes the yields on government bonds below the required rate of return for a zero-beta asset. Therefore, to be used as a proxy for the RfR, the yields on bonds issued by governments with a high sovereign credit rating would need to be adjusted upwards to remove the impact of the convenience premium. Indeed, Krishnamurthy and Vissing-Jorgensen (2012) write:[15]

> Treasury interest rates are not an appropriate benchmark for “riskless” rates. Cost of capital computations using the capital asset pricing model should use a higher riskless rate than the Treasury rate; a company with a beta of zero cannot raise funds at the Treasury rate.

Further, Berk and DeMarzo (2014) have observed that, due to the issue above, ‘practitioners sometimes use rates from the highest quality corporate bonds in place of Treasury rates in [the CAPM equation]’.[16]

To set an appropriate benchmark for the RfR under the current market conditions, it is also necessary to understand whether private investors can undertake risk-free borrowing at rates similar to governments. In the next

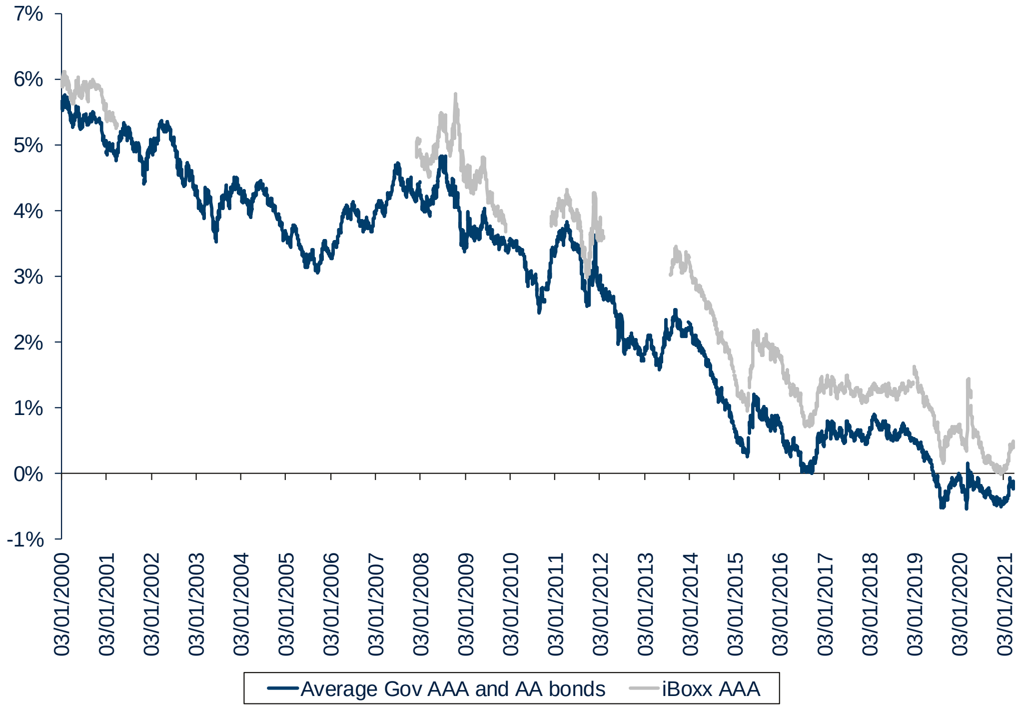
[13] Appendix A1 provides more detail on the regulatory precedent.
[14] The convenience premium reflects the money-like convenience services offered by government bonds, which have special safety and liquidity characteristics. We explain the concept of the convenience premium in detail in Oxera (2020), ‘Are sovereign yields the risk-free rate for the CAPM?’, prepared for the Energy Networks Association, 20 May.
[15] Krishnamurthy, A. and Vissing-Jorgensen, A. (2012), ‘The Aggregate Demand for Treasury Debt’, *Journal of Political Economy*, **120**:2, April, pp. 233–67.
[16] Berk, J. and DeMarzo, P. (2014), *Corporate Finance*, third edition, p. 404.

subsection, we present a comparison of highly rated government bonds and highly rated corporate bonds in Europe.

2.2.2 Yields on highly rated corporate bonds

In line with the trend observed in government yields, highly rated corporate bond (AAA and AA rate) yields have been decreasing since 2010.

Figure 2.2 Corporate vs government bond yields (ten years maturity)



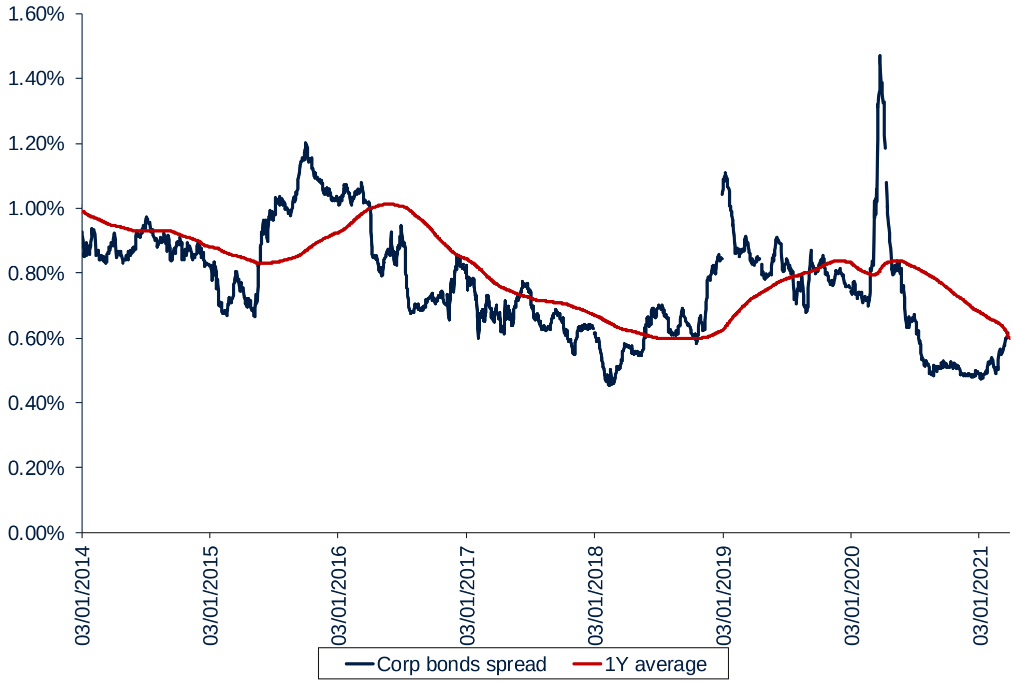
Note: The break in the series is due to a lack of data on the yield of AA bonds.

Source: Oxera analysis based on Thomson Reuters data. The cut-off date is March 2021.

The yields on AAA rated corporate bonds follow a similar trend over time to the yields on government bonds of similar maturity. Notably, however, government bond yields have been below zero since the beginning of the COVID-19 crisis (i.e. since February 2020), while corporate bond yields have remained positive in nominal terms.

We can also observe that the yields on corporate bonds have always been higher than yields on government bonds of similar maturity. The average spread between AAA rated corporate bonds and a blend of AAA and AA rated government bonds ranges from 0.7% to 0.8%. (Note that we use a blend of AAA and AA rated government bonds because the bonds issued by Germany and the Netherlands are rated AAA, while the bonds issued by France and Belgium are rated AA.)

Figure 2.3 AAA rated corporate bonds spread relative to AA and AAA rated European government bonds



Note: The break in the series is due to a lack of data on the yield of AAA corporate bonds.

Source: Oxera analysis, based on Thomson Reuters data.

The data suggests that non-sovereign institutions with even the highest creditworthiness face higher borrowing rates than those faced by governments. Specifically, the one-year average spread between AAA rated corporate bonds and highly rated EU government bonds (i.e. an average of the AAA and AA rated government bonds) ranges from 0.6% to 1.0%.

Based on the evidence above, we consider that, when assessing the RfR, it is necessary to account for the special properties of government bonds and uplift the benchmark by 50bp to 100bp to account for the convenience premium.

