UNIVERSIDAD PONTIFICIA COMILLAS

ESCUELA TÉCNICA SUPERIOR DE INGENIERÍA (ICAI)

OFFICIAL MASTER'S DEGREE IN THE ELECTRIC POWER INDUSTRY

Master's Thesis

THE WACC AS A METHODOLOGY TO APPROXIMATE THE SPREAD FOR THE ALLOWED RATE OF RETURN IN THE SPANISH FRAMEWORK

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UNIVERSIDAD PONTIFICIA COMILLAS & UNIVERITÉ PARIS-SUD

Abstract

COMISIÓN NACIONAL DE LOS MERCADOS Y LA COMPETENCIA (CNMC)

Subdirección de Regulación Económico-Financiera y Precios Regulados

Master in Economics and Management of Network Industries (EMIN)

The WACC as a methodology to approximate the spread for the allowed rate of return in the Spanish framework

by Francisco Javier Fournier González

In this research the allowed rate of return for electricity network investors for the next regulatory period (2020-2025) in Spain is analysed. The main purpose of this research is to propose a methodology to estimate the spread to be added to the allowed rate of return for transmission and distribution activities according to the Spanish regulation. Among the different ways to estimate such value, the Weighted Average Cost of Capital (WACC) was selected since it is commonly used by most of European regulators from different industries as the most accurate approach to recognize the fair return to network industries.

In order to come up with an orthodox and suitable methodology, theoretical principles, benchmarking analysis, recommendations of financial experts and preceding methodologies were analysed; additionally, the economic context, industrial organisation and current regulatory framework were also taken into account in order to properly reflect the Spanish reality. The estimation of all the involved parameters – Risk Free Rate (RFR), Beta coefficient, Optimal gearing ratio, among others – comprises the most challenging task due to the different considerations applying to the specific framework in Spain. Important parameters that are critical in the proposed methodology refer to the selection of a suitable peer group of utilities and the selection of the period of study that better estimates the next regulatory period. Furthermore, questions regarding the expected investors and the appropriate cost of debt were tackled by proposing different scenarios.

Results obtained in the case studies provide a range of possibilities regarding the allowed rate of return; however, a conclusive outcome was suggested based on critical considerations. Also, it was found that this conclusive outcome is in line with the assumption that costs of underestimating the allowed rate of return are higher in the long term that costs of overestimating it.

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"There is nothing permanent except change" – Heraclitus

Contents

List of Tables

List of Figures

Abbreviations

ACM: Authority for Consumers and Markets (Dutch regulator)

AEEGSI: Autorità per l'Energia Elettrica, il Gas e il Sistema Idríco (Italian regulator)

BPS: Basis points

CEER: Council of European Energy Regulators (Irish regulator)

CER: Commission for Energy Regulation

CNE: Comisión Nacional de Energía (National Commission of Energy)

CNMC: Comisión Nacional de los Mercados y la Competencia (Spanish regulator)

CRP: Country Risk Premium

DMS: Dimson, Marsh and Staunton

EDSO: (for smart grids): European Distribution System Operators

EEA: European Economic Area

EFTA: European Free Trade Association

ENTSOg: European Network of Transmission System Operators for Gas

ENTSOe: European Network of Transmission System Operators for Electricity

IPO: Initial Public Offerings

MIRAEL: Macquarie Infrastructure and Real Assets (Europe) Limited

MRP: Market Risk Premium

OECD: Organisation for Economic Co-operation and Development

RAB: Regulated Asset Base

REE: Red Eléctrica de España

RES: Renewable Energy Sources

RFR: Risk Free Rate

R&D: Research and Development

SEPI: Sociedad Estatal de Participaciones Industriales (Cluster of public companies).

SO: System Operation

S&P: Standard and Poor's

T&D: Transmission and Distribution (activities)

URV: Unitary Reference Values

WACC: Weighted Average Cost of Capital

Chapter 1

Introduction

1.1 The compensation to network investors

The Spanish electricity system was officially liberalized in 1998 through the Electric Power Act 54/1997 of November 1997. This act differentiates between two types of activities: 1) generation and retail, where competition would be favourable and 2) transmission and distribution (hereafter T&D), which should remain as regulated network activities due to their condition of natural monopolies (Linares & Sánchez de Tembleque, 2001).

The investor-owned electric utilities performing the Transmission and Distribution activities claim remuneration based on the capital used to finance the electricity network; however, as regulated activities, their remuneration must be set in accordance to parameters defined by the regulator.

Some of the regulator's tasks are related to the definition of the Regulated Asset Base (RAB) and the Allowed Rate of Return. For the latter one, a balance between interests has to be sought for the benefit of the both, investors and consumers (Overcast, et al., 2006); on the one hand, investors, also known as the owners of the utilities, have the right to get a fair, sufficient and attractive return to assure the financial integrity of their enterprises; on the other hand, consumers have the right to be charged with reasonable and non-monopolistic rates for the service they demand.

Furthermore, the remuneration has to take into consideration the risks involved in the regulated activities and also the alternative choices that investors may select to invest. Traditionally, the T&D activities are considered to be low-risk due to the inherent monopolistic component of the network; hence, the cost of capital is supposed to be low.

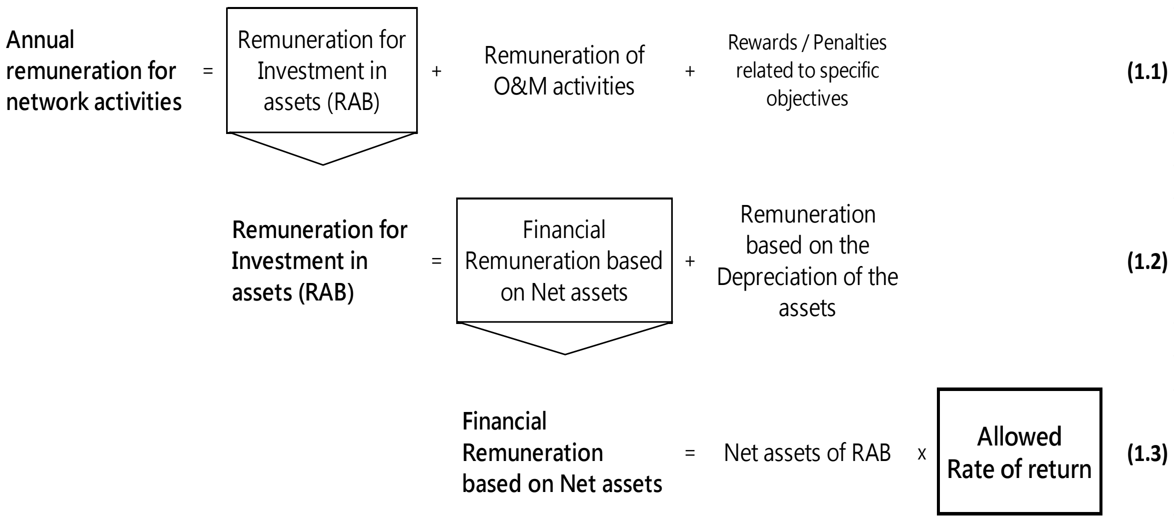


FIGURE 1.1 Schematic map of the annual remuneration for network activities

In Figure 1.1, a schematic map of the annual remuneration for network activities is shown. Here is possible to identify each of the gross components in the formula of remuneration to network utilities. From each of these formulas, the most important elements that concern this thesis are highlighted. In **Formula 1.1**, elements related to Operation and Maintenance (O&M) and Incentives to achieve certain quality levels will not be taken into account; in **Formula 1.2**, the way the remuneration based on the depreciation of the assets will be slightly introduced but it will not be part of this research since it refers to a parameter that is set by law. Finally in **Formula 1.3**, the most important parameter to compute is the Allowed Rate of Return for the regulated network activities; therefore, the aim of this thesis will be to define the methodology to get this value.

As it can be noted, the rate of return is applied directly to the recognized value of the investment (RAB) in order to determine the financial remuneration based on the net assets built in the system. Assuming that regulated utilities fund their investments at a given proportion on debt and equity, such remuneration has to cover both the cost of the debt and the expected return on equity.

There are several methodologies to determine the allowed rate of return; however, most of the European regulators fix it in accordance to the referenced WACC of the activity concerned (CEER, 2016). Conversely, in Spain the WACC is not used in the current regulatory framework. The rate of return for the T&D activities has been set up as a fixed value of 6.503%[1] for the current regulatory period; however, it is expected to be reviewed at the beginning of each regulatory period from now on.

[1] (Real Decreto-ley 9/2013, 2013) set the allowed rate of return at 5.503% at the beginning; later, from 01/January/2014 to 31/December/2019, was set at 6.503%.

Finally, it is worth to introduce some important data that will be exposed in next sections (see Table 1.1). The current regulatory period started in 01/January/2016 – after the publication of the ministerial decree that set the unitary reference values (URVs) – and it will come to an end on 31/December/2019; the RAB is based on URVs[2] and the allowed rate of return is fixed at 6,503%.

	Current Regulatory Period	**Next Regulatory Period**
Number of years	4	6
Starting date	01 / January / 2016	01 / January / 2020
Completion date	31 / December / 2019	31 / December / 2025
Regulatory Asset Base (RAB)	Based on URV	Based on URV
Allowed Rate of Return	6,503%	Royal Decree 1047/2013 Average yield of the 10-year Spanish bond + spread (bps)

TABLE 1.1 Important data regarding the current and the next regulatory periods in Spain

On the other hand, the new regulatory period, which is the aim of this thesis, will start the first day of 2020 and it will finish in 2025; the allowed rate of return will be fixed based on the average of the 10-year Spanish bond plus a spread, while the RAB is expected to remain based on reviewed URVs and audited costs for new assets.

1.2 The Motivation of the thesis topic

According to Article 8 (Real Decreto 1047/2013, 2013) and Article 14 (Real Decreto 1048/2013, 2013), the allowed rate of return for the next regulatory period applying for the regulated network activities (also known as T&D activities) will be computed as the average yield of the 10-year Spanish bond in the 24 months prior to the month of march of the year before the beginning of the regulatory period plus a *spread* – translated into basis points (bps).

Given the current regulatory framework in Spain, the motivation of this thesis comes from the necessity to define the spread that will be added in order to set the new allowed rate or return.

Several agents such as the Spanish regulator, stakeholders and experts, are interested to find a methodology to propose the previous mentioned spread; what is more, the law stipulates that the Ministry may ask the CNMC to submit a proposal for the next regulatory period before

[2] The RAB is exclusively based on URV for assets built before 31/December/2014. From then on, RAB is calculated taking into account URV and audited costs.

01/July/2018. The agents can submit their own proposal to the Ministry before 01/March/2018 (Real Decreto 1047/2013, 2013).

Agent's propositions might differ among them since some agents would be pursuing specific unrelated objectives to the regulation (e.g. distribution stakeholders might propose a higher rate of return based on their innate incentive to earn more money); however, an orthodox methodology will be sought, especially if it is founded upon theoretical principles and real-world evidences from other European countries and other related network industries.

Consequently, the law establishes explicit criteria to take into consideration when developing the methodology as follows (Real Decreto 1047/2013, 2013):

1) The proposed retribution has to be consistent to a low risk activity, such as the regulated network activities, taking into consideration the financial situation of the electricity system and the cyclical situation of the Spanish economy.
2) The proposed financing cost has to be equivalent to efficient and well-managed electricity utilities in Spain and the European Union.
3) The necessities of investment for the next regulatory period, according to the evolution of the demand.

Although it might be reasonable to think that the aim of this thesis is to suggest a final valuation for the so-called spread, the true goal is to go beyond this scope and propose a methodology – in accordance to the aforementioned principles and criteria – that can be applicable in similar regulatory frameworks and different regulatory periods, based on the stability principle that is required to strive a mature regulatory environment.

1.2.1 Previous methodologies

The rate of return of the current regulatory period – mentioned in the Table 1.1 – was computed without any publicly available methodology in 2013; it was made up the average yield of the previous three months[3] of the 10-year Spanish bond plus a spread of 200 bps; there was no reasoning to select such months or such spread[4] in the Royal Decree-Law that establishes such values.

Probably, the rate of return was set by the government in accordance to the economic situation of Spain at that given time, in which increasing deficit and an economic crisis were present. Hence, the rationale behind this decision could have been: fixing a low - long term (and stable) – rate of return with the objective to reduce the risk for the investors while providing an acceptable value that would not increase significantly the electric system costs.

[3] Months of April, May and June of 2012
[4] Spread of 100 bps for the first year, and 200 bps for the second year

In earlier regulatory periods, more reasonable methodologies were used. In 2008, the former national regulatory authority for energy in Spain (CNE) developed a methodology based on the WACC that was employed in order to set the rate of return for the investment in new assets of the distribution activity.

The methodology of 2008 – based on WACC – should be readapted and used as a reference; however, some consideration must be borne in mind:

1) The regulatory framework has changed; for example: both T&D activities and both types of facilities – existing and new ones – will be remunerated with the same rate of return, while the RAB of the existing ones has been set at depreciated cost of reposition based on unitary reference values as at 31/December/2014, and the RAB of the new ones at historical incurred costs (taking into account audited costs and unit reference values); the RAB will be no longer yearly updated based on an inflation factor; and, the new rate of return will be fixed for the next 6 years.

2) The economic and financial contexts worldwide – but especially in Spain – have changed; for example: Spanish's debt is no longer rated-AAA and some enterprises got financed at cheaper rates than the Spanish government nowadays; therefore, some financial parameters should be reviewed since they might no longer represent the economic situation.

Finally, once the proposed methodology is completed and the value for the WACC obtained with current available data, it will be required to find the process to translate such value into the suggested spread, since this process could be not straightforward when considering additional criteria.

1.3 Objectives

The objective of this thesis is oriented to propose an original, reasonable and suitable methodology to compute the spread to be added to the average yield of 10-year government bond for the T&D activities for the next regulatory period starting in 01/January/2020, taking into account the current economic context and the current regulatory framework in Spain.

Core activities to this thesis will be related to a benchmarking analysis of other European electricity systems, the telecom industry in Spain, antecedents in the CNMC and experts' opinions. The intention is to get the best evidence supporting the proposed methodology.

Additionally, a secondary objective is to give a brief insight into how the proposed methodology could be adapted to:

1) Investments of Smart Grid's assets in the T&D activities, taking into consideration a higher risk because their innovative element and their short payback period.
2) Renewable Energy Sources (RES) generation, taking into consideration a higher risk because their innovative element and their short payback period.
3) Electricity generation in the insular and extra-peninsular systems, taking into consideration their vulnerability due to the isolation of the mainland system.

It is important to note that this thesis is not intended to include proposals to reform the current regulatory framework but to work within the existing one in order to come up with feasible and reachable conclusions.

1.4 Structure of the report

The structure of this report is composed by seven chapters which are explained as following: chapter one introduced the importance, objectives and motivation of this research; also, basic notions regarding the Spanish regulatory framework were provided.

Chapter two aims to explain the theoretical principles and the main concepts to take into account regarding the network compensation: Regulatory Asset Base (RAB), Weighted Average Cost of Capital (WACC) and the Allowed rate of return.

Later, general backgrounds will be approached in chapter three in order to understand the network industry and the current regulation (concerning the network remuneration) applying in Spain; by doing this, the proposed methodology will be constrained and aligned by the specifications of the regulatory framework.

Chapter four will be devoted to deeply analyse the methodology that was carried by the CNE (former energy regulatory body) in 2008. This methodology will be considered the most relevant precedent due to its relevancy in the Spanish former electric distribution regulation.

Afterwards, a benchmarking of methodologies will be carried out in chapter five taking into consideration other European countries and other network industries in Spain (e.g. Telecom). Moreover, this chapter also includes the proposed methodology to estimate each parameter as result from this thesis research, the benchmarking analysis and financial experts' observations.

Finally, conclusive results will be delivered from the analysis over two particular scenarios concerning the expected investors for the next regulatory period: European investors or only-Spanish investors. Chapter seven will offer the final conclusions and limitations of this thesis report and the direction to be followed for further research.

Chapter 2

Theoretical principles

2.1 Monopoly Regulation

Monopoly regulation plays a key role in the electric power industry. This industry is mainly characterized by natural monopolies, large amount of long-term fixed assets and the supply of an essential good for both, human and economic development.

Since the electric power industry is based on a network structure, there are some activities that are required to act as monopolies due to the inefficiency it might represent to replicate the network by different agents. Moreover, large investments are required to build such network that will allow transport electricity from the production location to the final consumers. Finally, the continuity of supply in the short and long term is mandatory for economic interests.

Therefore, in order to avoid monopolistic pricing, guarantee access to the grid for all the producers/consumers and an adequate system prepared for the future demand, the transmission and distribution activities need to be awarded with the title of regulated monopolies.

The regulated cost of the system has to be paid by those agents that benefit from it; hence, the regulated costs – like the allowed rate of return – have to be included in the tolls (tariffs) that consumers shall pay.

As it was mentioned in previous sections, a balance between the rights of both the consumers and the investors has to be pursued; in other words, the regulator is encouraged to set low tariffs for consumers – since electricity is an essential good – but large enough to incentivize utilities to keep investing in the future. On top of that, such tariffs must reflect a balance between the economic efficiency in the short term and the system sustainability in the medium and long run.

One of the most striking features abovementioned is that regulated activities are characterized for their elevated proportion of long-term fixed assets. (Gandolfi, 2009) remarks that in order to recover the investment on these assets, a charge of annual depreciation should be computed based on the economic life of the asset, along with the annuity of the financing costs of these assets: a) return for the investors (the opportunity cost of their capital) and b) cost of the debt.

2.2 Principles of Good Regulation

The regulation must assure the recovery of the investment and a reasonable profitability to the investors based on the risk of the capital invested. Therefore, according to (Gandolfi, 2009) the Regulated Asset Base (RAB) and the Rate of Return should be based on three key principles: 1) *Sufficiency of the regulated revenue* - to recover the incurred costs and to attract new investments; 2) *Efficient remuneration* - subject to principles of competition by incentivizing the minimization of costs; and 3) *Fixation of parameters* based on fair, stable and predictable criteria.

It turns to be interesting that at the same time, these principles are proposed by (Pérez-Arriaga, 2013) as the basis in which tariff design must rely on: 1) *Sufficiency* - the revenues collected from the consumers correspond to the regulated revenues to be paid to the utilities; 2) *Pricing efficiency* - the cost of the system should stay close to its marginal costs, avoiding monopolistic pricing; and, 3) *Equity* - the tariff for consumers covers all the costs incurred by their consumption.

On the other hand, (Rivier & Olmos, 2015) stress the peculiarities of the basic principles that found the regulation of the transmission activity. It is worthy to note that these principles are in line with the concepts previously announced; however, they also introduce important features regarding their effect depending on the horizons (short term and long term); and also, on the main duties involved in the management of the network (investment and operation).

Therefore, the regulation of the transmission activity must be consistent with the following principles: 1) *Promote* long term efficiency for the transmission investments; 2) *Promote* short term economic efficiency for the O&M of transmission facilities; 3) *Ensure* economic viability of the transmission service; 4) *Promote* economic efficiency in the use of the network in the short term for the system as a whole: (optimal generation operation); and 5) *Promote* economic efficiency in the use of the network in the long term for the system as a whole (optimal generation investment).

One of the most striking features of these principles is that the revenues should ensure the company’s medium and long-term economic and financial viability, but at the same time they should not be detrimental to consumer interests. Consequently, two of the main objectives to take into account when defining the regulated revenues are: 1) the economic and financial sustainability of the utility – since the utilities' bankruptcy has a negative effect on the electricity system, and 2) the productive efficiency – trying to provide the service or product at the lowest possible cost (Pérez-Arriaga, 2013).

To sum up, (Pérez-Arriaga & Ruester, 2013)gives the basic insights to take into account when pricing the electricity networks. The two core approaches are related to promoting optimal short-term system usage, and guiding efficient long-term grid development.

Additionally, the following basic principles must also be borne in mind: 1) *Economic sustainability* – sufficient to recover the infrastructure costs; 2) *Allocative efficiency* – in order to send economic signals in both short term (operation) and long term (investments); 3) *Cost causality* – costs should be paid by those agents that make the network incur in these costs; 4) *Non-discrimination* – the use of the network has to match the money collected from the tariffs.

Finally, the methodology used is advised to comply with the following characteristics: 5) *Transparency* – public for all the stakeholders; 6) *Stability* – avoid changes in order to minimize the regulatory risk; 7) *Simplicity* – easy to understand in order to be easily accepted; and 8) *Consistent* – with the applicable legislation.

2.3 Regulatory Asset Base

The Regulatory asset base (RAB) refers to the recognized amount of investments incurred by the regulated network companies. In theory, it should correspond to the whole assets of a regulated utility; however, the risk of disallowing (to exclude some assets) plays a significant role when defining the RAB. Based on the regulatory economic theory (Gandolfi, 2009), "the RAB has to reflect the value of the non-totally-depreciated assets". In other words, once the asset is totally depreciated, the investor should not receive any remuneration from it any longer.

Two important concepts have to be defined within this regulatory process. First, it is needed to define the criteria to include (or to exclude) the assets in the RAB; secondly, it is also needed to value such assets. Nevertheless, these are challenging issues to solve when taking into account the both conflicting regulator's concerns: 1) security of supply of the electricity system, and 2) pursuing of the economic efficiency of the system by avoiding monopolistic pricing.

On the one hand the regulator is keen to provide an inefficient approach which allows including in the RAB the whole costs incurred by the utility; this approach would be in line with the regulator's concern to ensure the security of supply by promoting enough network investment for the long term. On the other hand, the regulator is also committed to define an approach consistent with a competitive context, in which some costs might be considered unnecessary and excluded from the RAB.

The two main concepts abovementioned – 1) defining and 2) valuating the RAB – will be explained deeply in the following paragraphs.

2.3.1 Definition of the RAB

In order to orthodoxly define the RAB, basic principles have to be reviewed[5]. According to the **prudent investment standard,** the RAB should only cover those investments that were reasonably and prudently made; it means that unnecessary investments should be excluded from the RAB – it could be inferred that consumers shall not pay for those costs that do not add value to the network. A problem regarding this principle refers to the ex-post analysis performed by the regulator due to some external conditions that could not been foreseeable; therefore, an adequate regulatory framework, which allows the regulator to identify irregular investments, is a key factor to establish (Gandolfi, 2009).

A second principle is related to the **used and useful test**. It states that the RAB should only cover those investments that are still used and remain useful for the system. A problem regarding this principle refers to the ex-post analysis performed by the regulator. This analysis is transformed into a risk of exclusion since some of the investments might not be recognized even if they were considered needed during the planning of the network. This principle contrasts with the sufficiency principle; therefore, investors would not be incentive to build up back up assets since they would not be included in the RAB; hence, the stability of the system could be jeopardized.

It can be observed that the risk of disallowing is critical when investing; however, as long as the approval criteria are *stable and predictable*, investors might measure this risk and include it into their expected rate of return. On the other hand, the expected rate of return for the investors can be lowered by reducing the risk of disallowing. This usually occurs when the planning of the system is carried out together with the government; in these cases, the investment plan is authorized beforehand and the totality of the assets is included in the RAB.

Finally, the moment in time when the recognition of the investments takes place is also fundamental when defining the RAB. The two alternatives are: 1) *ex-ante recognition* **(**at the beginning of the regulatory period) and, 2) *ex-post recognition* (either at the end of a given year where updating mechanism should be followed or at the end of the regulatory period concerned).

The advantage of the first alternative – ex-ante recognition – is related with the attraction of investments as the risk of disallowing is limited; however, conflicts between investors and regulator might arise if the regulatory framework fails to properly define the procedure in case of deviations from the initial investment plan. Conversely, the second alternative – ex-post recognition – offers more security to the regulator but investors are exposed to the risk of

[5] Principles existing in the US regulation

disallowing; in this case, the expected rate of return might be higher but incentives to perform efficiently can be included throughout an incentive-based regulation (Gandolfi, 2009).

2.3.2 Valuation of the RAB

The second concept to be explained is the valuation of the assets included in the RAB and how to define their depreciation. In this case, the difference among 1) existing assets and 2) new assets has to be brought into consideration.

The valuation of 1) existing assets normally takes place at the beginning of the deregulation and restructuring process; however, it can also be carried out when the regulatory framework is modified since it could be difficult to differentiate those costs which have already been recovered from those whose recovery is pending.

(Pérez-Arriaga, 2013) claims that the four most popular methodologies are: i) book value; ii) reproduction cost; iii) replacement cost and iv) market value.

The i) *book value* is characterized for its simplicity and objectivity; it is based on the financial statements of the company, so the real value of the company is presented. This methodology reduces the regulatory risk. However, one of its main drawbacks is related to the heterogeneous criteria used at the depreciation process for the utilities; while some could use accelerated depreciation, other could have used lineal depreciation, among others. Further comments regarding depreciation will be provided later.

The ii) *reproduction cost* and the iii) *replacement cost* methodologies share similar characteristics among themselves. The former one refers to an estimation of the current costs resulting when replicating the existing network with new assets delivering the same service and capacity, while the latter one refers to the replacing assets considering updated technology and a network reference model (NRF). These methodologies are preferred over the book value when reliable accounting data is not available.

Finally, the iv) *market value* refers to the collected amount if each of the current assets would be sold in a competitive market; hence, the best alternative use of the asset would be considered as its value; however, it is difficult to find a liquid market where such specific assets can be traded.

Additional methodologies are related to particular circumstances (see Gandolfi, 2019). Two examples are provided for illustrate some of these situations: v) when the ownership of the asset has changed throughout the time, a methodology based on the *Acquisition cost* can be considered; also, vi) when no historical records are available and circularity problems exists, a methodology based on the *Implicit valuation of the RAB* can be taken into account. It is important to note that these methodologies are only commented but not explained in detail since they are not relevant for this thesis research.

The valuation of 2) new assets is a simple task to perform. (Gandolfi, 2009) suggests that the value of the new facility will be based on the initial investment costs; it is normally implemented by comparing the audited costs versus the Unit Reference Values (URVs) and giving investors the incentive to build at a lower cost than those. On the other side, (Pérez-Arriaga, 2013) takes into consideration the ex-post review timing when updating the RAB in an incentive-based regulation. It is claimed that less frequent reviews implies higher incentives to invest efficiently; in other words, when reviews takes place in a yearly basis – so RAB updating – utilities are keen to overinvest.

2.3.3 Depreciation

As introduced in Figure 1.1, asset's depreciation plays a significant role when determining the allowed revenues for the regulated utilities. In simple words, the depreciation is the way how the utilities recover the money invested in assets. Moreover, the RAB is affected by depreciation since it is subtracted from the net assets which are pending to be recovered by future payments. Hence, the yearly depreciated proportion of the asset is reduced from the RAB since it had been already recovered by the utilities by means of their annual payments.

Two considerations have to be defined when properly valuating the depreciation: 1) the economic life of the asset, and 2) the methodology to depreciate the asset. The first one concerns to the time in which an asset will be used. This value can be based on accounting, economic or physical principles; normally, electricity assets are classified as long-lived fixed assets. In the same vein, the methodology selected is related to this long economic value since they might be used by several generations; therefore, an important issue arises: who has to pay for the assets: current or future consumers?

Among the vast universe of methodologies to compute the depreciation[6], the three most used methodologies will be briefly described: a) annuity method, b) straight line method, and c) accelerated depreciation method. Moreover, principles for the good regulation suggest that once a methodology is selected, it should be kept for the next regulatory periods.

The a) annuity method and b) straight line method can be catalogued as constant methodologies. While the former one relates to constant payments (the sum of depreciation plus return of the remaining capital), the latter one relates to constant depreciation (the payment is higher at the beginning and it decreases as time goes by).

On the contrary, the c) accelerated depreciation method entails that a higher proportion of the asset must be paid in the early years while the small pending amount will be paid in the upcoming years. This methodology is normally used to incentivize utilities when certain investments are required.

[6] See: http://library.vcc.ca/learningcentre/pdf/vcclc/HOSP2110-04-Depreciation.pdf

Depreciation method	Impact on current consumers
a) Annuity method	/
b) Straight line method	+
c) Accelerated depreciation	+ +

TABLE 2.1 Impact of depreciation methodologies on current consumers

It is important to note that the b) straight line method impacts more to current consumers than future consumers, while the a) annuity method impacts equally both types of consumers; nevertheless, the c) accelerated depreciation method has the greatest impact to current consumers (see Table 2.1).

Finally, (Pérez-Arriaga, 2013) argues that if these methods are correctly applied – including an appropriate rate of return – the present value of revenues is not affected since they all yield to the same result. The reasoning behind this statement is supported by (Gandolfi, 2009) “if the recovery from depreciation is lower, the total amount is compensated with a higher payment related to the rate of return”. Conversely, if the rate of return is set higher (lower) than its suitable value, then the utility will be keen to delay (accelerate) the depreciation rate.

2.4 Weighted Average Cost of Capital (WACC)

Since it is assumed that the capital used by the utilities to invest in the network might come from different sources, a weighted average of such sources is required to get their proportion in the sources funding the utility. However, the two main categories in which they are grouped are: 1) debt and 2) equity.

The 1) cost of debt is related to the interest rate paid to the lenders, while the 2) cost of equity is associated with the expected rate of return by the shareholders. When comparing the meaning of these two costs, (Pérez-Arriaga, 2013) highlights that “the interest rate on the debt is typically lower than the rate of the return on equity, since the shareholders are more exposed to the financial failure of the company than the lenders”.

Moreover, regulators and investors agree that the WACC should: reflect the cost of opportunity of investor’s capital; and also, measure an expected return from capital’s owners taking into account market’s references; therefore the WACC should provide some insights for the utilities’ most suitable financing strategy. However, from the regulator’s point of view, the rate of return should mostly estimate the cost of capital related to the regulated activities performed during the regulatory period (CNE, 2008).

Equation 2.1 shows the formula of the WACC before taxes. The 1) proportion of debt (also known as gearing ratio) compared to the total sources of funding (Debt + Equity) is multiplied by the cost of debt. On the other side of the formula the remaining part of financing, or 2) the proportion of the equity, is multiplied by the cost of the shareholder's money.

$$WACC_{bt} = \overbrace{\left[\frac{Debt}{\text{Debt + Equity}}\right] * R_{debt}}^{(1)} + \overbrace{\left[\frac{Equity}{\text{Debt + Equity}}\right] * R_{equity}}^{(2)} \qquad \textbf{2.1)}$$

It should be recall that the cost of debt is normally lower than the cost of equity. Therefore it might be reasonable to assume that the higher the proportion of 1) debt the lower the value of the WACC; nevertheless, as the proportion of 1) debt increases it implies higher risk of default and higher chances for bankruptcy. Hence, higher gearing ratio involves higher probability of default, which in turn will necessarily imply a higher interest rate that should be paid to the lenders for the risk acquired.

An interesting feature of the WACC is that it can be used as a rate of return to remunerate the investors and, at the same time, as the discount rate when getting the present value of the free cash flow projections. However, since the WACC is usually employed as a measure of the cost of capital of a given utility, the WACC should be represented after taxes and in nominal terms. **Equation 2.2** shows the formula of the WACC after taxes.

$$WACC_{at} = \left[\frac{Debt}{\text{Debt + Equity}}\right] * R_{debt} * (1 - Tax\ rate) + \left[\frac{Equity}{\text{Debt + Equity}}\right] * R_{equity} \qquad \textbf{2.2)}$$

As it can be noted, the formula of WACC after taxes includes a *Tax Rate* term which is multiplied by the 1) debt term. The importance of the Tax Rate relies on the debt as a **fiscal shield** (further explanations regarding this topic will be covered in the section 4.1.3).

The WACC after taxes explains the real profit obtained by the investors; hence, regulators have to be completely aware of this parameter when setting the rate of return. However, as it will be explained in section 2.5, the WACC will not match perfectly to the allowed rate of return since additional issues have to be included.

Additionally, **Equation 2.2** shows several parameters to be computed; these can be classified in 4 main categories: 1) Cost of equity, 2) Cost of debt, 3) Optimal gearing ratio, and 4) Tax rate. The computation of each of them will be further discussed in Chapter 4; theoretical and numerical approaches will be provided while the methodology proposed by the CNE in the 2008 – introduced in the section 1.2 – is described.

Despite the acceptance of the WACC as an approximation when setting the rate of return, there is not a general consensus among experts and regulators regarding the methodology to compute it; however, basic principles are suggested to take into consideration (Gandolfi, 2009): 1) *transparency* – the methodology to compute each parameter has to be published; 2) *replicability* – utilities and stakeholders must be able to perform the calculations by themselves; 3) *objectivity* – the use of observable market data should be favoured over hidden or subjective one; and 4) *realism* – the WACC has to show an attainable financing strategy for the utilities.

Finally, when calculating the WACC of a regulated activity which is not exclusively performed by a given company, difficulties might appear. The most used alternatives proposed when facing this issue involves the calculation of a "*Peer group of utilities*"; in general terms, it refers to computing the average of the data collected from utilities with similar risk profile (further details will be provided in section 4.1).

2.5 Allowed Rate of Return

This is the main topic of this thesis. In a competitive market, the companies define their expected rate of return through pricing their products or services; hence, they perceive a given income as a result of their sales; nevertheless, the T&D activities in the electricity system are regulated and the network utilities are not allowed to earn a return on detriment of the consumers. Therefore, the regulator is the main interested to set the appropriate rate of return.

The rate of return corresponds to the amount paid to the investors in exchange for the investments incurred. As previously mentioned, the rate of return has to reflect the risk involved in the activity concerned. Lower risk implies more certainty of the incomes the companies will receive and lower cost of the capital demanded by their lenders and investors. On the other hand, higher risk involves an uncertainty regarding the future profit, and consequently, investors and lenders claims for a higher return in exchange of their capital.

When computing the rate of return, the WACC is one of the main parameters taken into consideration; however, it doesn't fully match with the rate of return since other concerns must be included, as well. Some of these additional concerns are related to the regulated revenues, composition of the RAB, and supplementary costs/incomes which are not reflected in the WACC. Thus, the rate of return should provide additional investment signals which the WACC might dismiss.

As explained in the previous section, the WACC after taxes must be borne in mind when computing the rate of return because the fiscal shield of debt allows the company to get additional savings; otherwise, additional returns would be given to the investors on detriment of the consumers.