2.3 Forward premium

Since the cost of capital is determined for a future regulatory period, it is necessary to consider evidence on expected future interest rates. The expected future interest rates can be estimated using spot rates of bonds with different maturities:

$$Forward\ rate = \frac{(1+\ i_a)^{t_a}}{(1+\ i_b)^{t_b}} - 1$$

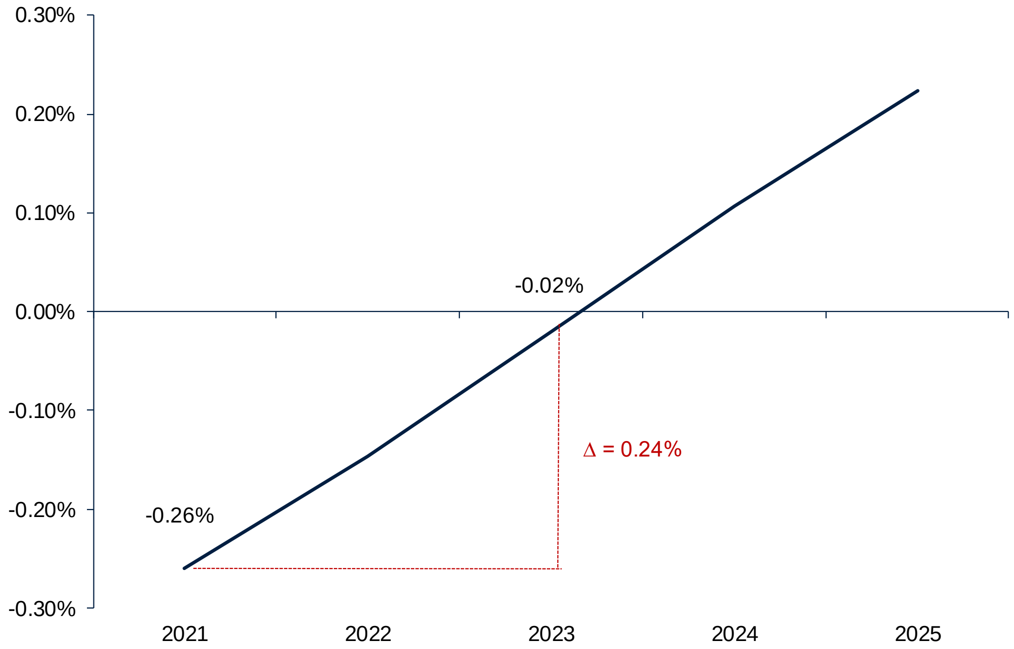
where:

- i_a = the yield on bond a of t_a periods;
- i_b = the yield on bond b of t_b periods.

We estimate a forward-rate adjustment based on the implied forward curve of the European Central Bank's AAA rated government bonds. We assume, based on the current regulatory framework, that the RfR parameter will be set for a period of three years. Therefore, our estimate of the forward adjustment is the implied increase in yields between our cut-off date and the mid-point of the

2022–24 regulatory period.[17] As Figure 2.4 below shows, the forward-rate adjustment implied by the eurozone AAA government bonds is 0.24%. Note that, due to data limitations, it is not possible to estimate the forward premium with reference to AA and AAA rated bonds.

Figure 2.4 Implied forward curves for AAA rated eurozone bonds



Note: Due to data limitations, the forward premium is estimated with reference to the AAA eurozone government bonds and all eurozone government bonds. The 2021 marker denotes the ten-year bond yields in March 2021, as provided in the yield curves, while the 2023 marker denotes the expected yields of the ten-year bonds in March 2023, estimated based on the forward rates implied from the corresponding yield curves.

Source: Oxera analysis, based on ECB data.

Assuming that the RfR parameter is set for a control period of three years (2022–24), and based on the implied forward curve in March 2021, we consider that, when assessing the RfR, it is necessary to account for a forward premium and uplift the benchmark by 24bp.

Further, we note that an additional uncertainty premium could be added to account for the risk of spot rates rising faster than forward rates suggest, which could lead to financeability problems.

2.4 Country risk premium

In the current regulatory framework, ARERA allows a CRP. In Oxera (2015), this was described as an additional return based on the premium an investor requires to invest in a utility operator in Italy compared to an identical operator in Germany.[18]

There is no single widely accepted methodology for quantifying the impact of country risk on the CoE and on the CoD. One approach is to assume that the extra return demanded by investors for exposure to sovereign risk can be approximated by the additional default premium required by investors in order

[17] The cut-off date is March 2021. We assume that the RfR is estimated every three years in line with the current methodology.
[18] Oxera (2015), 'Estimating the cost of capital for Italian electricity and gas networks', June, p. 13.

to hold bonds in Italy. This can be quantified as the spread of Italian bonds relative to highly rated government bonds of the same maturity.

Another approach is to use evidence directly from the equity markets. A common proxy used by practitioners is the relative volatility of different national equity markets, since volatility is typically related to risk. We note, however, that the differences in the composition of the national equity indices may affect the comparability of volatility statistics across markets. Other measures of the CRP may be derived from dividend growth model-based forward-looking models of equity returns.

For the 2019–21 control period, ARERA used an adjustment formula to update the CRP estimated in 2015:[19]

$$CRP_{II} = CRP_I * \left[1 + \left(\frac{Spread^{Corr}}{Spread^{base}} - 1\right) * SC\right]$$

where:

- CRP_{II} = updated CRP;
- CRP_I = original CRP;
- $Spread^{Corr}$ = spread in Italian government bonds in 2018 relative to German bonds;
- $Spread^{base}$ = spread in Italian government bonds in 2015 relative to German bonds;
- *SC* = dummy variable. This is 1 if the difference between $Spread^{Corr}$ and $Spread^{base}$ is higher than 20% in absolute terms.

We discuss the technical specifications of the spread estimation and the adjustment formula in the next subsections.

2.4.1 Government bonds spread

In this approach, the CRP is estimated as the yield on Italian bonds minus the average yield on the bonds of Germany, France, Belgium and the Netherlands, which is used as a benchmark for the estimation of the RfR.

We can observe in Figure 2.1 that the yield on government bonds has been falling since the end of the financial crisis. The yield on AAA and AA rated government bonds has been below zero during the COVID-19 crisis, and the spread between highly rated government bonds and lower-rated government bonds in the eurozone, such as in Italy, increased abruptly in the first months of 2020.

[19] ARERA (2015), 'Criteri per la Determinazione e l'aggiornamento del tasso di remunerazione del capitale investito per i servizi infrastrutturali dei settori elettrico e gas per il periodo 2016-2021 (TIWACC 2016-2021)', Allegato A, p. 6.

Table 2.2 Spread between Italian government bonds and average AAA and AA rated countries

	Germany	Belgium	France	Netherlands	Average	Italy	Spread
Spot	-0.3%	0.0%	0.0%	-0.2%	-0.1%	0.7%	0.8%
3m average	-0.4%	-0.2%	-0.2%	-0.3%	-0.3%	0.6%	0.9%
1Y average	-0.5%	-0.2%	-0.2%	-0.3%	-0.3%	1.0%	1.3%
5Y average	0.0%	0.4%	0.4%	0.2%	0.2%	1.8%	1.6%
10Y average	0.7%	1.3%	1.2%	0.9%	1.0%	2.8%	1.8%

Source: Oxera analysis based on Bloomberg data. The cut-off date is March 2021.

The figure below shows the spread on the ten-year Italian bonds relative to the average AAA and AA rated countries.

Figure 2.5 Italian bonds spread relative to AAA and AA eurozone bonds

Source: Oxera analysis based on Bloomberg data.

The spread on Italian bonds increased abruptly in the initial years following the financial crisis. The spread then reduced to c. 1% over 2014–17. There is a new peak in the data in 2018–19 due to the instability of the Italian government, and in early 2020, caused by the onset of the COVID-19 crisis.

In sum, the yield on Italian bonds increases significantly in relation to AAA and AA rated bonds in periods of crisis. It then decreases rapidly following central bank and government interventions. This pattern suggests that there is on average a positive CRP embedded in investors' valuation of Italian securities.

Based on a long-term average of the spread on Italian bonds relative to a sample of highly rated eurozone bonds, the CRP is equal to 1%. The one- and ten-year averages indicate a CRP of 1.3% and 1.8% respectively.

2.4.2 Trigger formula

As described above, ARERA adopts an adjustment formula to update the CRP in the mid-period review, which takes place every three years. The effect of this trigger formula is presented in Figure 2.6 below.

Figure 2.6 CRP trigger formula

Source: Oxera analysis based on Bloomberg data.

We can observe three important features in this figure.

- First, the spread tends to increase rapidly in periods of crisis. Following a crisis, the spread converges at a slower pace to the long-term average (c. 1%). For example, during the eurozone crisis, the spread went from 1% to 4.5% in less than a year (2011 to 2012), while it took almost three years for the spread to return to the 1% level.
- Second, due to the first trend, the adjustment formula is more often triggered when the spread is increasing or following a spike increase. In addition, the proportional difference is greater and the adjustment is larger. Note, for example, the step adjustments in years 2013–16 relative to years 2016–19.
- Third, by definition, a trigger must be backward-looking. There is therefore a lag between a spread increase (decrease) and the adjustment.

Based on the current trigger formula, updating the adjustment mechanism with reference to the average spread between October 2017 and September 2018 would result in a CRP of 1.2%. Overall, the trigger mechanism appears to map (with a lag) the historic spread. Further, the updated CRP appears to be aligned with the long-term average spread of 1%. We note that alternatives could be adopted in order to minimise the lag, and we explore these options in section 6.

2.5 Practical issues in beta estimation

Beta is a measure of systematic risk in the CAPM. Although it is a forward-looking concept, in practice its estimation means relying on the interpretation of historical market data.

For a company listed on the stock market, the equity beta can be estimated using information on actual share returns and market returns using simple regression analysis. There are, however, several practical issues involved in beta estimation:

- comparator selection;
- data frequency and the timeframe of analysis;
- de- and re-gearing betas;
- the inclusion of a 'debt beta'.

Table 2.3 Summary of key issues in beta estimation

Area	Key considerations
Comparator selection	Criteria for comparator selection: (i) relevance of operations; (ii) liquidity filters. **Possible filters for relevance of operations** • majority of revenues in the business line of interest • geographical distribution of the revenues—majority in the country/region of interest **Possible liquidity filters** • bid–ask spread • average share turnover
Data frequency and timeframe	**Possible options for data frequency** • daily • weekly • monthly **Possible timeframe for beta estimation** • two-year betas • five-year betas • ten-year betas **Structural breaks** Selection of specific estimation windows and data horizons to capture the relevant risk profile
Index selection	**Principle of diversification** Selecting the most diverse index in the currency of interest

Source: Oxera.

2.5.1 Comparator selection

Relevance of operations

By far the main challenge in estimating the beta for a specific economic activity is that it is difficult to find businesses with a stock market listing that are involved only in the specific activity of interest. To select a sample of comparators for a specific activity, one needs to consider:

- the distribution of revenues per activity: the majority (i.e. more than 50%) of the revenues should be in the activity of interest, and ideally more than 75% of the revenues. For example, in selecting a comparator sample for energy networks, it is important to consider companies that derive most of their revenues from regulated energy network activities;

- the geographical distribution of revenues: the majority of the revenues should be in similar economies with similar regulatory systems. For example, for energy networks in Europe, the sample of comparators should include companies that generate their revenues in regulated energy networks in Europe, including the UK.

In the absence of companies that fit these criteria, the sample of comparators can be expanded to other jurisdictions or industries. A degree of judgement is required in assessing how cross-industry and cross-jurisdiction differences need to be accounted for. For instance, in international comparisons, differences in the regulatory regime may affect the measured beta. However, given the limited number of pure-play regulated companies listed in the eurozone, it is typically necessary to consider evidence from a range of jurisdictions.

Liquidity filters

In choosing comparators, it is also important to ensure availability of data and sufficient liquidity of the stocks to allow a robust estimation of the beta. Illiquid stocks could take more than one period to reflect market information, which would lead to serial correlation of returns and a downward-biased estimation of the beta. As liquidity is a difficult concept to define and is subject to interpretation, it is useful to look at multiple measures. In particular, the following liquidity measures should be considered.

- **The bid–ask spread as a percentage of the closing price**—this is the difference between the lowest price at which an asset is offered for sale in a market and the highest price that is offered for the purchase of the asset. The lower the bid–ask spread, the more liquid the stock.
- **Share turnover—**this is a measure of stock liquidity, calculated by dividing the total value of shares traded over a period of time by the average market capitalisation of the stock for the period. The higher the share turnover, the more liquid a stock.

2.5.2 Data frequency and timeframe

Data frequency

Equity betas can be estimated using daily, weekly or monthly observations. The statistical robustness of the beta estimates is directly proportional to the number of observations used in the regression analysis, which would indicate the use of daily data. This assumes that daily returns are not serially correlated, and that the impact of any general market event is incorporated into the stock price on the same day. The latter assumption in particular might not hold for less frequently traded stocks, in which case information could take longer than one day to have an impact on the stock price. If this is the case, beta estimates based on daily data might be biased downwards. One practical way to tackle the issue is to check how liquid the stock is prior to performing the beta estimation.

Timeframe for beta estimation

Similarly, using a longer time period gives a larger dataset, which should reduce the standard error of the estimates. However, if systematic risk is changing over time, using a longer time period may be less relevant for assessing the current (or 'forward-looking') market risk exposure of a company.

To balance the trade-off between statistical precision and using the most recent reading of the beta, estimating two- and five-year betas based on daily observations is usually appropriate. It is also important to note that spot estimates are preferred. Relying on averages of rolling estimations is inappropriate, as greater weight is placed on data within the middle of the estimation period. For example, a three-year rolling average of a two-year beta covers the same estimation period as a straight five-year beta, but places far more weight on data in the middle of the period.

Cross-checks against betas estimated over a longer time period (e.g. ten-year weekly) can be used if the companies operate in a relatively stable and mature industry where market perceptions of relative business risk are not expected to change significantly over time. However, in this case it is useful to check that the companies have not gone through significant corporate changes.

2.5.3 Structural breaks

Using the full sample of available data might not be appropriate if there is evidence that exposure to systematic risk has changed over time. Furthermore, there are several reasons why the beta risk of a company could change over time, including changes in the business mix through acquisitions and disposals, and changes in market perceptions of the risk of certain business activities.

2.5.4 Index selection

Another consideration when estimating the equity beta is whether to use a domestic, regional or global market benchmark index. This decision depends on how well the individual capital markets are assumed to be integrated, and what the relevant market portfolio for the marginal investor in the stock is—i.e. the equity market index that an investor will typically use to benchmark the performance of an investment in a given company.

Assuming that investors will diversify their portfolios within the relevant currency zone, the use of a eurozone index to estimate the beta of eurozone companies is preferred.

2.5.5 Asset beta

The asset beta is a more relevant measure for assessing business risk than the equity beta, as it is not affected by the choice of capital structure.

Assuming a combination of debt and equity financing, the asset beta is a weighted average of the equity beta and the debt beta.

To de-gear and re-gear betas, ARERA uses the Hamada formula, which takes into account the impact of the tax shield, assuming a constant debt profile.[20] ARERA's formula is described by the following equation:

$$\beta^{equity} = \beta^{asset} * \left(1 + (1 - t_c) * \frac{g}{1 - g}\right)$$

[20] Alternative formulae are used in other jurisdictions. For example, in the UK, Ofgem and Ofwat use the Harris Pringle formula.

where:

- g = gearing level defined as $\frac{D}{D+E}$;[21]
- t_c = tax rate.

2.5.6 Debt beta

The debt beta measures the sensitivity of the returns of debt to systematic risk. It is analogous to the equity beta and asset beta, but it corresponds to debt. Four ways to estimate the debt beta are:

- the direct method;
- the indirect method;
- structural methods;
- decomposition methods.