The literature proposes some methodologies to compute the rate of return from the WACC. One of the most interesting is offered by (Gandolfi, 2009) in which a formula – comprising two components – is given. **Equation 2.3** shows the formulation:

$$RT = \left(\frac{1+W}{1+\pi} - 1\right) * \frac{1}{1-T} \quad + \quad \frac{1-\left(\frac{1+\pi}{1+W}\right)^{n} - \frac{1}{W} * \left(\frac{1+W}{1+\pi} - 1\right) * \left(1-\left(\frac{1}{1+W}\right)^{n}\right)}{n - \frac{1+\pi}{W-\pi} * \left(1-\left(\frac{1+\pi}{1+W}\right)^{n}\right)} \qquad \textbf{2.3)}$$

Where:

- RT – Rate of return
- W – WACC (nominal and after tax)
- π – Inflation
- n – Asset’s economic life
- T – Tax rate

The first component is the most important between both components. Here, the WACC (nominal and after tax) is converted into a real WACC before tax. As it can be noted, the inflation has to be discounted to the WACC since the rate of return applies directly to the net asset value (updated with inflation) – if the nominal rate is used, then the remuneration would comprise twice the value of inflation. Moreover, the WACC is converted to a real WACC before taxes since the rate of return is normally published before taxes, despite the fact that investors are interested to know the rate of return after taxes. The second component depends on the residual economic life of the asset and the depreciation rate. Although it includes numerous calculations, it is usually neglected due to its low relevancy.

Finally, it can be concluded that the WACC (nominal and after taxes) refer to the rate that the company will offer to its capital providers – lenders and shareholders. On the other hand, the real WACC before taxes is required when approximating the rate of return since it is published given these conditions. For example, if the nominal WACC (post tax) of a given regulated activity results 10% (it means the rate of return that the company has to offer to its capital providers), the allowed rate of return offered to the regulated utilities has to be around 12.32%[7].

[7] Data used to approximate this example: WACC=10%, T=35%, π=2.5%, n=30 years.

Chapter 3

General frameworks

3.1 Industry Framework in Spain

As previously mentioned, the T&D activities are regulated due to its status of natural monopolies; it means that the most efficient way to maximize the social welfare is by entitling these electric utilities as regulated monopolies without direct competition. This is normally achieved through territorial franchises in which the network companies are awarded with rights and obligations in a given area.

The total remuneration for the T&D activities is an important element of the regulated cost of the electricity system. These regulated costs – which include among others, subsidies for Renewable Energy Sources (RES), capacity payments, and others – are paid by the consumers through access tolls, while the energy cost refers to the energy traded via the market operator or through bilateral contracts.

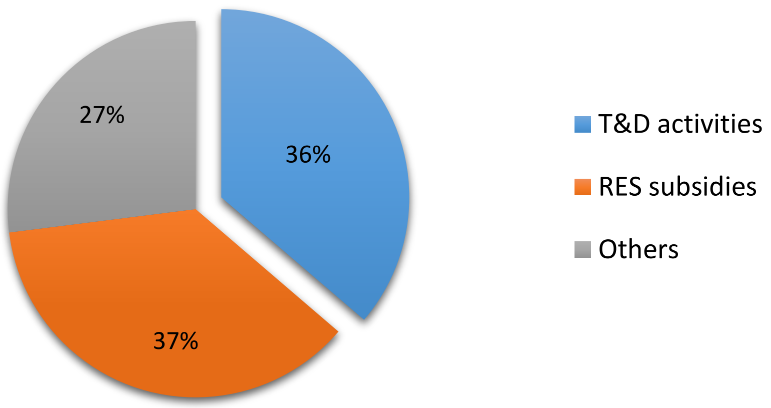


FIGURE 3.1 Share of regulated costs among regulated energy sectors in Spain

	Remuneration *(in thousand €)*	**%**
T&D activities	€ 6.687.707	36,27%
RES subsidies	€ 6.775.179	36,75%
Others	€ 4.974.487	26,98%
Total	€ 18.437.373	100,00%

TABLE 3.1 Share of regulated costs among regulated sectors in Spain

In order to give some insights regarding the magnitude of the regulated costs and the relevance of the T&D activities in Spain, the Figure 3.1 and Table 3.1 shows the total regulated costs – in euros (€) – corresponding to the Spanish electricity system during 2014[8]. The remuneration for the regulated network activities – T&D activities – was 6.6 billion euros representing more than 36% of the total regulated costs of the system.

With this in mind, it is worthy to analyse the proportion of each activity separately. Figure 3.2 displays the share of remuneration corresponding to each activity in 2014; Transmission utilities got 25% of the total remuneration while Distribution utilities acquired the remaining 75%. This can be roughly explained due to the amount of assets and facilities that are required to provide each service respectively.

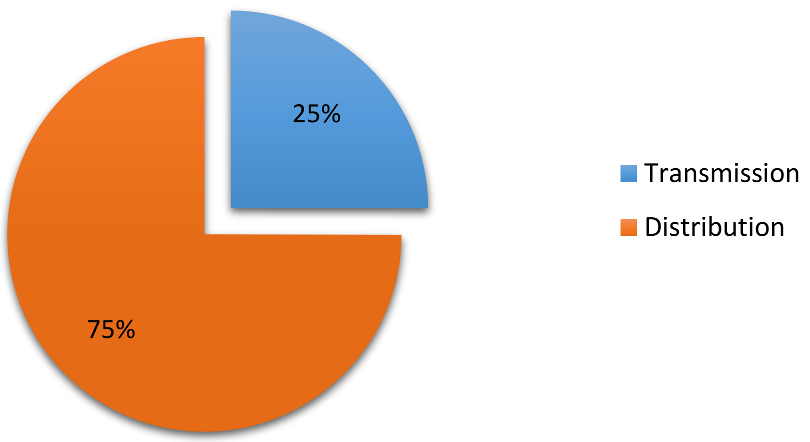


FIGURE 3.2 Share of remuneration among regulated electricity network activities in Spain

[8] Data from the 2014 (CNMC, 2015)

3.1.1 Transmission activity

The transmission of electricity is a regulated activity due to its natural monopoly foundation (Ley 24/2013, 2013). This activity consists in the transmission of electricity at high voltage from generation plants to the distribution network; however, some large consumers that demand electric power above 220kW are directly connected to the transmission network.

There exist two main transmission structures within the regulated transmission activity – TSO and ISO. In general terms, the former refers to the system operators who do not own the transmission network and their responsibilities are limited to guarantee a reliable supply and to facilitate the market interactions; the latter refers to the system operators that own the transmission network and their responsibilities are the same as the ISO but extended to the maintenance and to execute the investments of the transmission network. Nonetheless, it is important to emphasize that the network expansion decision-making process is a duty belonging to the system operator, despite the ownership of the assets; so, both TSO and ISO must comply with this activity.

For practical issues regarding this thesis, the TSO will be highlighted since it corresponds to the structure adopted in the Spanish transmission system. An important characteristic of this scheme is that the TSO has to be independent from other companies conducting competitive activities – e.g. Generation and Retail – due to the strategic relevance of the transmission grid in the system and the incentive to discriminate other participants regarding the access to the network.

(Pérez-Arriaga, 2013) shows that the main advantage of the TSO structure are the synergies created by executing both functions; in other words, when the investment planning, construction, maintenance planning, and the Operation and Maintenance (O&M) are implemented by the same company, the coordination of such tasks are easier. On the other hand, when such activities are

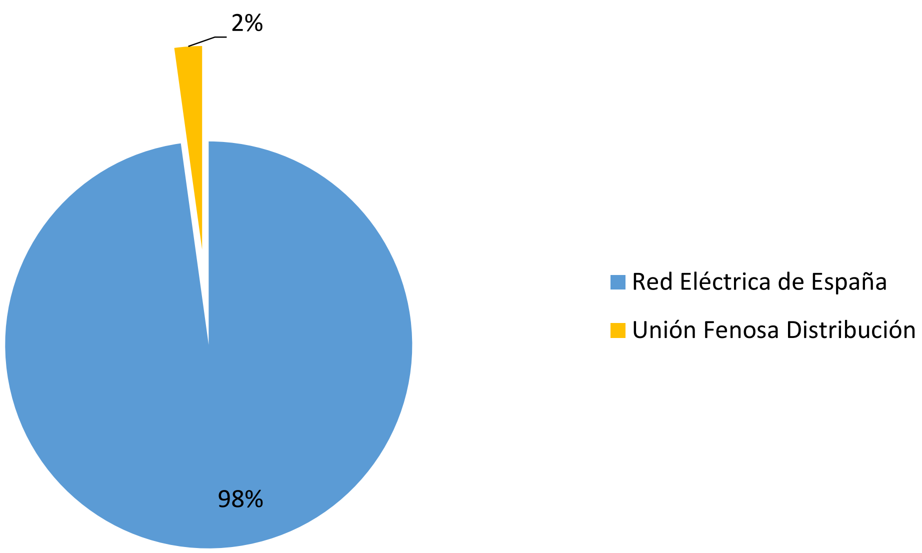


FIGURE 3.3 Share of remuneration among electricity transmission utilities in Spain

carried on by the same company, there is a risk to overinvest in the network since more investments represents more remuneration to the owner of the network assets. However, this issue could be solved through an ex-ante approval planning in which any network expansion proposal has to be approved by the regulator beforehand.

Figure 3.3 illustrates the share of remuneration among transmission utilities in Spain. Although this activity must be performed by a single-transmission utility[9] – and for reason that will not be covered in this thesis – there exist two transmission companies in the Spanish electricity system. However, the share of each company varies disproportionally: while REE owns 98% of the total transmission system[10], Unión Fenosa Distribution holds only the 2%, corresponding to the 400kW transmission circuit around Madrid.

Red Eléctrica de España [11]

Red Eléctrica de España S.A.U. (REE) is a company performing regulated activities of transmission and system operation in the Spanish electricity system, both on the mainland and the extrapeninsular systems. It has its headquarters in Madrid, Spain.

As abovementioned, it has the exclusivity to perform as TSO and it holds almost the entire transmission grid in Spain. As owner and manager of the transmission network its main responsibilities are: the system operation in the Spanish territory; management of the transmission network; and responsible for the construction, operation and maintenance of the transmission grid (Red Eléctrica de España, SA, 2014).

Added to that, REE belongs to a holding company called Red Eléctrica Corporación. S.A; some key characteristics of this holding are the following:

1. It is the parent body company of the holding.
2. It is a listed company in the stock market composed by several companies.
    a. Red Eléctrica de España – regulated activities.
    b. Red Eléctrica Internacional – activities in South America.
    c. Red Eléctrica Financiaciones – financing activities.
    d. Others.
3. It is obliged to keep the entire ownership of REE.
4. Its equity is constituted by 20% of the shares belonging to SEPI (conglomerate of public companies) while the other 80% is devoted to private capital.
5. There are some constraints in the participation of private capital.
    a. No investor is able to control more than 5% of the shares; in order to avoid any control or influence in the group.

[9] According to (Ley 24/2013, 2013)
[10] Based on the total remuneration assigned to the transmission activity in 2014
[11] Logos of utilities are available in Appendix A

b. No electricity company performing liberalized activities – Generation and Retail – is able to control more than 3% of the voting rights (ownership unbundling).

It is important to highlight that REE is certified by the European Union as unbundled TSO; it also plays a significant role in the group abovementioned since it is considered a regulated company. As suggested earlier, it carries out two specific activities subject to regulation: Transmission and System Operation. Additionally, account separation must exist when executing the following two activities.

1) *Transmission activity*: Build the transmission grid according to the ex-ante planning approved by the ministry and maintain the assets.
2) *SO activity*: It proposes the planning of the grid based on the expected needs of the system such as: demand variations, connection of new generation plants, interconnections with neighbour countries, among others. Additionally, it is responsible to ensure the stability of the system by defining the reserves (that are required to guarantee the security of the system), and matching the demand and generation in every moment.

Furthermore, given the relevancy of the SO activity in the system, the appointing of the Director of this unit must be accepted by the Ministry. Similarly, the ministry has to approve the investment plans of the system proposed by REE. A possible reasoning behind this rule is that the government – on behalf of the consumers – has to control the investments that will be included in the RAB (responsibility to accept only the required investments and reject overinvestments).

Unión Fenosa Distribución

In the next section – Distribution activity – a description of Unión Fenosa Distribución will be given; this is because this utility performs mainly activities related to electricity distribution while its role in transmission is quite insignificant (see Figure 3.3).

Nevertheless, it is important to highlight that the degree of unbundling applying to this concern is accounting separation. Hence, both regulated activities – transmission and distribution – are allowed to be carried out by the same company but it is obliged to keep separate accounts for each activity.

3.1.2 Distribution activity

The distribution of electricity is a regulated activity due to its natural monopoly nature (Law 24/2013). This activity consists in the transmission of electricity at medium and low voltage – below 220 kV – from the transmission grid to the final consumers; however, small generation sources can also be connected directly to the distribution network; the so-called distributed generation.

The main responsibility of the distribution utilities is to supply electricity to final consumers at a required quality, taking into account a reasonable level of losses, while pursuing the minimum cost for the electricity system. Hence, the distribution utilities are entitled as the owners and exclusive managers in charge of the fragment of distribution network in which they are operating; in other words, they are granted with territorial franchises.

Throughout the territorial franchise approach, utilities are able to operate in a regulated monopoly business model and they are the responsible of the activities and responsibilities relating to that area. Some duties of the distribution utilities, according to (Real Decreto 1048/2013, 2013), are the following: 1) building, operation, maintenance and development of their franchise network, and interconnections with other networks; 2) keeping an updated inventory of all the elements of the networks under their management; 3) elaborating annual demand forecasts with a horizon of 4 years; 4) coordination with neighbouring networks; and 5) calculating the losses coefficients of their networks. In order to efficiently perform these activities, they have the right to demand the required information to the different agents involved: system Operator, retailers, independent generators, etc.

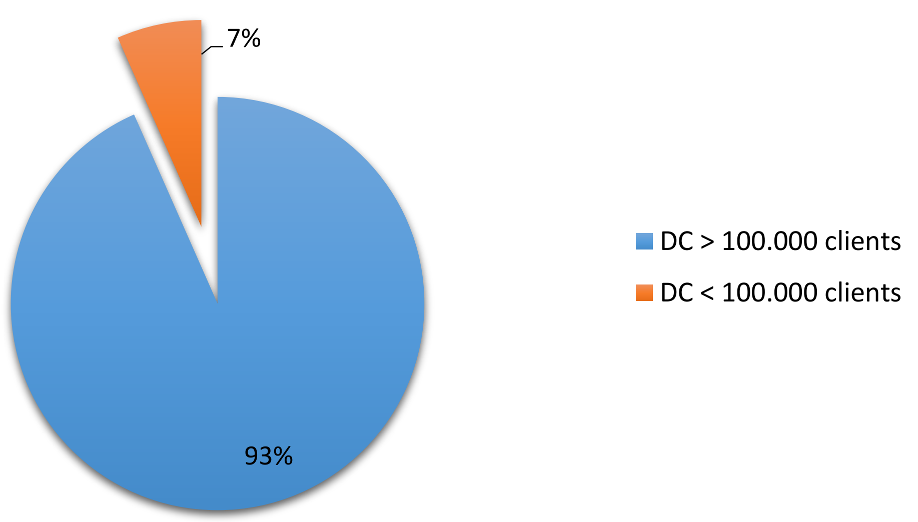


FIGURE 3.4 Share of remuneration among electricity distribution utilities in Spain

It is important to highlight that distribution utilities used to perform the retail activity in previous periods; however, since the entry into force of the last-resort tariff in 2009, the law establishes that electricity consumers have to buy the electricity directly through a retailer (providing that it is a competitive activity).

Distribution utilities are classified upon their size in two main groups (see Figure 3.4). The Spanish distribution system is an oligopoly where 5 main utilities – owning more than 100 thousand clients each – holding 93% of the total distribution system[12]. On the other hand, there are more than 300 small utilities with less than 100 thousand clients, accounting for the remaining 7% of the distribution system.

These 5 major utilities, among others, were created as a response of the unbundling process of the Vertical Integrated Companies (VIC) that took place in 1998; for that matter, the companies were forced to separate their regulated activities from those activities with competitive nature. Thus, distribution companies were set up as subsidiaries of the parent companies.

Most of the times, only parent companies are listed in the stock markets; so, analysis performed to the distribution utilities are usually affected since the data collected normally includes both regulated and competitive subsidiaries.

Article 12 of (Ley 24/2013, 2013) establishes the unbundling criteria that must be fulfilled by distribution subsidiaries belonging to parent companies that perform competitive activities through other subsidiaries within their group. A level of legal unbundling is required; however, criteria of independence are also mandatory; for example: no manager of a distribution utility can hold shares of the competitive subsidiaries. Therefore, any incentive that encourages monopolistic behaviour is reduced.