Historically, regulators have assumed a debt beta of zero when setting the allowed return for regulated companies in Europe and in the UK specifically. More recently, regulators in the UK and Northern Ireland have assumed a non-zero debt beta. Ofgem assumed a debt beta of 0.075 in the RIIO-2 final determinations. The CMA, in the PR19 water appeals, adopted a debt beta range of 0.05–0.1. There is some evidence of EU telecoms regulators setting a non-zero beta, and some international energy regulators such as the Australian Energy Regulator and the New Zealand Commerce Commission have considered the introduction of a non-zero beta but rejected the approach.[22]

We note, however, that there is little consensus on the appropriate level of the debt beta. The four methods used to estimate the debt beta produce a wide range of estimates depending on the data and the assumptions used.

We explain in Oxera (2020) that methods based on regressions (the direct and indirect methods) and structural models are more robust in measuring the systematic exposure of debt to market risk. The spread decomposition method lacks robust theoretical support and depends on multiple uncertain parameters. The degree of uncertainty over the assumptions required by the spread decomposition approach suggests that it provides little or no incremental evidential value relative to the other approaches.[23] The estimates of the regression and structural methods suggest that a debt beta of 0.0–0.05 would be appropriate for regulated utilities.

We also note that the adoption of a positive debt beta would require ARERA to change the asset beta formula from the Hamada equation to the Harris Pringle equation:

[21] The Hamada equation defines gearing as D/E. We have rewritten the D/E algebraically as $\frac{g}{1-g}$, where g is defined as $\frac{D}{D+E}$.

[22] Body of European Regulators for Electronic Communications (2018), 'BEREC Report Regulatory Accounting in Practice 2018', BoR (18) 215, 6 December. European Commission (2019), 'Commission Notice on the calculation of the cost of capital for legacy infrastructure in the context of the Commission's review of national notifications in the EU electronic communications sector', 2019/C 375/01, 6 November. Council of European Energy Regulators (2019), 'Report on Regulatory Frameworks for European Energy Networks', 18 January. Australian Energy Regulator Office (2018), 'Review of Rate of Return Guidelines concurrent expert evidence session 1', transcript of proceedings, 15 March. New Zealand Commerce Commission (2010), 'Input Methodologies (Electricity Distribution and Gas Pipeline Services)', Reasons Paper, December.

[23] Oxera (2020), 'Estimating debt beta for regulated utilities', 4 June.

$$\beta^{asset} = \beta^{equity} * \left(\frac{E}{E+D}\right) + \beta^{debt} * \left(\frac{D}{E+D}\right)$$

Note that the change in formula would implicitly entail a change in assumptions. The Hamada equation assumes a constant level of debt in monetary terms, whereas the Harris Pringle equation assumes a constant gearing ratio.

2.6 Total Market Return and Equity Risk Premium

The third component of the CAPM is the ERP. The ERP can be estimated directly or as a residual from an overall TMR, as the difference between the TMR and the RfR.

One view is that the ERP is approximately constant over time and largely independent of the RfR. Under this method, the long-run average excess return of equity relative to bonds is used as a proxy for the ERP. An alternative view is that the expected TMR is much more stable over time, and that changes in the RfR are largely offset by changes in the ERP.

Both views have co-existed for several years. However, the current economic context of low, often negative, interest rates has caused the ERP estimates implied by these views to diverge materially.

ARERA adopts the second view, estimating the TMR and the RfR first, and the ERP as a residual. Regardless of which option is chosen, it is important to consider the implications of the assumed ERP to ensure that the resulting TMR is reasonable (this is discussed in the next sub-section).

2.6.1 Historic ex-post approach

A key source of evidence on the TMR is long-run historical data, and one of the most widely cited sources of historical evidence is the annual publication by Dimson, Marsh and Staunton (DMS), which estimates historical returns using data since 1900.

The average TMR estimated using DMS data from 1900 to 2020 is presented in the following table.

Table 2.4 Historical TMR

	Belgium	France	Germany	Italy	Netherlands
Geometric	2.59%	3.39%	3.29%	2.13%	5.06%
Arithmetic	5.19%	5.89%	8.10%	6.01%	7.12%

Source: Oxera analysis based on DMS data.

The average TMR of the AAA and AA rated European countries shown in the table is 3.58% (geometric) and 6.58% (arithmetic), compared with 2.13% and 6.01% for Italy.

There is a material difference between geometric and arithmetic averages. Geometric averages are, by construction, lower than arithmetic averages as they do not take into account the volatility of annual returns over the averaging period. While there is debate about which is the more appropriate averaging method in any given context, in standard corporate finance textbooks the arithmetic average is generally adopted for estimating the ERP to use when computing required equity returns. Indeed, DMS themselves make the following statement:[24]

> This [the arithmetic mean risk premium] is our estimate of the expected long-run equity risk premium for use in asset allocation, stock valuation, and corporate budgeting applications.

Cooper (1996) notes that corrected discount rates are closer to the arithmetic than the geometric mean, and that the geometric mean is a significantly downward-biased estimate of discount rates.[25]

2.6.2 Survey evidence

Another source of evidence on the ERP and TMR is surveys. The results of surveys need to be interpreted with caution, however. Issues with interpretation of survey evidence include the following:

- respondents' answers may be influenced by the way questions are phrased—for example, whether the question asks about required returns to equity or expected returns on a specified stock market index;
- there is a tendency for respondents to extrapolate from recent realised returns, making the estimates less forward-looking and prone to be anchored on recent short-term market performance;
- the results are based purely on judgement, which may also be influenced by the respondent's own position or biases, and are less reliable than estimates based more on market evidence on pricing.

Notwithstanding the need to interpret the survey evidence with caution, this sub-section presents up-to-date evidence in relation to respondents' expectations about the ERP and TMR.

Survey evidence from Fernandez et al. is summarised in Table 2.5 below.

Table 2.5 Fernandez et al. survey results on the ERP by country (%)

	Average survey result by year (%)					
	2016	2017	2018	2019	2020	Average (2016–20)
Germany	5.3	5.7	5.3	5.7	5.8	5.6
Netherlands	5.1	6.0	5.8	6.0	5.9	5.8
France	5.8	6.5	5.9	6.0	6.2	6.1
Belgium	5.6	6.4	6.2	6.2	6.2	6.1
UK	5.3	5.9	5.5	6.2	5.8	5.7
Average (>A rating)	**5.4**	**6.1**	**5.7**	**6.0**	**6.0**	**5.9**
Italy	5.6	6.4	6.1	6.3	6.2	6.1
Portugal	7.9	7.6	7.2	7.5	7.1	7.5
Spain	6.2	6.6	6.7	6.4	6.3	6.4
Ireland	6.6	6.7	6.5	6.0	6.6	6.5
Average (<A rating)	**6.6**	**6.8**	**6.6**	**6.6**	**6.6**	**6.6**

Source: Fernandez, P., de Apellániz, E. and Fernández Acín, I. (2020), 'Survey: Market Risk Premium and Risk-Free Rate used for 81 Countries in 2020'. Fernandez, P., Martinez, M. and

[24] Dimson, E., Marsh, P. and Staunton, M. (2015), 'Credit Suisse Investment Returns Sourcebook 2015', p. 34.
[25] For further details, see Cooper, I. (1996), 'Arithmetic versus geometric mean estimators: Setting discount rates for capital budgeting', *European Financial Management*, **2**:2, p. 157.

Fernández Acín, I. (2019), 'Market Risk Premium and Risk-Free Rate used for 69 Countries in 2019: A Survey'. Fernandez, P., Pershin, V. and Fernández Acín, I. (2018), 'Market Risk Premium and Risk-Free Rate used for 59 Countries in 2018: A Survey'. Fernandez, P., Pershin, V. and Fernández Acín, I. (2017), 'Discount Rate (Risk-Free Rate and Market Risk Premium) used for 41 Countries in 2017: A Survey'. Fernandez, P., Ortiz Pizarro, A. and Fernández Acín, I. (2016), 'Market Risk Premium used for 71 Countries in 2016: A Survey with 6,932 Answers'.

The survey evidence suggests a range of about 5.4–6.1% for economies rated AAA and AA. When Italy, Portugal, Spain and Ireland are considered together, on average, the expected ERP is higher. This would be consistent with the presence of a CRP in the CoE for companies in these markets.

Note that Fernandez et al. attempt to poll academics globally, but the respondents are not necessarily the same academics each year and it is not clear how this affects trends. As such, we do not place weight on year-to-year changes in this survey.

2.6.3 Forward-looking evidence

Forward-looking models can provide a useful cross-check on the historical estimates. The basic concept behind forward-looking models is the assumption that the current market price of an asset represents the expected discounted value of all future cash flows of that asset.

Therefore, a DDM can be used to infer the discount rate applied to future dividends; under DDM theory, the expected market return is the discount rate at which the present value of future dividends is equal to the current market price. Any DDM is composed of three parameters:

- dividend yield, which is observed in the market;
- share buybacks, which are also observed in the market;
- the growth rate of dividends and buybacks, which needs to be assumed.[26]

The result of the DDM is the expected market return (or TMR), which is equal to the sum of the three components above.

DDMs are typically highly sensitive to the growth rate assumptions, and in particular the long-term growth rate. Therefore, when constructing a DDM one needs to carefully consider the base index and the growth rate associated with the index of choice.

[26] Some dividend growth models assume different dividend growth rates in the short, medium and long term.

3 Cost of Debt

A company's CoD refers to the financing costs that a company pays on its borrowings, including loans, bonds and other debt instruments.

There are two methods to estimate the CoD:

- the **market CoD** can be estimated with reference to current yields of comparable market-traded debt instruments, using similar credit ratings and debt tenors. For example, to estimate the CoD of a company rated BBB, one can refer to BBB rated bonds in the market or a BBB rated index such as the BBB iBoxx non-financial corporate bond index;
- the **actual CoD** can be calculated with reference to the company's existing debt obligations. This information is generally available in the financial statements of the company.

In the PWACC I control period, ARERA estimated a market-based CoD with reference to a DRP:

$$CoD = RFR + CRP + DRP$$

where the DRP is estimated as the difference between the yield on the debt of Italian operators and the RfR and the CRP. The DRP is set at 0.5%.

In setting the allowed CoD, it is important to consider the objectives of the regulator. Generally, two key principles to follow in setting the allowed CoD are:

- cost recovery;
- incentives.

With respect to the principle of **'cost recovery'**, the regulator should aim to set the allowed CoD so as to ensure that the sector can recover the efficiently incurred CoD.

From an **incentive** perspective, a notional CoD that reflects the credit rating of an efficiently financed firm incentivises companies to issue new debt at the lowest possible rates consistent with that credit rating.

In the context of the Italian market, which is characterised by a large number of small operators, an approach considering the sector-average CoD is consistent with the objectives of the regulator. This would also be consistent with the regulator's approach to other aspects of the price control such as operating expenditure, which is assessed based on an industry average.

Note that, when setting the allowed CoD, it is important to consider the embedded CoD as well as the new CoD. That is, an operator should be able to recover the efficiently incurred costs through the embedded CoD allowance and, as the debt matures in the course of the control period and new finance needs to be arranged, it should be allowed to recover the costs of issuing new debt. Adopting the simplifying assumption of a stable DRP, the cost of embedded debt could be estimated with reference to the historical RfR measured over a particular period, while the new debt could be estimated with reference to the forward-looking level of the RfR. In this case, the CRP would be embedded in the DRP, which reflects the spread between the yield on the sample of debt instruments selected and the RfR.

$$CoD_{embedded} = historical\ RFR + DRP$$

$$CoD_{new} = spot\ RFR + forward\ adjustment + uncertainty\ premium + DRP$$

Note that an allowance for additional costs of borrowing can also be included in the formula. This allowance can be set to cover costs such as transaction costs and costs of carry. Regulators in Europe, and the UK in particular, have set the additional cost allowance at 15bp to 20bp.[27]

3.1 Estimation of the CoD with reference to market parameters

In this subsection we present a summary of the analysis containing 175 bonds of Italian utilities that operate in at least one of the sectors to which the TIWACC methodology is applied. We note that these companies are considered to be large operators. The bonds were issued by:

- Snam
- Terna
- A2A
- Enel
- Edison
- Hera
- Italgas
- Acea
- Iren

The following table summarises the average maturity of these bonds at the issue date.

Table 3.1 Average maturity of Italian bonds (years)

	Observations	Mean	Standard deviation	Minimum	Maximum
Tenor	175	11.24	11.03	2.00	62.67

Source: Oxera analysis based on Thomson Reuters data. The cut-off date is March 2021.

The average maturity of the bonds analysed is around 11 years.

The credit ratings of the bonds analysed are summarised in Table 3.2 below.

[27] In the UK, the additional CoD allowance is 20bp. In the Netherlands and Belgium, the additional CoD allowance is 15bp. The UK 20bp value is the sum of allowances for transaction costs (6bps), liquidity/revolving credit facility (RCF) cost (4bps), and cost of carry (10bps).

Table 3.2 Fitch rating of Italian bonds

Fitch rating	Frequency	Percentage
A+	1	1.67%
A	1	1.67%
A-	9	15.00%
BBB+	35	58.33%
BBB	13	21.67%
BBB-	1	1.67%
Total	**60**	**100.00%**

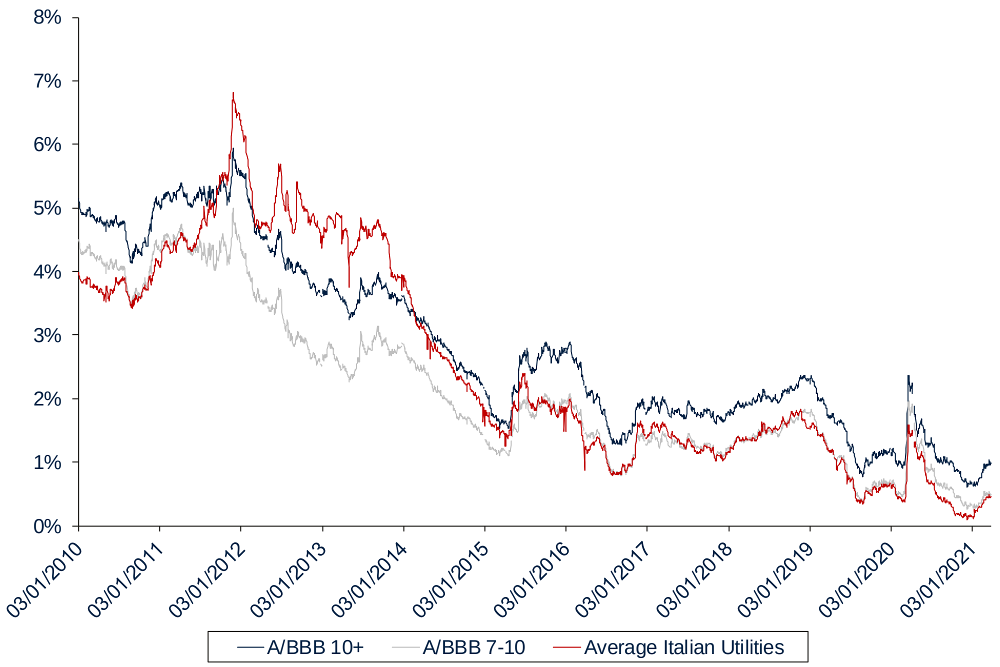
Note: The total sample contains 175 bonds; however, only 60 are rated by Fitch.

Source: Oxera analysis based on Thomson Reuters data.

We can observe that most of the bonds of Italian utilities are rated A-, BBB+ and BBB.

We have compared the sample of Italian bonds with the iBoxx A and BBB series. We use the average of the iBoxx A and BBB series to proxy the average credit rating of the sample of Italian bonds. We use the iBoxx 7–10 and 10+ series to proxy the average maturity of the Italian bonds analysed, which is approximately 11 years.

Figure 3.1 Italian utilities' bonds and iBoxx 10+ yields, nominal



Source: Oxera analysis based on Thomson Reuters data. The cut-off date is March 2021.