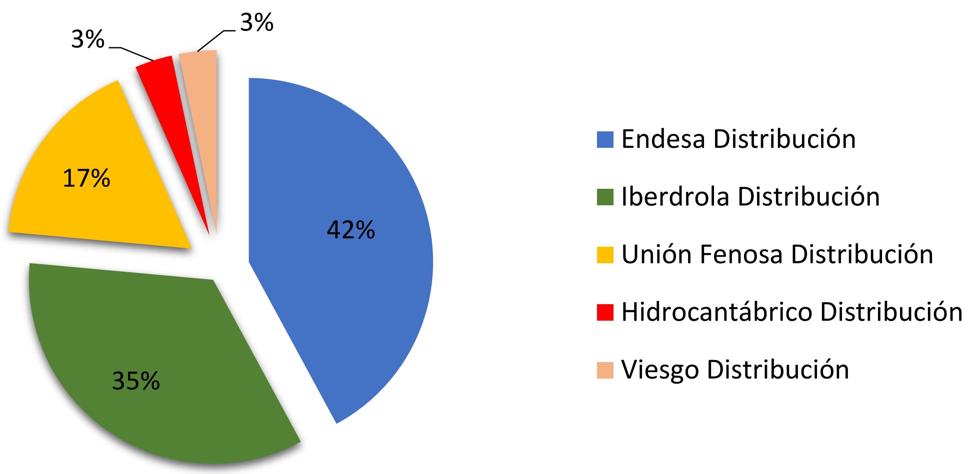


FIGURE 3.5 Share of remuneration among the 5 main electricity distribution utilities

[12] Based on the total remuneration assigned to the distribution activity in 2014

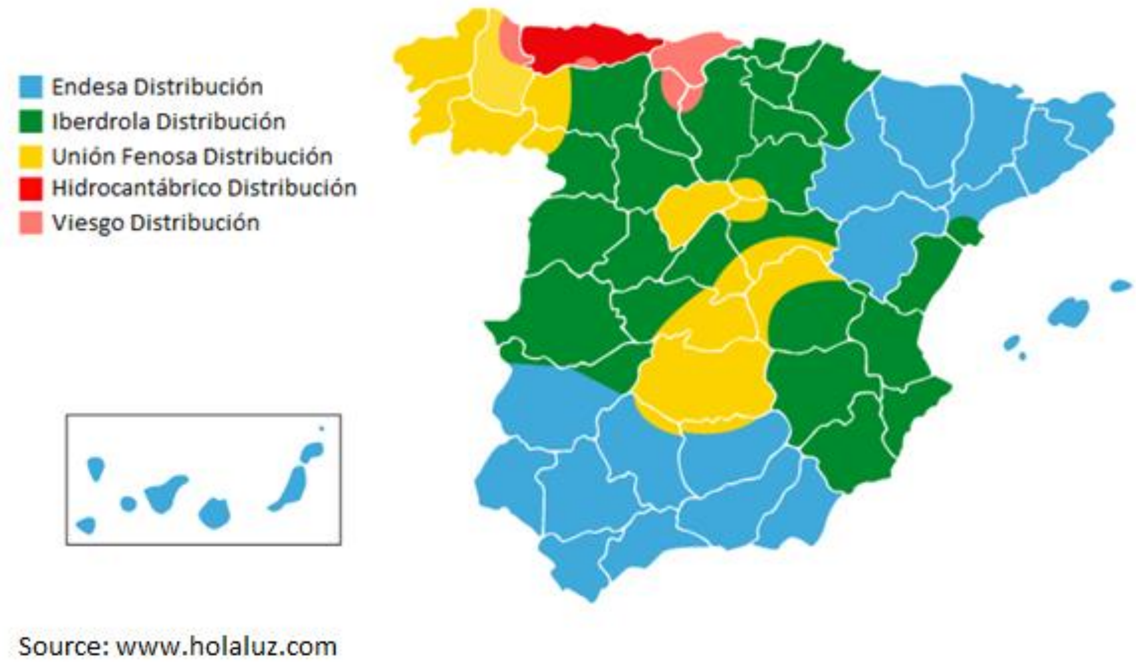


FIGURE 3.6 Territorial franchises of the main electricity distribution utilities in Spain

The next section will be devoted to give a brief description of the abovementioned companies. Only these companies were selected due to its relevancy for the electricity distribution system: a) Endesa Distribución, b) Iberdrola Distribución, c) Unión Fenosa Distribución, d) Hidrocantábrico Distribución, and e) Viesgo Distribución. It is important to highlight that within this small group, the size of each utility varies impressively.

Figure 3.5 shows the share of remuneration among the companies earlier mentioned. Endesa Distribución and Iberdrola Distribución hold more than 3/4 of the distribution system shared by these 5 utilities, while Hidrocantábrico Distribución and Viesgo Distribución, both located in the north part of the Spanish territory, own 3% each of them. These data is supported by the analysis of each of the franchise territories in the Spanish electricity system occupied by the main distribution utilities (see Figure 3.6). As it can be noted, Endesa – holding the 42% of the distribution system – occupies the quasi-totality of the regions of Andalusia, Cataluña, Aragón, Balearic Islands and Canary Islands. Furthermore, Iberdrola and Gas Natural Fenosa share among themselves some provinces belonging to Madrid and both Castillas.

It is important to note that the most of the region of Galicia belongs to Gas Natural Fenosa, provided that this company was conceived in this region. Therefore, it can be concluded that the current division of the territorial franchises among the companies are based on historical reasons; in other words, they kept their former territories at the time when they used to be Vertical Integrated Companies (VICs).

Endesa Distribución Eléctrica

ENDESA DISTRIBUCIÓN ELÉCTRICA S.L is the largest distribution utility in the Spanish electricity system in accordance to the total remuneration assigned to the distribution activity[13]; it was constituted in 2000. Although it is a legally independent company, this utility belongs to a group of companies: ENDESA S.A. – listed in the stock market – holds 100% of its equity, and it can be considered as its parent company; however, it is important to recall that ENDESA belongs to a larger international group called ENEL, S.p.A (the biggest Italian electricity company) which controls more than 70% of the equity of ENDESA[14].

The official location of the offices of these companies varies significantly; while **Endesa Distribución** has its registered office in Barcelona (Spain), the parent company – ENDESA – has its own in Madrid (Spain). Furthermore, the head company – ENEL – has its registered office in Rome (Italy).

Besides from distribution activities, ENDESA – as a conglomerated group – also performs activities related to retail and generation of electricity mostly in Spain and Portugal (and formerly in Latin America); additionally, it carries out activities related to the natural gas and other energy services (Endesa Distribución Eléctrica, 2014).

Finally, the activity performed by Endesa Distribución represents only 10% of the total revenues of the entire group[15]. Furthermore, Endesa distributed 110,945 GWh of electricity in Spain during 2014, which means a reduction of 1% compared to 2013.

Iberdrola Distribución Eléctrica

IBERDROLA DISTRIBUCIÓN ELÉCTRICA, S.A.U. was constituted in 2000 by its parent company IBERDROLA S.A (listed company in the stock market) throughout its subsidiary IBERDROLA REDES, S.A.U; this latter is the owner of the 100% of the shares of **Iberdrola Distribución**. While **Iberdrola Distribución** has its registered office in Bilbao (Spain), the parent companies are officially located in Madrid (Spain).

IBERDROLA – as a group – carries out activities related to generation, retail, trading, distribution of electricity and gas in several countries worldwide; its main locations are Spain, United Kingdom, México, Brazil and USA (Iberdrola Distribución Eléctrica, 2014).

Finally, the activity performed by **Iberdrola Distribución** represents only 6% of the total revenues of the entire group[16]. Furthermore, it distributed 91,656 GWh of electricity in Spain during 2013, while its total distribution – including all its locations – during the same year was 214,809 GWh.

[13] Data from 2014
[14] At 31/December/2014
[15] (Endesa Distribución Eléctrica, 2014) pg. 54-55 (2.038/20.473)
[16] (Iberdrola Distribución Eléctrica, 2014) (1,909/30,032)

Hence, it can be assumed that the share of the Spanish distribution business comprises around 43% of its total distribution business.

Unión Fenosa Distribución

UNIÓN FENOSA DISTRIBUCIÓN, S.A. (formerly GAS NATURAL DISTRIBUCIÓN ELÉCTRICA) has its registered office in Madrid (Spain) and it was constituted in 2003. This utility resulted from mergers and acquisition of other utilities, including: Unión Fenosa Distribución S.A.U., Hidroeléctrica Nuestra Señora de la Soledad de Tendilla y Lupiana, S.L.U., Electra de Jallas, S.A.U y Electra de Abusejo S.LU. In addition, **Unión Fenosa Distribución** belongs to the GAS NATURAL FENOSA group, which main company is GAS NATURAL SDG, S.A (the listed company of the group). The registered office of the group is in Barcelona (Spain).

GAS NATURAL FENOSA – as a group – carries out activities related to retail and distribution of natural gas; also, activities regarding electricity like generation, retail, and distribution are performed. Such activities, including other projects are conducted in many countries including the 5 continents (Unión Fenosa Distribución, 2014).

As introduced in section 3.1.1, **Unión Fenosa Distribución** also performs the activity of transmission in the Spanish network (around Madrid) due to historical reasons; however, such activity is quite small in comparison to the distribution one.

Finally, the activity performed by **Gas Natural** represents only 3.4% of the total revenues of the entire group[17]. Furthermore, it distributed a total of 51,412 GWh of electricity in Spain, Moldavia and Latin America during 2014. Specifically, the European market represents around 67% of its distribution business[18].

Hidrocantábrico Distribución Eléctrica

HIDROCANTÁBRICO DISTRIBUCIÓN ELÉCTRICA, S.A.U. is a distribution utility performing mainly activities in Asturias (see Figure 3.6). It was constituted in 1999 and its registered office is located in Oviedo.

Although it is a legally independent company, this utility belongs to a group of companies: HIDROELÉCTRICA DEL CANTABRICO, S.A (non-listed private company) holds the totality of its equity; however, since 2001, this company belongs to a larger international group called ELECTRICIDADE DE PORTUGAL (EDP) which is one of the biggest operators in the Iberian Peninsula.

[17] (Unión Fenosa Distribución, 2014) (824/24,742)
[18] 34.262 GWh for Europe

In 2011, **Hidrocantábrico Distribución** acquired other distribution utilities in order to increase their influence in Spain: Fuerzas Eléctricas de Valencia S.A., Solanar Distribuidora Eléctrica, S.L. and Instalaciones Eléctricas Rio Isabena, S.L.

Besides the distribution of electricity, EDP – as a group – performs activities associated to production, generation, and retail of electricity and gas, among other services[19]. Nevertheless, the activity performed by **Hidrocantábrico Distribución** represents only 4% of the total revenues of the entire group[20]; as an additional figure, it distributed a total of 9.177 GWh of electricity in Spain during 2014.

Viesgo Distribución Eléctrica

VIESGO DISTRIBUCIÓN ELÉCTRICA, S.L. is a distribution utility which activities are mainly conducted in the regions of Galicia, Asturias, Castilla y León and Cantabria (see Figure 3.6). It was initially constituted in 2001, but it has been involved into some corporate restructurings over the past years. Its registered headquarters are found in Santander (Spain).

Viesgo Distribución is a subsidiary company of VIESGO (not listed private company)**.** Until 2015, VIESGO used to be part of the German group E.ON; however, it currently belongs to a consortium formed by KIA, owning 40%, and MACQUARIE, having the remaining 60%.

On one side, KIA – Kuwait Investment Authority – was founded in 1953 and it is the responsible to manage the funds of the Kuwaiti State (a percentage of the incomes from oil are saved for the Future Generations of the country). Its headquarters are located in Kuwait and London; the latter one is called the Kuwait Investment Office (KIO). KIO owns a company called WREN HOUSE INFRAESTRUCTURE MANAGEMENT LIMITED which main goal is to invest in the G-20 countries' infrastructures, having special interest in those belonging to regulated sectors.

On the other side, the Macquarie European Infrastructure Fund 4 is an infrastructure fund managed by MIRAEL – MACQUARIE INFRASTRUCTURE AND REAL ASSETS; the main objective of this fund is to invest in infrastructure businesses in the EU, Norway, Sweden and Iceland.

Finally, VIESGO – as a group – carries out activities related to the generation, distribution and retail of electricity and natural gas; these activities, among other projects are conducted mainly in Spain and Portugal.

[19] http://www.edpenergia.es/es/
[20] (Hidrocantábrico Distribución Eléctrica, 2014) (156/4.086)

3.2 Regulatory Framework in Spain

This section is aimed to provide the insights to get familiar with the regulatory framework in Spain for investments in the T&D activities. Apart from this, the author would like to recall that the objective of the thesis – covered in the Section 1.3 – is in line with the proposition of a methodology to approximate the spread of the rate of return for the next regulatory period. Hence, only those features regarding this topic will be highlighted from the vast spectrum enclosed in the relevant legislation.

As a brief introduction, the main concepts of the regulatory framework applicable to the Spanish electricity system are covered by the following points, according to (Ley 24/2013, 2013): 1) the generation of electricity is performed in a free competition scheme; 2) the transmission, distribution and system operation are entitled as regulated activities; 3) the energy dispatch is carried out through a daily market which is organized by the market operator; 4) the generation of electricity from renewable energy sources is subject to regulated remuneration; 5) the retail activity is liberalized and all the consumers must contract that service through a retailer; 6) the access tariffs are the same within the Spanish territory; and, 7) the remuneration for the Extrapeninsular generation and generation with indigenous coal is also regulated.

Important peculiarities of the current regulation that are relevant for the thesis are related to the existence of a unique rate of return that will apply for both regulated T&D activities; moreover, there will be no differentiation among utilities, so the same rate of return will apply for large or small utilities. Although this generalization is a matter of debate, this research will not attempt to change the current regulation, so no alternative proposals will be suggested regarding this topic.

The methodologies to remunerate the T&D activities are detailed in the Official State Gazette (known in Spanish as BOE) by separate; (Real Decreto 1047/2013, 2013) for transmission and (Real Decreto 1048/2013, 2013) for distribution. These methodologies have the objective to set the criteria to remunerate the network utilities for their activities in construction, operation and maintenance of their respective networks. The criteria are homogenous for the whole Spanish territory and based on the lowest possible cost for the electric system; it is important to note that these comply with the conditions discussed in section 2.2, where the methodology is preferred to be clear, stable, and predictable in order to enhance the regulatory stability and reduce the financing costs of the system.

Finally, the remuneration processes for both activities – which will be explained afterwards - are based on the schematic map of the annual remuneration of network activities introduced in the Introduction (see Figure 1.1). Remuneration terms for Investment, O&M and economic incentives must be easily identifiable; similarly, conditions to compute the RAB for existing and new assets will be addressed. Finally, the allowed rate of return and the investment plans will also be discussed.

3.2.1 General conditions applying for both T&D activities

Despite the fact that the methodologies to compute the remuneration for each network activity – transmission and distribution – are different among themselves, there are some conditions and features that are applicable for both approaches; these will be explained in the following paragraphs.

The first feature is related to **the regulatory period and payments to utilities**. As explained in Table 1.1, the regulatory periods in Spain are composed of 6 years each; however, the concept of base year must be introduced due to upcoming understandings that will be later discussed. Therefore, the base year refers to the second preceding year from the starting date of the regulatory period; for example, for the current regulatory period, the base year is 2014 since the first regulatory period started in 01/January/2016 (after two years). Moreover, payments – due in annual basis – and depreciation charge will involve a 2-year delay; hence, assets set up in *year n* will be remunerated starting from *year n+2*.

The second feature relates to the **valuation of the RAB** (see Section 2.3).

- Firstly, the unitary reference values (URVs) are used to value the assets entitled to remuneration. As explained further below, these references values will be used in the valuation of both existing and new assets. However, the URVs are different between T&D activities; there is a catalogue of URVs for transmission[21] and distribution[22] separately. Moreover, the URVs also differ from their particularities derived from the location where the assets will be installed and their isolated condition; the three different locations being considered by the law are: 1) peninsular area, 2) Balearic Islands and Canary Islands, and 3) Ceuta and Melilla.
- Secondly, the value of the RAB will not be updated every year, nor the URVs. This is based on (Ley 2/2015, 2015) which states the new framework for the regulated prices and public budgets justified in the existing and more stable economic environment.
- Finally, despite the RAB will not be updated once its value is obtained, the law envisages the possibility to update the URVs from one regulatory period to the next one, if required. As the RAB for new assets is obtained taking into account the regulatory period's URVs and the audited costs, the update of URVs will only affect new assets built within the regulatory period.

[21] (Orden IET/2659/2015, 2015)
[22] (Orden IET/2660/2015, 2015)

The third feature is in line with the **allowed rate of return** (see Section 2.5). As previously explained, it will be the same for all the utilities belonging to transmission and distribution activities. Additionally, since these activities are considered as low risk businesses, their remuneration should be based on the low-risk condition of regulated activities. Therefore, the allowed rate of return will be computed as the average yield of the 10-year Spanish bond plus a spread. Finally, the law also envisages the possibility to update the allowed rate of return from one regulatory period to the next one, if required.

The last feature refers to the **investment plans** for new assets. All investments that aim to be recognized in the RAB have to be in line with the Investment Plan previously delivered; additionally, there is a maximum limit of annual investments (e.g. % of the annual GDP). Such Investment Plan must be approved by the Secretary of State, receiving support from the CNMC. Finally, ex-ante approval of Investment Plans helps to reduce the disallowing risk, since most of the assets will be included in the RAB.