We observe that the evolution of the yield on the sample of Italian bonds over time is similar to that of the two iBoxx series. Between 2012 and 2015 the utility bond yields are closer to the iBoxx 10+ series, and since 2015 the yields are more aligned with the iBoxx 7–10 series. Therefore, based on the rating and the historical development of the yields in the sample, an average of iBoxx A and BBB could be an appropriate benchmark for the Italian utilities. Furthermore, the average of the 10+ and 7–10 series appears to be appropriate to reflect the average maturity at issuance of the sample of Italian bonds.

To estimate the CoD for a hypothetical operator, we calculate the average of the iBoxx A and BBB series with maturities of 10+ and 7–10 years. We note that, if yields are falling, which has been the case in Europe since the outcome of the financial crisis, the yield on old debt is likely to be higher than the spot (current) yields. Therefore, the cost of embedded debt, which accounts for instruments issued in the past, is higher than the cost of new debt. Table 3.3 summarises these results.

Table 3.3 Average iBoxx series

	A/BBB 10+	A/BBB 7–10	Average
Spot	0.98%	0.49%	0.74%
1Y average	1.07%	0.69%	0.88%
5Y average	1.58%	1.09%	1.34%
10Y average	2.57%	1.90%	2.23%

Source: Oxera analysis based on Thomson Reuters data.

Since the average maturity at issuance of the sample of Italian bonds is 11 years, a ten-year average of the 10+ and the 7–10 series could be used to estimate the cost of embedded debt using market data.

Furthermore, as some of the embedded debt will be refinanced during the three-year regulatory control period and additional debt will be raised, a specific allowance for new debt should be reflected in the overall allowed CoD. The appropriate weighting of embedded and new debt depends on the refinancing needs of the Italian operators as well as growth in the RAB. As an illustrative example, we assume that the same proportion of debt matures every year and that the RAB stays constant. Hence, for a debt portfolio that matures in ten years, approximately 10% of the portfolio would need to be refinanced every year.[28] For a price control that lasts three years, the average amount of debt that needs refinancing is approximately 15%.[29]

Table 3.4 CoD illustrative example (nominal)

	Estimation
Spot—average A/BBB 10+ and 7–10 [a]	0.74%
10Y average—average A/BBB 10+ and 7–10 10Y [b]	2.23%
Forward premium [c]	0.24%
Uncertainty premium [d]	0.25%
Weighting of new debt [e]	15.00%
New debt [f = a + c + d]	1.23%
Embedded debt [b]	2.23%
Transaction costs [g]	0.15%
CoD [f * e + b * (1 - e) + g]	2.23%

Note: It is a common regulatory practice to permit an allowance for transaction costs in the embedded and new debt. Evidence from regulatory determinations in Europe and in the UK suggest a range of 15bp to 20bp for transaction costs. The uncertainty premium is assumed to be 25–50bp based on data from regulatory determinations.

[28] The 10% assumes that every year a fixed proportion of the debt matures and is refinanced. Hence, after ten years, the debt portfolio is completely refinanced.

[29] 15% is estimated as the average portion of debt refinanced at the beginning of the control period (zero) and at the end of the control period (30%). By the end of the control period, 30% of the debt would be refinanced, hence the average would be equal to (30% – 0%)/2.

Source: Oxera analysis based on Thomson Reuters data.

Note that, by estimating the CoD with reference to the iBoxx series directly, the CRP and the DRP would be subsumed in the final figure. In other words, the yield on the sample of bonds selected already includes a DRP, which in turn includes the CRP.

The parameters of the CoD can be disaggregated. In particular, the spot and ten-year averages can be disaggregated into RfR spot plus DRP and CRP, and the ten-year average of the RfR plus DRP and CRP respectively.

$$CoD_{spot} = Spot\ RFR + DRP$$

$$CoD_{10Y} = 10Y\ average\ RFR + DRP$$

To carry out such a disaggregation exercise, the DRP would also have to be estimated with reference to iBoxx, ensuring consistency among estimators. Other benchmarks can be used as long the parameters are estimated consistently.

4 Gearing

Gearing is the share of a company's total assets that are financed with debt. Gearing is generally estimated as the ratio of net debt over the sum of net debt and equity. The net debt is equivalent to the sum of the company's debt minus its cash positions.

4.1 General considerations in determining a regulatory gearing assumption

In the context of setting an allowed rate of return, regulators typically estimate the cost of capital based on an assumed notional level of gearing, which aims to balance the tax benefits of higher gearing against the potential costs of financial distress. Hence, the gearing used to estimate the WACC is not necessarily equal to the observed gearing ratio of the company of interest.

To estimate the notional gearing, regulators would normally consider the following sources of evidence:

- actual observed gearing for the regulated entity (entities);
- observed gearing from comparator companies/industries—for example, if comparators are used to estimate the beta, the regulator might consider their gearing;
- guidance from credit rating agencies;
- regulatory precedent—for example, gearing adopted in previous regulatory decisions or in similar sectors by other regulators.

Table 4.1 shows recent regulatory decisions on gearing, which lie mostly in the 50–60% range.

Table 4.1 Regulatory precedent on gearing

Country	Gearing	Sector
UK	55–60%	Electricity transmission and distribution
UK	60%	Gas transmission and distribution
UK	60%	Water
Germany	60%	Electricity
Germany	60%	Gas
France	60%	Electricity transmission
France	50%	Gas transmission
Portugal	55%	Electricity transmission and distribution
Portugal	50%	Gas
Spain	50%	Electricity and gas transmission

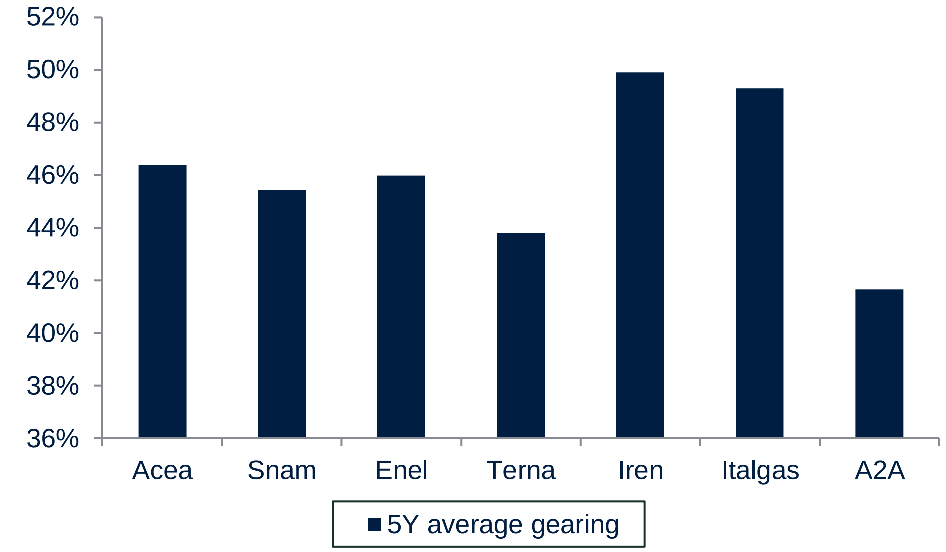
Source: Oxera, based on regulatory documents.

The gearing used by ARERA is towards the lower end of the assumptions used in other jurisdictions.

4.2 A review of gearing data in the Italian industry

Figure 4.1 shows the observed gearing ratios (five-year average) for a sample of Italian traded utilities.

Figure 4.1 Gearing ratios of Italian listed utilities relative to the market enterprise value



Note: Data updated as to April 2021. Since Italgas has values from 2017, the graph shows the four-year average of its observed gearing ratio.

Source: Oxera analysis.

We observe that, on average, the gearing ratio of Italian listed utilities relative to the market enterprise value is between 40% and 50%.

4.3 Conclusion

In sum, we consider that a notional gearing between 40–60% is aligned with the regulatory and market evidence. As long as changes in gearing appropriately feed into changes in the individual WACC parameters, the overall impact of the gearing assumption on the WACC should not be material.