3.2.2 Remuneration scheme

The remuneration for both Transmission and Distribution activities is carried out in annual basis by the Ministry, getting support from the CNMC; the procedure of remuneration is established in the official gazette of the state (BOEs)[23] . **Equation 3.1** shows the general remuneration formula for transmission activity; additionally, **Equation 3.2** disaggregates the terms concerning the remuneration of the assets. It is important to note that for the sake of simplicity, formulas within the following sections were adapted and some unrelated terms were neglected.

$$R_n^i = \sum_{\forall assets\ in\ service\ year\ n-2} R_n^j + I_n^i \qquad \mathbf{3.1})$$

$$R_n^j = \left(RI_n^j + ROM_n^j\right) \qquad \mathbf{3.2})$$

Where:

- R_n^i – Remuneration of the utility i in the year n
- R_n^j – Remuneration of the asset j in the year n
- I_n^i – Incentives of the utility i in the year n (Availability of facilities)
- RI_n^j – Remuneration for investment of the asset j in the year n
- ROM_n^j – Remuneration for O&M of the asset j in the year n

[23] (Real Decreto 1047/2013, 2013)

As it can be noted, the annual remuneration is composed of two parts: the remuneration of the assets plus the associated incentives. This same composition can be found in the formula of the remuneration of distribution activities (see **Equation 3.3**). However, there are three main differences among the remuneration formulas of both activities which must be highlighted:

1. The remuneration of distribution includes two terms concerning remuneration of the assets – base remuneration and new installations – while the remuneration of transmission only considers one term. The reasoning behind this is because it is assumed that the distribution activity does not have clear historical records regarding the totality of their existing assets before 2014, so they must be separated, summed up into an asset pool (RAB base) and remunerated according certain conditions. This assumption relies on the fact that distribution utilities have too many assets and, more important, they use different systems to value them and depreciate them. The common conditions used are explained in the Section 3.2.3. It is worthy to mention that this same mechanism was performed for the transmission activity in 1998, where all the existing assets before that year were included into a common base (RAB base); after that moment, the new assets were valued individually.
2. Distribution activity is also remunerated for performing other regulated activities, such as: meter reading, phone support, planning tasks, among others.
3. The quantity of incentives for each activity is different; while transmission activity has only one incentive: availability of the facilities; the distribution activity includes three different incentives: quality of service, reduction of technical losses, and reduction of economic losses (consumer’s fraud).

The methodology for remuneration T&D activities considers economic incentives through rewards and penalties in order to enhance quality levels and availability of the facilities; compliance on such incentives is established individually utility by utility. Equation 3.3 shows the general remuneration formula for the distribution activity.

$$R_n^i = R_{n\,(base)}^i + R_{n\,(NI)}^i + RO_n^i + I_n^i \qquad \mathbf{3.3})$$

$$R_{n\,(base)}^i = \left(RI_{base}^i + ROM_{base}^i\right) \qquad \mathbf{3.4})$$

$$R_{n\,(NI)}^i = \sum\nolimits_{\forall j} \left(RI_n^j + ROM_n^j\right) \qquad \mathbf{3.5})$$

Where:

- R_n^i – Remuneration of the utility i in the year n
- $R_{n\,(base)}^i$ – Remuneration (base) of the utility i in the year n comprising all the assets installed before the base year (2014).
- $R_{n\,(NI)}^i$ – Remuneration (new installations) of the utility i in the year n comprising all the assets installed after the base year (2014).
- RO_n^i – Remuneration for other regulated activities of utility i in the year n
- I_n^i – Incentives of the utility i in the year n (Quality, Losses and Consumer's Fraud)
- RI_{base}^i – Remuneration (base) for investment of the asset j in the year n
- ROM_{base}^i – Remuneration (base) for O&M of the asset j in the year n
- RI_n^j – Remuneration for investment of the asset j in the year n
- ROM_n^j – Remuneration for O&M of the asset j in the year n

The remuneration of the asset in all the cases (see **Equation 3.2**, **Equation 3.4** and **Equation 3.5**) is computed as the sum of the remuneration for investment of assets and the O&M of assets; however, since the objective of this thesis is not related to issues concerning O&M, the aim will be focused only on the first term. Therefore, the remuneration for investment of assets is computed as the sum of the remuneration of lineal depreciation plus the financial remuneration (see **Equation 3.6**). This formula is also related to the **Equation 1.2**.

$$RI_n^j = Dep_n^j + RF_n^j \qquad 3.6)$$

$$Dep_n^j = \frac{gRAB^j}{Life^j} \qquad 3.7)$$

$$RF_n^j = nRAB_n^j * RoR_n \qquad 3.8)$$

Where:

- RI_n^j – Remuneration for investment of the asset j in the year n
- Dep_n^j – Remuneration of lineal depreciation of the asset j in the year n
- RF_n^j – Financial Remuneration of the asset j in the year n
- $gRAB^j$ – Gross RAB of asset j
- $Life^j$ – Economic life of the asset j
- $nRAB_n^j$ – Net RAB of asset j in year n
- RoR_n – Allowed rate of return of the year n

Although these formulas are generally applied for both Transmission and Distribution activities, they are more related to the inclusion of new assets; hence, formulas regarding the base remuneration (see **Equation 3.4**) varies slightly since the computation of the terms abovementioned do not depend on each asset j but on the total amount of the asset pool.

Moreover, the way the RAB is calculated varies among existing assets and new assets. These methodologies will be explained in the following Section 3.2.3 and Section 3.2.4 respectively. Also, the methodology to compute the economic life of assets varies among existing and new assets. Table 3.2 shows the different economic life values for each asset's scheme.[24]

Finally, special remark must be done on the difference among existing assets for transmission and distribution. As previously explained, the whole transmission's assets have been under control since 1998 so historical records are valid when determining their economic life; on the other hand, historical data regarding distribution's assets is more limited; therefore, existing assets are all included in an asset pool and an average of their economic life is computed.

Regulated network activity	Asset's scheme	General assets	Switching offices
Transmission	Existing assets	Historical records	
Transmission	New assets	40 years	12 years
Distribution	Existing assets	Mean value	
Distribution	New assets	40 years	12 years

TABLE 3.2 Economic life values of assets depending on their scheme

3.2.3 RAB of existing assets

The RAB of the transmission assets after 1998 is valued asset by asset; therefore, this process is similar to the one that will be explained in section 3.2.4 regarding the valuation of new assets. Perhaps, the remuneration for transmission activities could be seen as an easier process compared to the one of distribution since it comprises only one utility: REE. Furthermore, it is assumed that a greater control over the investments performed in transmission have been put in place. On the other hand, distribution activity is more difficult to control due to the quantity of assets involved; hence, the way the RAB concerning distribution utilities results more complex than transmission utilities.

As introduced in the previous section, the RAB of existing assets for each distribution utility is computed by adding the totality of their assets that where put into operation before 2014 into an asset pool (RAB base). Each distribution utility provided an audited inventory of their total assets,

[24] Values of new assets are indicative; however, economic life of specific assets can be found in: (Orden IET/2659/2015, 2015) and (Orden IET/2660/2015, 2015)

in order to be valued in accordance to their replacement cost; however, book values are irrelevant for this purpose since distribution utilities might have used different systems to value them and depreciate them (accelerated depreciation, lineal depreciation, etc.); therefore, the URVs were used as a standard procedure for economic valuation of assets at replacement cost. **Equation 3.9** shows formula used to compute the RAB of existing assets for each distribution utility.

Nevertheless, a drawback of the replacement costs methodology is in line with extra valuation that is given to existing assets; therefore, the value of some assets might be overestimated. For example, the cost of an asset in 1990 is not the same as its today's price. However, it might be understood as an implicit compensation for the utilities given the regulatory changes in the last years.

$$RAB_{base}^{i} = k^{i} * \sum_{\forall j} Quantity^{j} * URV^{j} \qquad \mathbf{3.9})$$

Where:

- RAB_{base}^{i} – RAB of existing assets of utility i.
- k^{i} – Efficiency factor of utility i [0.8 – 1.2]
- $Quantity^{j}$ – Audited inventory of asset j of utility i
- URV^{j} – Unitary Reference Values of asset j

Moreover, a particularity of the **Equation 3.9** is related to the efficiency factor[25] (k^{i}) that multiplies the asset pool value of each distribution utility. Such efficiency factor – which value falls between 0.8 and 1.2 – is related to the likeness of each distribution network to an efficient. Therefore, an efficient network would receive a value closer to 1.2, so the value of the asset pool would be increased; conversely, an inefficient network would receive a value closer to 0.8, so the valuation of their assets would be decreased.

Finally, the Network Reference Model is a supporting tool of the CNMC; it determines the optimal distribution network by minimizing the overall costs (investment, operation and maintenance, technical losses) and complying with the quality levels. The use of the Network Reference Model is possible under the current regulation but not mandatory.

3.2.4 RAB of new assets

Few differences are found between Transmission and Distribution activities when assessing the value of the RAB of new assets; therefore, both activities will be explained throughout the same characteristics within this section.

[25] (Orden IET/2659/2015, 2015) and (Orden IET/2660/2015, 2015)

It is acknowledged that the valuation of new assets corresponds to those assets that were put in operation after 2014. Unlike the process followed when computing the RAB of existing assets – aggregation into an asset pool – the valuation of the new assets is performed individually (asset by asset).

Equation 3.10 shows the basic formulation to compute the RAB of new assets; it is simply a sum of the recognized value entitled to remuneration of all the assets. Although the procedure seems really obvious, there are some concepts to bear in mind when computing such value.

The formulation to compute the recognized value (see **Equation 3.11**) includes incentives to invest efficiently; in other words, accordingly to the URVs. Hence, the recognized value is based on the audited value – the real cost paid by the utility – plus half of the difference between the URVs (standard values) and the audited cost; by doing this, the utility is incentivised to invest below the standard values (given by the regulator) of a given asset in order to earn an extra income.

Later, once the recognized value is obtained, it is multiplied by the factor that reflects the real proportion invested by the utility. This process is important to note since the legislation is aware of the right of the utilities to appropriate facilities from third parties (e.g. transmission line built and financed by an interested company); therefore, despite the fact that such new asset legally belongs to the utility, it should not be included in the RAB. The reasoning behind this argument is that the utility did not invest on it so it should not receive any remuneration for it.

Similarly, any subsidy granted to the utility regarding a given asset should be also deducted from the total recognized value entitled of remuneration; therefore, only the money belonging to the utility (debt and capital) used for network investments should have the right to be compensated.

Finally, the Delay Remuneration Factor is included in the formulation as a way of compensation to utilities. As introduced in section 3.2.1, payments comprise a 2-year delay; therefore, the regulation considers an equivalent capitalisation of the *benefits* that would have generated during this time.

$$RAB_{NI}^{i} = \sum_{\forall j} RecVal^{j} \qquad \mathbf{3.10})$$

$$RecVal^{j} = \left(\left(Aud_{n-2}^{j} + \frac{1}{2} * \left(URV_{n-2}^{j} - Aud_{n-2}^{j}\right)\right) * \partial^{j} - Sub^{j}\right) * Delay^{j} \qquad \mathbf{3.11})$$

Where:

- RAB_{NI}^{i} – RAB of new assets of utility i
- $RecVal^{j}$ – Recognized Value to be remunerated of asset j
- Aud_{n-2}^{j} – Audited cost of asset j put in place in the year n-2
- URV_{n-2}^{j} – Unitary Reference Values of asset j according to the year n-2

- ∂^j – Percentage reflecting the real proportion invested by the utility in the asset j
- Sub^j- Amount of money (Subsidy) received by the utility for the asset j
- $Delay^j$ – Amount of money related to the Delayed Remuneration Factor of asset j

For illustrative purposes: if an utility managed to build a facility below the URVs (audited costs < standard costs), half of that difference will be recognized in the RAB on top of the audited costs; on the contrary, if the utility builds a facility above the URVs (audited costs > standard costs), only half of that difference will be recognized in the RAB on top of the standard costs.

However, audited costs are constrained by two main measures set in the regulation. First, in the case the audited costs of an asset exceed the standard cost by 15%; a technical report should be presented to the regulator to justify such deviation. Secondly, the outcome resulting from the difference between the standard costs minus the audited costs, times $\frac{1}{2}$ should not be higher than the 12.5% of the audited cost, either in transmission and distribution activities.

3.2.5 Final considerations of the Allowed rate of return

As mentioned in section 3.2.2, investors have the right to receive two kinds of remuneration: the first one is associated to the depreciation of the asset (recovery of the money invested), while the second is related to the financial remuneration of their investments (see **Equation 3.6**). The latter usually applies to the net value of the RAB, and one of its key concepts refers to the allowed rate of return.

It is worthy to recall that according to Article 8 of (Real Decreto 1047/2013, 2013) and Article 14 of (Real Decreto 1048/2013, 2013), the allowed rate of return for the next regulatory period applying for the regulated network activities will be computed as the average yield of the 10-Year Spanish bond in the 24 months prior to the month of march of the year before the beginning of the regulatory period plus a *spread*. However, the methodology to calculate such spread must be based on explicit criteria that were previously detailed in Section 1.2.

The importance of the allowed rate of return relies on the fact that it will equally apply for both activities – Transmission and Distribution – as it will also be used when valuating existing assets and new assets. Nevertheless, the legislation devises that the rate of return can be changed at the beginning of each regulatory period, if necessary; therefore, it also may work as a mechanism to adapt the remuneration in the event that is required for economic reasons.

Finally, a huge concern to bear in mind regarding this topic is in line with the existence of additional incomes legitimated by the regulatory framework but which are not related to the allowed rate of return (nor the WACC). 1) The revaluation of the existing RAB based on the reposition costs comprises an extra profit to utilities; the reasoning behind this argument relies on the fact that the money used some years ago does not correspond – and it is usually lower – to the valuation of the assets nowadays. 2) The incentive to invest (or operate) below the URVs.

Chapter 4

Analysis of precedents

4.1 CNE methodology (2008)

As previously introduced, a methodology to compute the allowed rate of return based on the WACC was proposed by the CNE in April 2008. The aim of this methodology was to support the Spanish regulatory body in some of its tasks such as: 1) reducing the costs of the electricity system by minimizing the regulatory risk; and 2) providing a stable and predictable environment that fosters the investments (CNE, 2008).

The methodology mainly consisted in computing the WACC (see **Equation 2.2**) of the regulated network activities in the Spanish electricity system in order to propose a rate of return for the transmission and distribution utilities.

As mentioned in the section 2.4, the WACC should reflect both, the opportunity cost and the expected return of the capital suppliers. On the other hand and for regulatory purposes, the WACC approximates the average cost of capital used to fund a specific venture – in this case, the regulated network activities – and, a possible financing strategy for the utilities concerned.

The methodology proposed by the (CNE, 2008) is based on three basic principles:

- **Transparency**: Each parameter of the WACC should be computed separately applying a specific and understandable methodology.
- **Replicability**: The computation of each parameter is able to be replicated by third stakeholders in accordance to the methodology proposed (no hidden data).
- **Best practices at regulated activities**: There is no general agreement regarding the best methodology to apply. Therefore, a benchmarking analysis should be prepared among

homogenous regulatory frameworks in order to determine the most appropriate characteristics for the given purpose.

The methodology analysed both transmission and distribution activities separately; the reasoning behind this decision is founded in the Spanish regulatory framework at that time. Although it recognized the T&D activities as regulated natural monopolies (so their remuneration schemes must be regulated by the energy authority at that time) and activities with similar systematic risk profile, their remuneration schemes were different among themselves.

The remuneration for the investment in the transmission activity was based on the recognition of real investment costs compared against standard costs – asset by asset approach. On the other hand, the remuneration for the distribution activity was based on the recognition of the total investment costs.

Finally, one of the main problems during the application of this methodology was related to the scarcity of pure listed peer utilities (utilities listed in the stock market which perform exclusively regulated activities); therefore, companies carrying out also non-regulated activities were taken into consideration when performing the analysis.

4.1.1 Cost of equity

It refers to the profit demanded by the owners of the capital. This parameter is not observed straightforwardly so it should be calculated. (Gandolfi, 2009) presents four generally accepted methods to compute the cost of equity: 1) Capital Asset Pricing Model (CAPM), 2) Dividend Growth Model (DGM), 3) Risk Premium Model (RPM) and 4) Arbitrage Pricing Theory (ATP). However, she also claims that the first two models are the most widely used by the regulators: the CAPM is the commonly used in Europe and Latin-America, while the DGM is almost exclusively used in North-America.

The first model – CAPM – will be explained into greater detail owing to two reasons:

1) The focus of this master thesis is related to a European context.
2) The DGM is hardly applicable to Europe since it requires a constant dividend policy in order to compute the dividend growth rate.

The CAPM is based on the principle that investors are able to reduce their risk by diversifying their portfolio; therefore, the risks that cannot be reduced by the investor correspond to the systematic risk (related to the market). The demanded return must only depend on the non-diversifiable risk of the regulated activity since investors are only exposed to this type of risk.

Then, the CAPM can be approached as the valuation of an asset based on its contribution to the non-diversifiable risk (CNE, 2008). CAPM formula is shown in the **Equation 4.1**.

$$R_e = R_f + [\ \beta_L * MRP\ ] \qquad \textbf{4.1)}$$

Where:

- R_e – Cost of equity
- R_f – Risk-free rate
- β_L – Beta value: measurement of the volatility of an underlying asset with respect to the market.
- MRP – Market Risk Premium

This model is based on some important assumptions regarding investors and markets – which are not always realistic: 1) Investors are rational and risk adverse; 2) homogenous future prospects about the expected returns of the assets; 3) feasibility to invest and borrow money at the risk-free rate; 4) no transaction costs; and 5) same temporal horizon. However, this is the best model created so far that explains the investor's behaviour and the expected market return (Gandolfi, 2009).

Some advantages of this model are: 1) transparency, 2) impartiality and 3) simplicity; these are some reasons that explain the preference of regulators for this model. Its parameters can be directly found in the market, so subjective valuations are avoided. On the other hand, some drawbacks can also be found: 1) Investment signals might not be taken into account; and 2) only the systematic risks are included, while other risks, like the regulatory risk, are dismissed. For example: the risk of disallowing costs ex-post, and the risk of non-expected regulatory changes are not included.

In next sections, each of the components abovementioned will be explained and computed separately.

a) Risk-free rate – R_f

When determining the risk-free rate, five key decisions must be borne in mind:

1) <u>Define the risk-free asset</u>. In general terms, it can be explained in two ways:
   i. It refers to the asset whose covariance with respect to the market (its beta) is zero; therefore, it is not exposed to a systematic risk and it can be totally diversifiable.
   ii. It refers to the asset whose ex-post return equals its expected return. In other words, two conditions must be fulfilled: 1) no bankruptcy risk, and 2) no reinvestment risk.

   Typically, regulators and financial analysisits propose the government sovereign debt as the best approximation of the risk-free asset since 1) the government has the power to raise taxes or restrict some rights before to go into bankruptcy, and 2) the maturity of the asset has to correspond to the investment horizon in order to avoid the reinvestment risk.

2) Define the reference country.

   The selected asset is normally found in many markets; therefore, a reference country has to be selected. Two alternatives are introduced: 1) select the country whose debt cost is the lowest or 2) select the – local – country where the activity concerned is performed.

   The disadvantage of the former one is related to the necessity to add both the exchange risk, if the currency is different, and the country risk to the CAPM formula (see **Equation 4.1**) since the country concerned implies a higher risk for investors.

   However, it has been observed that both approaches are equivalent since the second option includes implicitly the country risk and the exchange risk as long as the debt of the local country is liquid enough and the condition of free movements of capital exists.

3) Define the source of the data.

   The data can be selected from historic data or market data; nevertheless, the general recommendation is to use the best available information included in the market.

4) Define the investment horizon (maturity).

   Three approaches regarding the horizon of the asset might be considered: 1) taking the regulatory period horizon – typically 4 to 6 years; 2) taking the asset's economic life horizon– typically 30 to 40 years; or 3) taking the investor horizon – typically medium to long term.

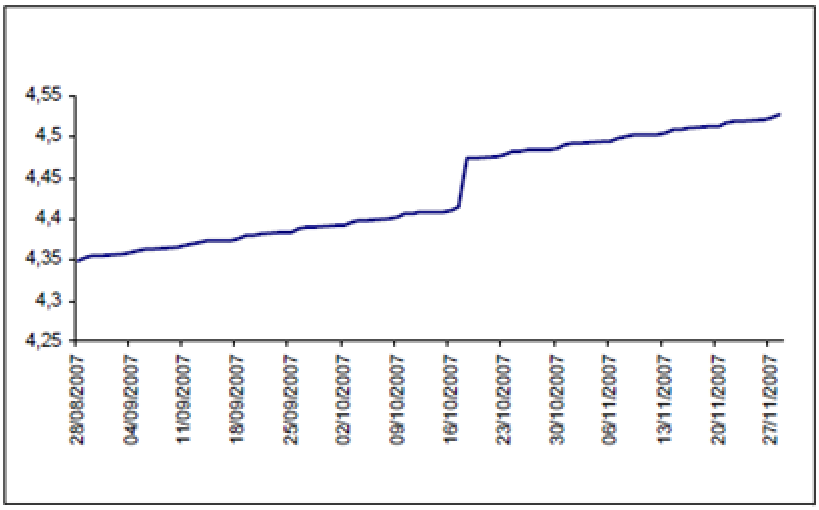
   According to (Gandolfi, 2009) "the investor horizon is the most relevant to consider"; moreover, regulators are keen to use the 10-year horizon due to its market's liquidity, and its medium-to-long term quality.

5) Define the period of the study.

   Two options can be approached: 1) selecting a medium-to-long term period in order to provide a stable equilibrium value in which several years are considered, or 2) selecting a shorter period considering only recent data. According to the theory of WACC (Gandolfi, 2009), the second approach must be preferred over the first one since it is assumed that the current data explains better the characteristics that will prevail in the future.

Regarding the methodology proposed by the (CNE, 2008), the key decisions selected are explained as following: The 1) free-risk asset selected was the Spanish sovereign debt because the market where it is traded is very liquid; indirectly, the 2) reference country selected was Spain since the regulated activities are performed in this particular country; therefore, the country risk is implicit within the rate. The 3) data was taken from market values; more specifically from a strip bond (zero coupon bond with no reinvestment risk) and it is computed as its daily average yield.

Moreover, the 4) horizon selected was 10 years, since this criterion matches with the medium-long term investor profile. Finally, the 5) period selected was the last three months from the time when the study took place; although the proposal do not specify the reasoning behind this decision, it is highly probable that it was due to the yearly revision of the WACC which was allowed in the regulatory framework at that time. Therefore, if the economic situation would have changed, the WACC – and the allowed rate of return – would have been modified accordingly; thus, there was no need to take longer periods of time.



Source: Datastream

FIGURE 4.1 Average daily yield of the Spanish strip bond from 28/08/07 to 27/11/07

In conclusion, the daily average yield of the Spanish strip bond with a maturity to 10 years for the last 3 months was computed in order to get the free-risk rate of return. The result in the numerical application of the proposal conducted in 2008 was 4.43%; the average can be computed from the data displayed in the Figure 4.1.

b) Beta coefficient – $\boldsymbol{\beta_L}$ & $\boldsymbol{\beta_U}$

The Beta coefficient refers to the correlation between the return of the underlying and the return of the market portfolio. In simple words, it measures the systematic risk – the non-diversifiable risk – of a give asset.

There are several ways to determine the value of beta, however the most used can be summarized in two big areas: 1) it can be computed from raw data applying several methodologies and assumptions or, 2) it can be taken directly from financial sources (e.g. Bloomberg or experts' reports). The advantages of the former are related to the suitability of the data for the own specific purposes, while the disadvantages are the complexity and time-consuming of the calculations.

Thus, the *"Peer group of utilities"* approach was selected in this methodology due to its suitability to represent a similar risk-profile among utilities.

Although the literature proposes 4 steps for this methodology (Gandolfi, 2009), the procedure followed by (CNE, 2008) extended up to 5 steps. These are explained down below:

1) Selection of the peer utilities – Peer group of utilities.

   The applicable criteria have to be strict enough to come up with an objective list; at the same time, the data – number of utilities – has to be large enough to minimize the error of the analysis. Also, in order to provide transparency and replicability to the methodology, (Gandolfi, 2009) recommends using utilities belonging to a given stock index.

   Some criteria proposed by the author are the following:

   a. Listed companies whose main activity corresponds to the regulated activity subject of the study. It is important to bear in mind that regulated activities are characterized as lower risk compared to the competitive ones. Therefore, in order to properly represent the risk of the utility at stake, the relative weight of the regulated activity within the company has to be significant; however, it is not observed straightforwardly. Thereupon, financial statements might be used to determine such amount.
   b. Companies whose financial volume is relevant at liquid stock markets – because most of the data used to compute the beta will be taken as market values.
   c. Companies that operate in similar regulatory frameworks – since the type of regulation and the remuneration scheme influences the utilities' financing decisions, and therefore, their cost of capital.

2) Computation of the leveraged beta coefficient for each utility – β_L

   Regression analysis is used to determine the beta coefficients. However, utilities' data has to be selected beforehand. Four methodological aspects must be taken into account during this step. No standard procedure is set as reference since each of them has advantages and disadvantages.

   a. **Frequency**: It points out the regularity at which the data is taken. A higher frequency, such as daily returns, implies a higher number of observations. On one hand, the regression error tends to be minimized, while on the other hand, the information might be unavailable.
   b. **Horizon**: It refers to the period of time that investors are expecting to lend their capital; it is included in the nature of the underlying asset. Again, a longer horizon implies more number of observations and less statistical errors; however, the financial structure of the companies has to be considered and it tends to change over the time, altering the associated risk.

c. **Period of study**: It refers to the term used when getting the observations. A shorter period of time involves assuming constant volatility; in other words, it assumes that current volatility will prevail for the next years. By contrast, longer periods of time smooth the volatility change by considering different market conditions throughout the whole study.

d. **Reference market**: Theoretically, the CAPM stated that the reference market should include all the investment possibilities where investors might place their capital; however, in the reality, no index includes all these alternatives. Therefore, the most common practice is to use the most relevant index for the domestic investors. Additional considerations are related to:

   i) Selection of a global, European or national index. With this in mind, (Gandolfi, 2009) introduces the concept of '***home bias'***, which alleges that "investors tend to invest in securities from their same country due to their market knowledge and the existence of transactions costs".

   ii) Selection of a general index or selective index. The latter one might be preferable since it may consider only liquid securities; nevertheless, the sample might be biased due to the subjective criteria employed.

3) <u>Find the unleveraged beta – β_U – of each utility.</u>

Betas for each company that is obtained in the previous step cannot be directly compared among themselves since they are affected by their own level of leverage. Therefore, two concerns arise: a) the level of leverage of each utility differs among themselves, and b) when leverage increases, the volatility of rate of return increases accordingly, as well as the correlation between the asset and the portfolio. In conclusion, the betas of all the utilities must be homogenized by removing the leverage effect by applying the Modigliani –Miller theorem[26] (see **Equation 4.2**):

$$\beta_U = \frac{\beta_L}{\left[1 + \frac{D}{E} * (1 - T)\right]} \qquad \textbf{4.2)}$$

Where:

- β_U – Utility's beta without leverage.
- β_L – Utility's beta with leverage (obtained in step 2).
- D/E – Utility's leverage ratio.
- T – Corporate tax rate applicable for each utility.

[26] http://www.iese.edu/research/pdfs/DI-0488-E.pdf

Transmission Utility	Main country	Sector	Degree of importance on its market	
			Gas	Electricity
REE	Spain	Electricity		SO and single op.
ENAGAS	Spain	Gas	SO and main op.	
TERNA	Italy	Electricity		SO and main op.
SNAM RETE GAS	Italy	Gas	SO and main op.	
NATIONAL GRID	UK	Both	SO and main op.	SO and main op.
EDF	France	Electricity		Main op.
GAZ DE FRANCE	France	Gas	Main op.	
E ON (XET)	Germany	Both	Relevant op.	Relevant op.
RWE (XET)	Germany	Both	Relevant op.	Relevant op.
VERBUND	Austria	Electricity		Main op.
PUBLIC POWER	Greece	Electricity		Single op.

TABLE 4.1 Peer group of utilities – Transmission (2007)

Debt (D) and equity (E) can be obtained from book or market values. Additionally, corporate tax rate (T) is obtained from the tax rate applicable in each of their countries at that time.

4) Computation of the unleveraged beta β_U of the regulated activity.

The unleveraged beta of the regulated activity can be approximated throughout the average of the unleveraged betas of all the peer utilities – found in step 3.

5) Computation of the re-leveraged beta of the regulated activity β_{RL}.

It is important to highlight that only leveraged – or re-leveraged – betas can be used in order to compute the WACC. Thus, leveraging the beta of the regulated activity (obtained in the step 4) is required. **Equation 4.3** is typically used to help in this process by applying both, an optimal leverage ratio and an expected tax rate (these terms will be explained in subsequent sections).

$$\beta_{RL} = \beta_U * \left[1 + \left(\frac{D}{E}\right)^{opt} * (1 - T^{exp})\right] \quad \textbf{4.3)}$$

Where:

- β_{RL} – Re-leveraged beta of the regulated activity.
- β_U – Unleveraged beta of the regulated activity (obtained in step 4).
- $\left(\frac{D}{E}\right)^{opt}$ – Optimal leverage ratio.
- T^{exp} – Expected tax rate.

Distribution Utility	Main country	Sector	Degree of importance on its market	
			Gas	Electricity
ENDESA	Spain	Both	3rd main op.	2nd main op.
IBERDROLA	Spain	Electricity		1st main op.
UNION FENOSA	Spain	Electricity		3rd main op.
GAS NATURAL SDG	Spain	Gas	1st main op.	
ENERGIAS DE PORTUGAL	Portugal	Both	2nd main op.	1st main op.
ENEL	Italy	Both	2nd main op.	1st main op.
ACEA	Italy	Electricity		2nd main op.
AEM	Italy	Both	4th main op.	3rd main op.
HERA	Italy	Both	3rd main op.	5th main op.
SCOTTISH & SOUTHERN ENERGY	UK	Both	Relevant op.	Relevant op.
UNITED UTILITIES	UK	Both		Relevant op.
EDF	France	Electricity		1st main op.
GAZ DE FRANCE	France	Gas	1st main op.	
E ON (XET)	Germany	Both	Relevant op.	Relevant op.
RWE (XET)	Germany	Both	Relevant op.	Relevant op.
EVN	Austria	Both	Relevant op.	Relevant op.
FORTUM CORT.	Finland	Electricity		1st main op.
PUBLIC POWER	Greece	Electricity		Single op.

TABLE 4.2 Peer group of utilities – Distribution (2007)

In the 2008 CNE methodology, the beta used was based on the steps aforementioned:

Step 1: This methodology took only European utilities belonging to the **Dow Jones STOXX Total Market Utilities Index**; this decision complied with the abovementioned advises regarding the number of data, the liquidity of the stock market and the similarity among their regulatory frameworks. As conclusion, some utilities were excluded due to the following reasons:

- Utilities not belonging to Europe –difference in their financial structures.
- Swiss utilities – difference in their regulatory frameworks as they are not affected by European Common Directives.
- Utilities from other regulated sectors – different from gas and electricity.
- Utilities with not relevant proportion of regulated activities in their business portfolio.

From the 41 utilities belonging to the index 17 were excluded in accordance to the criteria lately presented, resulting in the final "*Peer group of utilities*" of 24 valid utilities. These were later clustered into two groups: Transmission (Table 4.1) and Distribution (Table 4.2), according to their relevance in their main activity.

Step 2: Betas for each utility were computed through regression analysis based on the methodological aspects previously explained:

a. **Frequency**: Weekly observations.

Available and sufficient data were important factors taken into account. Additionally, Bloomberg – used as reference – used the same criterion.

b. **Horizon**: Two-year horizon.

Available and sufficient data were important factors taken into account; also, 2-year period was assumed to represent a stable financial structure. Again, Bloomberg – used as reference – used the same criterion.

c. **Period of study**: From 2000 to 2006

It was assumed that regulatory frameworks become homogenous since 2000. On the other side, complete and recent data was available until 2006 when the study took place.

d. **Reference market**: Dow Jones STOXX Total Market Utilities Index.

Explanation is found in the abovementioned *step 1*.

Results	**Transmission**	**Distribution**
Max	1,16	1,29
Min	-0,24	-0,06
Mean	0,47	0,54
Standard Deviation	0,34	0,30

TABLE 4.3 Statistical results of leveraged betas

Once this information was defined, a frequency histogram was built for each of both activities; outliers were found (negative and greater-than-one values) but they were kept in the sample. Statistical results are shown in Table 4.3. The mean of the sample can be proposed as the beta of each of the activities on the basis of the peer group of utilities employed; however, leveraged betas cannot be analysed conjointly since they are affected by their diverse level of leverage.

Step 3: Following the reasoning of the conclusion in the previous step, the values computed in step 2 are not conclusive due to their heterogeneous characteristics; therefore, unlevered betas should be calculated. In order to do so, **Equation 4.2** is applied for each of the utilities' leveraged betas found in step 2 taking into the account the following:

- The Debt and Equity parameters were obtained from market values.
  - *Debt*: Net debt.
  - *Equity*: Market capitalization.
- The Tax rate parameter was obtained from OECD's rates that applied for each country and in each year throughout the period 2000 to 2006; besides, local tributes and taxes were also added, if any. Table 4.4 shows the summary of the applicable taxes for each country and year.

As previously done, a frequency histogram – now using unleveraged betas coefficients – was built for both regulated activities; this time, outliers were found in less extend but they were still kept in the sample. Statistical results regarding the histogram are shown in Table 4.5.

Finally, it is possible to note that statistical results in Table 4.5 – corresponding to unleveraged betas – are lower than those results in Table 4.3, where leveraged betas were presented.

Country	2000	2001	2002	2003	2004	2005	2006
Germany	52,03	38,89	38,9	40,22	38,9	38,9	38,9
Austria	34	34	34	34	34	25	25
Spain	35	35	35	35	35	35	35
Finland	29	29	29	29	29	26	26
France	37,76	36,43	35,43	35,43	35,43	34,95	34,4
Greece	40	37,5	35	35	35	32	29
Italy	41,25	40,25	40,25	38,25	37,25	37,25	37,25
Portugal	35,2	35,2	33	33	27,5	27,5	27,5
UK	30	30	30	30	30	30	30

TABLE 4.4 Corporate tax rate applicable in each country during 2000 and 2006

Step 4: According to the methodology proposed by the (CNE, 2008), the mean of the sample observed in Table 4.5 is taken as the unleveraged beta of each of the regulated activities. Therefore, unleveraged betas for transmission and distribution activities are 0.35 and 0.41 respectively.

Results	Transmission	Distribution
Max	0,97	1,05
Min	-0,08	-0,05
Mean	0,35	0,41
Standard Deviation	0,28	0,24

TABLE 4.5 Statistical results of unleveraged betas

Step 5: Finally, it is important to recall that only leveraged betas can be used when computing the WACC. Then, unleveraged betas of the regulated activities were converted to re-leveraged betas by applying the **Equation 4.3**. Additional parameters such as an optimal leveraged ratio and an expected tax rate are required. The way to compute these parameters will be explained in section 4.1.3 and 4.1.4; these parameters also belong to the WACC formula (**Equation 2.1**).