5 Treatment of taxation

The price control packages must provide companies with sufficient revenue to meet their corporation tax liabilities. There are two approaches to setting the revenues at a level that would allow companies to pay taxes:

- the first is the 'tax wedge'. Here, the CoE is converted from post-tax to pre-tax by multiplying it by a 'tax wedge'. When the pre-tax value is applied to the RAB, it provides sufficient revenues to meet the tax liabilities. After tax payments are made, it still provides sufficient returns to satisfy equity investors;
- the second is the 'vanilla' WACC. Here, the WACC is calculated as the weighted average of the pre-tax CoD and post-tax CoE. Taxes are remunerated as a separate cash flow.

5.1 Pre-tax vs post-tax WACC

The first point to note is that the two approaches can be made equivalent. If a vanilla WACC is adopted, the tax liability is modelled and remunerated separately. Hence, a detailed tax modelling needs to be undertaken to estimate what the tax liability of a company will be during the price control period. As an example, the box below summarises the approach adopted by Ofgem in the RIIO regulatory controls.

Box 5.1 Treatment of taxation: evidence from the UK

The use of a vanilla WACC (i.e. pre-tax CoD and post-tax CoE) is not common in Europe. The energy regulator in the UK, Ofgem, provides one of the few examples of the vanilla WACC framework in use.

The use of a vanilla WACC would require the regulator to estimate a separate tax allowance. In the case of Ofgem, the allowance is estimated based on the assumed notional level of gearing, and additional protections are built on, incentivising companies to manage their tax liabilities efficiently and enabling them to recover their tax costs.

This framework includes a tax reconciliation system, submitted by each operator to Ofgem on an annual basis, and the introduction of a tax review mechanism. The latter enables Ofgem to review and, if necessary, adjust the companies' tax allowance during the course of the control period.

In RIIO-1, a financial model was used to calculate a tax allowance on a notional gearing basis, as a proxy for efficient corporation tax costs, supplemented by two specific uncertainty mechanisms:

- a tax trigger mechanism that reflects changes in tax rates, legislation and accounting standards;
- a tax clawback mechanism that claws back the tax benefit that a licensee obtains as a result of gearing levels that are larger than assumed.

The options considered for RIIO-2 included:

- a notional allowance with added protections;
- a pass-through for actual payments made to HMRC each year;
- a 'double-lock', which involves setting the allowance at the lower of the previous two.

In the Final Determinations, Ofgem adopted the first option, estimating a notional taxes allowance and adding a number of mechanisms to improve reporting and to enable the review of the allowance when necessary. For instance, the tax trigger and the tax clawback mechanisms were maintained in RIIO-2.

Source: Oxera, based on Ofgem documents.

In contrast, the adoption of a pre-tax WACC does not require a detailed modelling of the tax liabilities of each operator, thereby introducing simplicity and transparency to the regulatory price-setting formula. Generally, the pre-tax WACC is estimated using the statutory tax rate. We note that, in some cases, the effective tax rate of the company in question can differ from the statutory rate, which can lead to companies being either under- or over-remunerated for their tax liabilities. Furthermore, the estimation of the WACC is often accompanied by an assumption of the gearing level. The actual and notional gearing can also differ, which causes discrepancies between the implicit tax allowance and the effective tax.

We note that, because of the difficulties in modelling the tax liabilities of each operator, most regulators in Europe specifically adopt a pre-tax WACC framework.

6 Managing uncertainty

In this subsection, we explore the options available to a regulator to deal with the uncertainty of the cost of capital parameters. In the current approach, the WACC is set for a six-year period, with a mid-period review of the base parameters—the RfR and CRP.

In principle, especially at times of market uncertainty, a mechanism to account for unexpected changes in specific cost of capital parameters may be needed. Given the recent developments in the COVID-19 crisis, ARERA may wish to consider a different approach in terms of the frequency of parameter review.

We note that, in evaluating the options and determining the frequency of the adjustment, the regulator should consider the notion of risk allocation—that is, whether the company or customer is best placed to manage the risk. Furthermore, in choosing between options it is crucial to adopt a method that is perceived as transparent and objective. In practice, any updating to the cost of capital within a price control period may therefore need to be limited to parameters that can be estimated relatively 'mechanistically' from market data (such as yields on government bonds). It is also important that the selected approach does not impose an excessive regulatory burden. Thus, the approach should be relatively simple to implement and to maintain until the end of the price control.

6.1 Options for mid-period WACC review

Trigger

If the objective of the regulator is to continue updating the WACC mid-period, a trigger mechanism could be introduced, whereby some parameters are adjusted only if some clearly defined benchmark moves beyond (i.e. above or below) a pre-determined threshold. Note that the current approach used by ARERA envisages a trigger mechanism to update the CRP every three years.

A similar trigger mechanism could be adopted for other parameters such as the CoD. That is, if ARERA chooses to estimate the CoD with reference to the iBoxx directly and not through the aggregation of different components (i.e. RfR, CRP and DRP), a trigger mechanism could be used to reduce the risk borne by the companies, protecting them against shocks beyond a predefined threshold.

A trigger mechanism involves a number of practical issues in defining the benchmark and the trigger level, as well as the adjustments that are required once the threshold is breached. However, the implementation of a trigger mechanism remains relatively simple compared with other mid-period review options, as explained in the following sub-sections.

Re-opener

A re-opener mechanism is similar to a trigger, but its occurrence would be subject to the discretion of the regulator and company. The main difference between a trigger and a re-opener is that a re-opener mechanism would not necessarily follow a mechanistic formula, and it would allow the regulator to reassess the parameters if necessary, giving more flexibility to the regulatory period. However, the introduction of a re-opener could increase the uncertainty of the regulatory framework and the burden on the regulator.

Indexation

Another potential approach is the use of an indexation mechanism, whereby the allowed cost of capital (or a component of it) varies mechanically with some clearly defined benchmark.

This method ensures that companies have an incentive to outperform while providing protection against most shocks—the exposure to adverse shocks would be limited to the period between indexation dates. As the benchmark is specified at the beginning of the control period, the adjustment to the allowed returns would be automatic during the price control period, ensuring transparency.

We note, however, that the introduction of indexation would involve a number of practical issues such as the definition of an appropriate benchmark and the review periods. Furthermore, indexation would add volatility to the current framework that is in place, as parameters would be updated more frequently.

Pass-through

An ex-post pass-through of the actual cost of capital (or a component of it) would be similar to the indexation mechanism, except that the allowed revenue would be updated to cover the actual cost already incurred by the company.

Although this method presents limited scope for outperformance, it protects companies against adverse shocks of any size. In addition, provided that companies have information on actual costs, this approach is relatively simple to implement.

Similarly to the indexation mechanism, this method would increase the volatility with respect to the current framework.

6.2 Practical issues in managing uncertainty

The above options for updating the WACC are characterised by a number of practical implementation issues.

- **Identification of relevant WACC parameters to update.** These mechanisms could be applied to all or specific WACC parameters. Possible options include the following.
    - **Updating the CoD.** This option would focus on ensuring the financeability of regulated companies in cash terms; however, the CoE would be left unchanged. As the CoD can be directly observed, it would be feasible to come up with a relatively objective mechanism for ensuring that any significant movements in the cost of raising finance are reflected in the WACC. This would reduce the financing risk borne by the companies, as long as the updating mechanism appropriately reflects typical debt issuance patterns of the industry.
    - **Updating the CRP.** The spread between the Italian bonds and the average of Germany, Belgium, the Netherlands and France was characterised by a significant increase in the first half of 2018. It also increased at the beginning of 2020, followed by a decrease towards the 1% long-term average spread. Having a mechanism in place that allows significant movements in this parameter to be reflected in the WACC could reduce investors’ risk exposure.

  - **Updating all (or a selection of) parameters in the context of a re-opener**. This option would not necessarily follow a mechanistic formula, and would allow ARERA to update all the parameters if necessary. This would have the advantage of providing ARERA with extra flexibility, but it could create an unnecessary regulatory burden and potentially increase the uncertainty for the regulated companies.