- The optimal leveraged ratio – broadly calculated as the average of the Debt/Equity ratio of each activity list of the peer utilities – resulted in 0.39 for transmission and 0.37 for distribution.

- The expected tax rate corresponded to the Spanish corporate tax rate in force in 2008 (30%).

Results	Transmission	Distribution
Re-leveraged Beta	0,47	0,57

TABLE 4.6 Results of the re-leveraged betas

Table 4.6 shows the leveraged betas for both activities, which can be used directly in the WACC formula. It is worth to mention that an additional re-leveraged beta was computed using pure-transmission utilities. In other words, the *Peer group of utilities - Transmission* (see Table 4.1) was shrunk by keeping only the utilities which do not perform also distribution activities. The pure-transmission utilities were the following:

- REE
- ENAGAS
- SNAM RETE GAS
- TERNA
- NATIONAL GRID

The reason for this distinction was to establish the lower bound of the expected riskiness of the pure transmission companies without considering the complementary risks related to other activities; thus, no beta can be lower than this value since pure companies are assumed to be less risky than utilities performing combined activities. The value of the re-leveraged beta for the pure-transmission activity resulted in 0.41.

Finally, in order to validate the results obtained in the step 5 (see Table 4.6), three constraints must be fulfilled:

a) No beta from any regulated activity can be higher than 1 – since it is assumed that no regulated activity is riskier than the market itself.

b) Beta from the transmission activity cannot be lower than the lower bound set in 0.41 – obtained for the pure-transmission activity.

c) Beta from distribution activity cannot be lower than beta from transmission activity – since it is assumed that transmission activity is less risky than distribution activity, due to the regulatory framework that applied at the time.

As it can be observed, results from Table 4.6 complied with these three assumptions; therefore, betas for transmission and distribution were validated.

c) Market Risk Premium – MRP

The market Risk Premium can also be represented as the difference between the average expected return of the market and the risk-free rate (see **Equation 4.4**); however, the expected values are not directly observable.

$$E(MRP) = E(R_M) - R_f \qquad \textbf{4.4)}$$

Where:

- $E(MRP)$ – Expected Market Risk Premium
- $E(R_M)$ – Expected Market rate of return
- R_f – Risk-free rate

According to (CNE, 2008), there are three approaches to compute this value: 1) Price-Earnings Ratio method; 2) Expectation polls; and 3) Historical analysis. The former one among these options – Historical value – was selected since it is the most frequently used approach by regulators; therefore, it involves computing the MRP based on the statistical analysis of the market yield with regard to the free-risk rate.

Authors	Period	Reference countries	Recommended MRP
Bodie, Kane and Marcus (2003)	1926-2001		5,0% - 8,0%
Penman (2003)			6,00%
Fernández (2004)			4,00%
Bruner (2004)	1926-2000	USA	6,00%
Palepu, Healy and Bernard (2004)	1926-2002		7,00%
Weston, Mitchel & Mulherin (2004)	1926-2000		7,30%
Bolsa de Madrid (2004)	1980-2004	Spain	5,24%
Brealey and Myers (2005)			5,0% - 8,5%
Goedhart, Koller & Wessels (2005)	1903-2002	USA	3,5% - 4,5%
Ross, Westerfield y Jaffe (2005)	1926-2002	USA	8,40%
Arzac (2005)			5,08%
Demodaran (2006)	1928-2006	USA	6,57%
Dimson, Marsh y Staunton (2006) "Global Investment Returns Yearbook 2006"	1900-2005	South Africa, Germany, Australia, Belgium, Canada, Denmark, Spain, France, The Netherlands, Ireland, Italy, Japan, Norway, UK, Sweden, Switzerland, USA	6,08% * 3,98% **
Ibbotson Associates Inc. (2006)	1926-2005	USA	7,10%

** Using the arithmetic mean*

*** Using the geometric mean*

TABLE 4.7 Sources providing historical data to approximate the MRP

Some key conventions were proposed in this methodology in order to reduce the impact of the volatility and to get an average historical MRP value: a) selection of a long period of time, b) availability of the most recent values and c) use of historical data from several countries.

Therefore, from the vast spectrum of sources where historical data could be found in those years (see Table 4.7) the main reference selected was the report of Dimson, Marsh and Staunton (DMS)[27]. It is important to note that the period of time of this research is quite long – covering all years since 1900; also, one of the main reasons to use the DMS report as the main reference it is the fact that it is considered the most solvent source.

The next step is to select the countries to be used in the sample. In this case, only European countries were selected from the original 16-countries included in the DMS study (see Table 4.8)[28]. The idea behind this decision was to be coherent with the reference European market – STOXX Total Market Index – used in the estimation of the Beta.

The final step is to compare the result against other existing researches. However, the obtained result was validated and the Market Risk Premium (MRP) was set on 5.53 for the purposes of this study, corresponding to the average of the sample list.

Countries	MRP - Arithmetic mean of historical returns (%)	Standard Deviation of historical series (%)	Standard Deviation of Arithmetic mean (%)
Germany	8,35	22,41	2,67
Sweden	7,51	22,34	2,18
Italy	7,68	29,73	2,90
The Netherlands	5,95	21,63	2,11
United Kingdom	5,29	16,60	1,62
France	6,03	22,29	2,18
Ireland	5,18	18,37	1,79
Belgium	4,37	20,10	1,96
Spain	4,21	20,20	1,97
Denmark	3,27	16,18	1,58
Norway	5,26	27,43	2,68
Switzerland	3,28	17,5	1,71
Average of the sample	5,53	-	-

TABLE 4.8 MRP estimation for European countries (1900 - 2005)

[27] 2006 Global evidence on the risk premium
[28] Dimson, Marsh and Staunton, "Global Investment Returns Yearbook 2006" and (CNE, 2008)

4.1.2. Cost of debt

It refers to the return demanded by the lenders, and unlike the cost of equity, it can be easily taken directly from different sources proving the real financing cost for the companies. However, there is an issue that must be taken into account: most of the regulated utilities belong to larger corporations, and they hold businesses with different risk profiles; hence, their debt is generally centralized for the whole activities. This does not show the real cost of debt of the regulated business, although it provides for a method to estimate the cost of debt from market sources.

The selected methodology in the current study is based on peer utilities – as previously done when computing abovementioned parameters. **Equation 4.5** shows the basic principles of this approach: the cost of debt is the sum of a risk- free rate plus a risk premium.

$$R_D = R_f^* + DRP \qquad \textbf{4.5)}$$

Where:

- R_D – Cost of debt (nominal before taxes)
- R_f^* – Risk-free rate *(different from the cost of the equity)*
- DRP – Differential Risk Premium

The Risk-free rate (R_f^*) is computed through the mean of the last three months of the 10-Year Interest Rate Swap (IRS) of the euro. Again, taking into consideration the key decision introduced in previous sections: the 1) data was taken from market values; 2) the horizon selected was 10 years since this criterion matches with the medium-long term investor profile; and finally, 3) the reference asset was the interest rate swap of the euro (€) since it reflects the financing cost in the interbank market. The result in the numerical application of this methodology was 4.60%; the average can be computed from the data displayed in Figure 4.2.

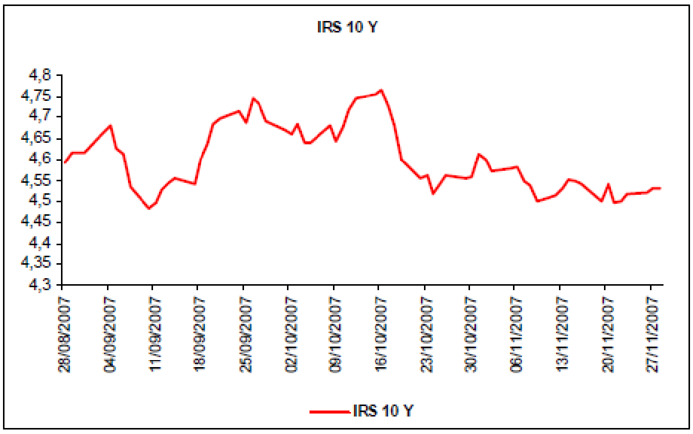


FIGURE 4.2 Average daily yield of the 10-year IRS of euro from 28/08/07 to 27/11/07

Transmission	CDS Spread	Credit ratings	
		S&P	Moody's
National Grid PLC SEN 10Y CDS - CDS PREM. MID	62,54	A-	A3
GAZ DE FRANCE SEN 10Y CDS - CDS PREM. MID	38,88	AA-	Aa1
E ON AG SEN 10Y CDS - CDS PREM. MID	45,33	A	A2
RWE AG SEN 10Y CDS - CDS PREM. MID	39,17	A+	A1
VERBUND OSTER ELIK AG SEN 10Y CDS - CDS PREM. MID	41,59	A	A1
Average spread	45,50		

TABLE 4.9 CDS average spread of the Peer group of utilities – Transmission

On the other hand, the DRP is computed through the mean of the last three months of the – available – 10-Year Credit Default Swaps (CDS) of the *Peer group of utilities* – both transmission and distribution – presented in the calculation of the beta, as long as their credit rating falls within the AA/A ranking. It is worth recalling that the CDS price reflects the hedging cost in case of default; therefore, it can be understood as a risk premium: the more creditworthiness a company has, the lower its CDS premium is – since the risk of default is lower. Additionally, CDSs refer to listed companies and they are traded every day.

As already mentioned, this methodology applies for the regulated network activities separately: transmission and distribution; the result in the numerical application of this methodology was 0.46 and 0.52, respectively. Results are shown in Table 4.9 and Table 4.10.

(Gandolfi, 2009) explains the advantages and drawbacks of applying this approach. Some *advantages* are: 1) the problem to sum a spread – with reinvestment risk and different periods (8 and 10 years) – to a non-reinvestment risk asset (like the 10-year strip bond) is avoided; and, 2) the CDS are products that are traded daily, independently if bonds are issued in the period of

Distribution	CDS Spread	Credit ratings	
		S&P	Moody's
ENDESA SA SEN 10Y CDS - CDS PREM. MID	73,15	-	A3
IBERDROLA SA SEN 10Y CDS - CDS PREM. MID	58,62	A	A2
GAS NATURAL SDG SA SEN 10Y CDS - CDS PREM. MID	40,22	A+	A2
ENERGIAS DE PORTUGAL SEN 10Y CDS - CDS PREM. MID	61,07	A-	A2
ENEL SPA SEN 10Y CDS - CDS PREM. MID	67,12	A	A1
SCOTTISH HYDROO PWR. DS. SEN 10Y CDS - CDS PREM. MII	36,33	A+	A1
UNITED UTILITIES PLC SEN 10Y CDS - CDS PREM. MID	61,93	A-	A3
GAZ DE FRANCE SEN 10Y CDS - CDS PREM. MID	38,88	AA-	Aa1
E ON AG SEN 10Y CDS - CDS PREM. MID	45,33	A	A2
RWE AG SEN 10Y CDS - CDS PREM. MID	39,17	A+	A1
FORTUM OYJ SEN 10Y CDS - CDS PREM. MID	51,86	A-	A2
Average spread	52,15		

TABLE 4.10 CDS average spread of the Peer group of utilities – Distribution

calculation. On the contrary, the *drawbacks* are more in line with the use of CDS, for example: 1) it might be the case that not all the utilities in the Peer group of utilities have CDS; and, 2) this market might be less liquid, so the real financing cost of the companies might be exaggerated.

Bearing this in mind, the total cost of debt (R_D) – expressed in nominal rate before tax – was found to be 5.06 for transmission and 5.12 for distribution. These values were gotten by adding the results from the risk-free rate – related to the IRS – and the differential risk premium – related to the CDS. It is important to note that the former term refers to both equally (T&D), while the latter makes a distinction between activities; therefore, 4.60 (IRS) plus 0.46 (CDS-Transmission) equals to 5.06; while 4.60 (IRS) plus 0.52 (CDS-Distribution) equals to 5.12.

4.1.3 Optimal Gearing Ratio

The gearing ratio refers to the capital structure of a company given the proportion of the money that belongs to the lenders (debt) and the money that belongs to the shareholders (equity). It affects both the cost of debt and the cost of equity.

On one hand, the cost of debt is affected since a higher level of debt, compared to the equity, implies a higher risk of bankruptcy; the reasoning behind this statement relies on the fact that the total interest increase while the interest coverage ratio decreases. Therefore, the creditworthiness of a company also decreases and the lenders demand a higher rate of return for their capital due to the higher risk they are exposed to.

On the other hand, (Gandolfi, 2009) states that a higher level of debt involves more profitability on account of the fiscal shield generated by the payment of interest. Therefore, the optimal gearing ratio is the point at which it is profitable to issue debt while the return increases. By finding the optimal gearing ratio, the WACC of the company is minimized.

Trying to define this parameter from an accepted way is not an easy task; nevertheless, it is important to note that the gearing ratio is entirely under the control of the company. Therefore since the companies have incentives to find the optimal ratio in order to reduce their WACC – and maximize their company value – it is usually assumed that companies always achieve their optimal gearing ratio.

Although it is possible to approximate the optimal gearing ratio by taking the observed gearing ratios of the companies, there is a strong chance that regulated companies belong to larger corporations (as indicated in Section 4.1.2); in this case, an analysis of peer utilities is highly recommended. Finally, (Gandolfi, 2009) recommends using market values over book values.

Results	Transmission	Distribution
Max	0,76	0,69
Min	-0,04	-0,04
Mean	0,39	0,37
Standard Deviation	0,18	0,16

TABLE 4.11 Statistical results of optimal gearing ratios

The methodology implemented by the (CNE, 2008) when computing the optimal gearing was based on the assumption that companies achieved the optimal gearing ratio; therefore, the optimal gearing ratio of the regulated activity may be approximated by the mean of the ratios of a Peer group of utilities. Some characteristics of the methodology are explained as follows:

- Same "Peer group of utilities" used in section 4.1.1 used for computing the beta.
    - Considering only utilities whose credit rating falls within the AA/A ranking.
    - European utilities with homogenous regulatory framework.
    - Grouped by activities: Transmission and Distribution.
- Period of the study: From 2000 to 2006.
- The Debt and Equity parameters were obtained from market values.
    - Debt: Net current debt
    - Equity: Market capitalization.

As part of the procedure, frequency histograms were built, for both of the activities, in order to get the statistical results from the Peer group of utilities within the selected period. Outliers were found (negative and values greater than 60%) but they were kept in the sample.

4.1.4 Tax rate

As introduced in section 2.4, the tax rate plays a key role when determining the WACC. There are two tax rates that can be used: 1) the corporate tax rate and the 2) effective tax rate. The first one is commonly used due to its simplicity and applicability in the tax shield. On the other hand, the second rate considers the specific situation of each company – including their tax deductions and other issues related. Additional arguments support the idea that effective tax rate should not be considered when computing the WACC since the tax gains accomplished by the utilities are the result of an efficient management. Therefore, the corporate tax rate – which applies for the whole companies in general – should be pursued.

Regarding the methodology proposed by the (CNE, 2008), a tax rate of 30% was used corresponding to the Spanish corporate tax rate in force in 2008. It is worth to point out that this parameter corresponds to the expected tax rate used when computing the beta in the section 4.1.1.

Chapter 5

Proposed Methodology

In order to come up with an orthodox methodology for the estimation of the allowed rate of return, the analysis of several factors must be borne in mind.

First, the regulatory precedents, both in the Spanish and European frameworks, will provide insights regarding the best practises that are being applied in the European network industries' regulation. Secondly, the existing regulation (see Section 3.2) might constraint the proposed methodology and the selection of its parameters; for instance, the allowed rate of return will be applied to transmission and distribution utilities regardless their size. The methodology shall consider a wider scope when identifying the suitable peer group of utilities. Moreover, historical and expected economic conditions will allow setting the right context where the allowed rate of return is going to be implemented. Finally, recommendations from experts will also be consulted in order to provide theoretical support from researches and studies.

This chapter is divided into three main sections:

Section 5.1 comprises a benchmarking analysis from different methodologies applied in different industries (Telecommunications) and other European countries; this section – along with the section 4.1) will contribute with important principles regarding the proposed methodology.

Section 5.2 describes the proposed methodology throughout the estimation of its parameters and the fundamentals behind those decisions.

Section 5.3 introduces a qualitative analysis regarding the criteria to take into consideration when applying this methodology to other regulated activities: smart-grid investments, renewable energy sources (RES), and generation at isolated systems (islands).

5.1 Benchmarking analysis

One of the main propositions of this thesis is related to a benchmarking analysis of other methodologies to approximate the allowed rate of return for regulated electricity network industries (throughout the estimation of the WACC). The criteria to perform this analysis were based on the following three principles:

1) According to previous experience: As earlier introduced, a methodology to compute the allowed rate of return for distribution utilities based on the WACC was used by (CNE, 2008); this experience shall be a key starting point for the current analysis.
2) According to regulator's jurisprudence: Methodologies to approximate the allowed rate of return by the CNMC in different sectors are preferred to be coherent among them. Hence, a benchmark analysis of the methodology applied in the telecommunication sector will also be a main feature at this stage.
3) According to regulation: The proposed allowed rate of return has to be equivalent to efficient and well-managed electricity utilities in Spain and the European Union (as previously explained in Chapter 1); therefore, this thesis aims to understand the methodologies that other European regulators use when estimating the WACC of electricity industries.