- **Timing of updates.** Currently, the TIWACC period (over six years) is split into two sub-periods**.** At the end of each sub-period, some of the key parameters (RfR, inflation, taxation, CRP, gearing) are updated based on new evidence. The frequency of these updates could reflect the uncertainty associated with macroeconomic fundamentals over the coming years. From a financeability perspective, the update of WACC parameters should be such that tariffs can adjust in a timely manner in the event of market shocks. A move from two sub-periods of three years to three sub-periods of two years could reflect this, also considering the uncertainty characterised by the developments in the post-COVID-19 recovery.

- **Choice of relevant benchmarks and thresholds.** When indexation mechanisms are applied, WACC parameters vary with some benchmark. When this occurs, it is crucial to identify clearly defined benchmarks that are perceived as transparent and objective. In setting **trigger mechanisms,** it is important to identify pre-determined thresholds (e.g. deadbands) that result in a fair allocation of risks between companies or customers.

6.3 Conclusion

The alternatives suggested in the previous sections should provide the regulator with an idea of the drawbacks and benefits of reviewing some of the WACC parameters in a shorter time than the full regulatory period. The proposed policy options have been assessed against a range of criteria, the consistency with the regulator's financing duty, as well as the transparency and the simplicity of the measure.

Each measure can also be analysed from the customers' perspective, in terms of its impact on tariffs' volatility. It should be noted that all the approaches present a degree of volatility, which is higher in the case of indexation and pass-through mechanisms.

Finally, we note that a hybrid approach could be used as an alternative, in which the regulator applies different mechanisms to the distinctive parameters of the WACC.

A1 Appendix: review of regulatory precedent in setting the WACC

As part of the methodological review, Oxera has considered recent international precedent in setting the allowed return for regulated sectors, with a focus on the following countries:

- the UK;
- Spain;
- France;
- Belgium;
- Germany;
- Portugal;
- the Netherlands;
- Australia;
- New Zealand.

This review focuses on the application of WACC formulae and the estimation of the RfR, CoD and beta in the electricity and gas transmission and distribution sectors. We note that not all of the countries mentioned above use a notional WACC to calculate the allowed returns in the energy sector. For instance, Germany has a separate CoD allowance, and Spain introduced the notional WACC framework in 2020.

Table A1.1 presents an overview of the type of WACC adopted in each country, where applicable.

Table A1.1 Methodology in the WACC formula

Country	Methodology
UK	Real-CPI vanilla WACC (post-tax CoE and pre-tax CoD)
Spain	Nominal post-tax WACC from 2020
France	Gas: pre-tax, real; electricity TSO: pre-tax, nominal
Belgium	n/a
Germany	n/a
Portugal	Nominal, pre-tax; indexed to the Portuguese ten-year bond benchmark with a cap and a floor
Netherlands	Real, pre-tax
Australia	Nominal vanilla WACC for the first year of the determination, updated annually to reflect changes in debt costs
New Zealand	Nominal vanilla WACC

Note: in Belgium, the regulatory system differs across regions.

Source: Oxera, based on regulatory documents.

The following tables present the methodology used to estimate the RfR, the CoD and the beta.

Table A1.2 Methodology in risk-free rate estimation

Country	Methodology
UK	Estimated with reference to 20Y index-linked government bonds. The RfR is indexed in the regulatory period and a short-term average is used to estimate the value at the beginning of every year of the control period
Spain	Calculated as the average of the daily prices of the last six years of the Spanish ten-year government bonds. An additional premium is allowed to account for the impact of the ECB monetary policy on the yield of the Spanish bonds
France	Long-term average of 10–30-year government bonds
Belgium	• Electricity and gas transport: average over the past year of ten-year government bonds • Electricity and gas distribution: depends on the region. Flemish region: weighted average—over the last year—of Belgian and German ten-year government bonds. Walloon region: average of the last ten years of Belgian ten-year government bonds. Brussels region: average of the last year of ten-year government bonds. Limits are set: minimum 2.2% and maximum 5.5%
Germany	Ten-year average of government bills and bonds of all maturities (including over 30 years)
Portugal	Average of the last five years' A rated eurozone countries' government bonds (Germany, Finland, Austria and the Netherlands) plus a CRP
Netherlands	Average over the last three years of Dutch and German government bonds
New Zealand	Linearly interpolated, annualised bid yield to maturity on New Zealand government bonds with maturity matching the regulatory period

Source: Oxera, based on regulatory documents.

Table A1.3 Methodology in cost of debt estimation

Country	Methodology
UK	Estimated as the trailing average of the utilities index. Ofgem takes into account embedded debt and new debt. The allowance for new debt is set with reference to up-to-date yields and a transaction cost
Spain	A comparator-based approach is used. The CoD is estimated as the sum of a reference interest rate plus a spread. The reference interest rate is the Interest Rate Swap (IRS), to which the Credit Default Swap (CDS) corresponding to each comparator is added as a spread.
France	Electricity transmission, gas transmission and gas distribution: the regulator examines the different parameters used to calculate the WACC based on historical and forward-looking approaches. After internal and external assessments, a range of admissible values for the WACC is proposed and the regulator decides on a value within this range
Belgium	Electricity and gas distribution in the Flemish region: the debt premium is calculated based on market observations of A rated bonds of eurozone utilities
Germany	Based on the operators' actual costs
Portugal	Based on the operators' analysis
Netherlands	The CoD is computed as the sum of the RfR and a DRP. The DRP is estimated as the average spread between European A rated utilities bonds and the RfR. The cost of new debt is estimated with reference to the data of the last three years and includes a 15bp premium for transaction costs
Australia	Based on the operators' actual costs
New Zealand	Computed as the sum of the RfR, the average debt premium (five-year rolling average of the spread between the RfR and the yield on BBB+ corporate bonds) and the debt issuance costs based on estimates of the cost of issuing publicly traded bonds

Source: Oxera, based on regulatory documents.

Table A1.4 Methodology in beta estimation

Country	Methodology
UK	Two-, five-, ten-year betas of UK utility companies. Ofgem also places weight on trailing averages. The de-gearing formula assumes a positive debt beta
Spain	Comparator method based on the selection of listed companies performing the same activities and operating in a similar regulatory environment. In the calculation of the unlevered beta for each company—with the Modigliani–Miller formula—included in the comparator group, the statutory tax rate of the country corresponding to each company is used. The unlevered beta of the regulated activities is then estimated as the value of the average unlevered beta for the group of comparators that have passed the liquidity test and the period considered
France	Comparator method based on the selection of listed companies performing the same activities and operating in a similar regulatory environment. For the gas sector, it also takes into account the significant increase in uncertainty concerning long-term gas prospects in France
Belgium	• Electricity transmission: based on the value of TSO shares and the BEL stock index over the last three years. No de-gearing or re-gearing approach is used. • Gas transmission: based on the value of TSO shares and the BEL stock index over a three-year period, with a guaranteed minimum level. No de-gearing or re-gearing • Electricity and gas distribution: it depends on the region. Flemish region: based on international market data (Bloomberg) from a comparator group of network operators. Walloon and Brussels regions: based on the average of the book-to-market betas of similar European companies available on international exchanges, without de-gearing or re-gearing
Germany	Based on advisory reports
Portugal	The beta estimations take into account: • benchmarking of similar companies • stock market analysis (of listed companies) • Bayesian adjustment of betas • the risk of bottom-up analysis of listed companies' activities
Netherlands	Based on international market data from pure comparators of network operators (daily data for three years)
New Zealand	Based on the average value of survey results of the asset beta of comparable businesses

Source: Oxera, based on regulatory documents.

Table A1.5 WACC, pre-tax nominal (mid-point estimate)

Country	Regulatory period	Rates
UK	2021–26 2021–26	Electricity: 5.49% Gas: 5.45%
Spain	2020–25 2021–26	Electricity TSO: 5.58% Gas TSO: 5.43%
France	2021–25 2020–24	Electricity TSO: 4.57% Gas TSO: 5.59%
Portugal	2020–23 2018–20	Gas: 5.00% Electricity: 5.53%
Australia	2020–25	TSO: 3.96%
New Zealand	2022	Electricity DSO: 4.89%

Note: due to data availability we do not report the value for all operations in all countries.

Source: Oxera, based on regulatory documents.

www.oxera.com

oxera
compelling economics