Regarding to the last principle, the first stage of the European benchmarking was carried out through the analysis of three European countries. Features taken into account when selecting the countries were the following: 1) countries belonging to the European Union and 2) to the Eurozone; additionally, the selection of 3) countries considered as peripheral economies was assumed to be a good approach to identify a suitable methodology for Spain; however, 4) AAA-economies could also provide a practical background, so it should be worth it to include one country from this group to the analysis. Finally, 5) credit rating was also considered since countries with lower rating than Spain should not be considered.

Table 5.1 shows the analysis applied to some European countries. On one hand, Portugal and Greece were dismissed since they did not comply with the credit-rating criterion; therefore, Ireland and Italy were the two countries selected from the peripheral economies group. On the other hand, it is important to note that only those AAA-rated countries were considered that where rated by all the rating agencies as AAA-economies; therefore, Austria and Finland were also dismissed from the analysis.

Finally, among the two remaining countries – Germany and the Netherlands - the latter one was chosen due to some similarities between the Spanish and the Dutch regulatory frameworks; specifically, the fact that the Netherlands applies "the same allowed rate of return to all investments, regardless of the type of assets or their age" (Glachant, et al., 2013) as Spain does.

Country	Rating			AAA economies	Peripheral economies	Eurozone (€)
	Moody's	S&P	Fitch			
Germany	Aaa	AAA	AAA	X		X
Netherlands	Aaa	AAA	AAA	X		X
Austria	Aaa	AA+	AA+			X
Finland	Aaa	AA+	AA+			X
Norway	Aaa	AAA	AAA	X		
Sweden	Aaa	AAA	AAA	X		
United Kingdom	Aa1	AAA	AA+			
Ireland	A3	A+	A		X	X
Spain	Baa2	BBB+	BBB+		X	X
Italy	Baa2	BBB-	BBB+		X	X
Portugal	Ba1	BB+	BB+		X	X
Greece	Caa3	B-	CCC		X	X

TABLE 5.1 Selection process applied for European countries

As a conclusion, the three countries selected to perform an analysis of their methodologies to estimate the WACC of the regulated electricity networks were Ireland, Italy and the Netherlands.

Furthermore, a supplementary analysis of European methodologies was conducted through a review of the Report of Investment Conditions in European Countries released by (CEER, 2016); nevertheless, only general information and simple explanations regarding the regulatory framework and the parameters involved of every country were found in this report. Hence, the proposed methodology and figures obtained will be compared against this report as a way of ensuring relevancy of the results at European level.

5.1.1 Telecom methodology

One of the key points of the proposed benchmarking relates to the analysis of the methodology used by the Telecommunication's regulator – a division of the CNMC. The approximation of the allowed rate of return of Spanish telecom utilities has been regularly performed through the estimation of WACC; however, regulation and common practices between these two sectors differs in major topics, so these differences need to be acknowledged beforehand.

First of all, the allowed rate of return in Telecom is estimated on a yearly basis and independently for each company; hence, the methodology is applied separately to each company and results are obtained individually (although there are some common parameters – risk free rate, beta, and leverage, among others – that are used for all the utilities indistinctively).

Two reports for the annual remuneration based on WACC for the year 2015 were analysed: 1) CELLNEX TELECOM S.A. (CNMC, 2015) and, 2) TELEFÓNICA DE ESPANA SAU, TELEFÓNICA MÓVILES DE ESPAÑA SAU, VODAFONE ESPAÑA SA, ORANGE ESPAGNE

SAU (CNMC, 2015). For the sake of example, only results of the first report will be shown within the following section. It is important to note that data available until December 2014 was taken into account.

General parameters of the WACC are explained down below:

a) Selection of a peer group with comparable utilities which allows approximating the leverage and the beta of the industry. This peer group was formed by 10 utilities from USA, India, Italy, France, UK, Indonesia, and Luxembourg. Two requirements must be fulfilled when building this group: the peer utilities have to perform similar activities and they must be listed in the stock markets. It is important to note that criteria regarding the region and the regulation do not constrain the decision when building up the peer group.
b) Leverage of the industry (D/E) was computed based on the average leverage of the peer group. Utilities with atypical information[29] were excluded from the exercise. Results in the first report were found as following: Leverage ratio[30]: 34.1%; Gearing ratio[31]: 25.5%.
c) The tax that was considered during this study refers to the nominal tax rate of Spain in 2014. This tax (30%) is used for different purposes in the WACC calculation. Additionally, nominal tax rates of the countries of the peer group were required at the levering process of beta.

The cost of equity was based on the CAPM model (see Section 4.1.1); therefore, parameters like risk free rate, re-levered beta and expected market premium were required.

a) The RFR was the average yield of the 10-year Spanish bond; in detail, the arithmetic mean of daily observations within the last 6 months[32]. This selection offers enough data for the statistical analysis (minimizing the estimation error) and it takes into account recent data. Outcome: 2.21%.
b) The market premium was taken from the median of seven designated sources based on their prestige and their periodic updating; these sources must have reference to Europe and to long-term investments; therefore, two sources out of the seven were excluded. Outcome: 6.85%
    1) Credit Suisse – DMS (Spain) – Long term (Bonds)[33]
    2) Surveys – Pablo Fernandez (Spain)[34]
    3) Mean of investment reports (Spain)[35]

[29] Atypical information refers to levering ratios outside the range (0-3).
[30] Net Debt / Equity
[31] Net Debt / (Net Debt + Equity)
[32] Until 31/December/ 2014
[33] Dimson, Marsh and Staunton: The Credit Suisse Global Investment Returns Sourcebook 2014
[34] Pablo Fernandez: Market Risk Premium used in 88 countries in 2014

4) Bloomberg – 8 years (Spain)[36]
5) Damodaran – S&P500 (Spain)[37]
6) Ibbotson Associates (not referenced to Europe) - EXCLUDED
7) Credit Suisse – DMS (Spain) – Short term (Bills) – EXCLUDED

c) The beta of the industry was based on the peer group abovementioned. Therefore, weekly raw betas of the peer utilities within the last 5 years based on their current equity indices – directly observed from Bloomberg – were transformed through a Bayesian adjustment[38]. Following, a process of deleveraging (outcome: 0.62) and re-leveraging (outcome: 0.77) of betas – according to the Modigliani – Miller formula – was carried out (see Section 4.1.1).

The cost of debt (before taxes) was obtained through the arithmetic mean of the yield-to-maturity of the observations within the last 6 months of debt issuances of the utilities concerned[39]; however, the following criteria must be fulfilled: they must be recent issuances, with a 10-year horizon (11 and 12 years were also considered) and they must have "significant" volume. Moreover, issuances linked to specific projects of unregulated activities were dismissed. (Outcomes: 2.09% - 4 debt issuances found).

Nevertheless, in the case where no "sufficient" debt issuances were found[40] – based on the abovementioned criteria – one of the following two approaches could be used: 1) average of the debt issuances of peer utilities provided that they have the same rating and they operate in an equivalent-rating country (Spain); or 2) the result given by the sum of the Interest Rate Swap (IRS) and the Credit Default Swap (CDS) of the company concerned (see Section 4.1.2).

Finally, WACC formula is applied bearing in mind the abovementioned parameters. The resulting WACC for the first report corresponds to the annual rate (pre-tax). Outcome: 8.50%.

As mentioned at the beginning of this section, a second report was analysed in order to corroborate the methodology just explained. Although the methodologies mostly resemble, two features are worthy to be noted: 1) this time, the peer group of utilities includes 15 utilities from Europe and Russia; 2) the cost of debt of each utility was applied differently to each company since it was based on the average of their own debt issuances.

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[35] Investment banks reports: S&P500, Goldman Sachs and KPMG.
[36] Bloomberg 2014 (2006-2014)
[37] A. Damodaran Equity Risk Premium (ERP): Determinants, Estimation and Implications – The 2013 Edition. Relative to S&P 500
[38] Marshall Blume formula, which transforms 1/3 of the values into 1; therefore, the beta is increased
[39] Debt issuances belonging to the whole corporate group
[40] It is not specified in the Resolution the criteria to understand "sufficient" debt issuances.

5.1.2 European benchmarking

As abovementioned, the European benchmarking was conducted in two phases. In the first one, a broad analysis of the Memorandum on Investment Conditions published by the (CEER, 2016) was executed; in this report, general ideas were understood regarding the methodologies and parameters used by many European countries; results of this analysis will be brought into discussion in Section 5.2. Secondly, a deep analysis of the relevant countries introduced at the beginning of Chapter 5 (Italy, Ireland and Netherlands) was carried out; results from this analysis are presented separately for each country in the following section.

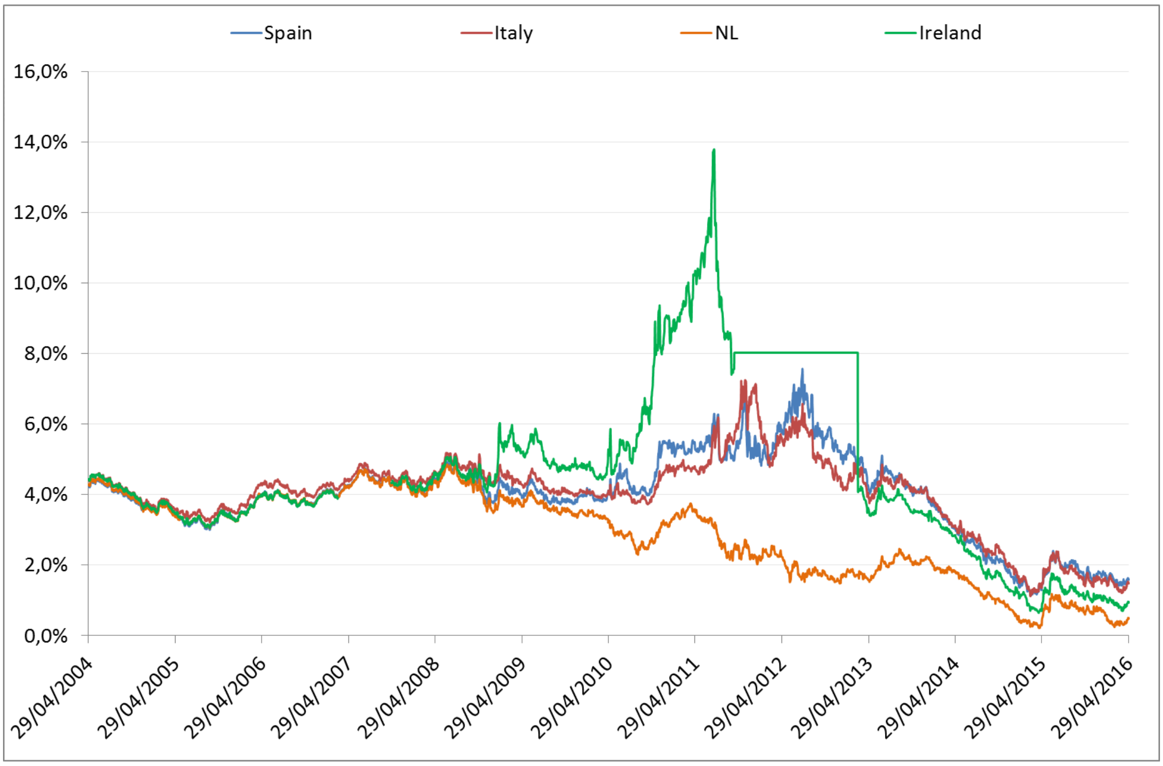

FIGURE 5.1 Nominal yields of the 10-Y government bonds of benchmarking countries, 2004-16

Italy

Italy[41] and Spain share interesting features regarding their economic and regulatory situations. On one hand, Italy is considered a peripheral economy which was affected by the economic and financial crisis of 2008; therefore, it has experienced in the last years – like Spain – unusual high yields and sovereign credit rating downgrades along with an increased market volatility. On the other hand, regulatory frameworks of both countries have some similarities among them; for instance, their remuneration methodology comprises a combination of models (cost plus and incentive-based)[42].

[41] The analysis of this methodology (2013) is based on (OXERA, 2015)
[42] http://www.ey.com/GL7/en/Industries/Power---Utilities/Mapping-power-and-utilities-regulation-in-Europe

For these reasons, it can be said that the methodology used by the Italian regulator (AEEGSI) is based on the following criteria: stability and reduction of risk for utilities and investors. Nonetheless, an interesting feature regarding this methodology includes the use of “triggers” – thresholds – and “re-openers” to activate changes in some parameters (based on easily observed statistics) if significant differences are observed. In other words, if the expected conditions variates, the regulator is able to change the parameters initially set; this gives flexibility to the regulator to adapt to the new observed conditions, but this might also involve a higher regulatory risk and uncertainty for utilities.

Some differences between the Italian and the Spanish regulatory frameworks are the following: First, the Italian methodology comprises a mid-period review of the WACC which helps to assess the methodology given the current conditions before the end of the regulatory period (6 years). Furthermore, the methodology entails an updating factor affecting only the Risk Free Rate every two years. Finally, real WACC is taken into account according to this methodology; it is obtained by deflating the nominal WACC with the expected inflation.

Key parameters used in this methodology will be described in the following points:

a) Peer group of comparable utilities is based on utilities with sufficiently high share of profits or revenues generated by the business line of interest. This group will be used to estimate the beta of industry.
b) The gearing ratio used in the Italian methodology (44.4%) is consistent with recognized financing structures in the industry. It is noteworthy that it is lower than the ratios observed in other European countries – where typical values range between 50% and 60%.

According to this methodology, the cost of equity must be decomposed in several parameters: Risk free rate (RFR), Country risk premium (CRP), Market risk premium (MRP) and Beta. Most of these parameters were already explained in the previous sections. However, the inclusion of a country risk premium (spread between Italian and AAA-countries values) would be needed in case the chosen risk free rate is referenced to government bond yields of other countries.

(OXERA, 2015) proposes the use of the Total Market Return (TMR=RFR + MRP) since there is more consensus among regulators regarding this value than its individual components; by doing this, greater stability is ensured. In this way, the selection of the Market risk premium – either backward-looking or forward-looking approach – needs to be consistent with the TMR.

Regarding the CRP, two approaches can be used: 1) spread between government bonds (Italian bond vs German bond), or 2) spread between corporate bonds (Italian utilities vs German utilities). Therefore, values of CRP are found between the range 0.5% and 1.0%.

The beta is estimated based on the peer group of utilities selected beforehand. Weekly observations are preferred over daily observations due to the assumption that estimations based on daily data might be biased downwards[43]; moreover, a 2-year period is chosen in order to balance the trade-off between statistical significance and using most recent data of the beta. Finally, the process of deleveraging and re-leveraging of betas – explained in previous sections – was implemented.

Added to that, the estimation of the cost of debt is proposed to be carried out throughout the analysis of debt issuances of Italian utilities; the objective is to identify typical issuance patterns that might capture any possible country risk premium in the cost of debt.

Finally, the Italian regulator recognizes the importance to take into account the different size of the utilities comprising the energy industry in Italy; according to this approach, the structure of the sector would be considered in the methodology (see Figure 3.4). Other sectors in Europe have already implemented a premium on the allowed rate of return for small companies (e.g. Water industry in UK). The reasoning behind this decision is the recognition of a larger cost of debt for small utilities, since they have more limited access to debt finance; therefore, it aims to discourage the merger and acquisition between large and small utilities. Nevertheless, there is no evidence that this approach has been used in the energy sector, so the Italian regulator choices not to include it in the Italian framework after considering it.

Ireland

Interesting features regarding the Irish methodology[44] can be highlighted. Like the Italian and Spanish situation, Ireland was affected by the economic crisis of 2008; it also suffered from a sovereign credit rate downgrading and its government 10-year bond reached really high yield levels (over 12% in 2011). However, among these three peripheral countries, Ireland currently enjoys a better credit rating position and a lower yield on its sovereign bond (see Figure 5.1).

The analysed methodology corresponds to the one applied by the Irish regulator (CER) for the regulatory period 2010-2015. It is important to note that Ireland – like Italy – performed a mid-term review which allows assessing the proposed methodology given the current conditions.

General WACC parameters are described below:

a) Analysis through relevant comparators (peer utilities) shall be used to estimate the beta of the sector. More specifically, listed companies performing equivalent activities and subject to similar regulation. The peer group was composed of 24 European utilities belonging primarily to the energy sector (gas and electricity); however, water utilities were also considered since the regulator recognizes the similarities among their regulation. The breakdown of utilities belonging to European countries was the following: UK (8), Italy

[43] Assumption that information takes more than one day to have an impact on the stock price
[44] The analysis of this methodology (2010) is based on (Europe Economics, 2015)

(4), Spain (3), Portugal (2), France (3) and Germany (3). It is noteworthy that companies performing other activities (e.g. generation, retail) were not excluded from the list.

b) The gearing ratio proposed the same value (55%) of previous periods since they did not find any reason to change it. Theoretically, the gearing ratio must be between 50% and 60% after analysing other jurisdictions and regulated sectors. Moreover, this value matches with the one proposed by the Irish utilities.

c) This methodology considers the nominal tax rate of Ireland in that year (12.5%). The same tax rate was proposed in the previous regulatory period, as it is the same proposed by the Irish utilities.

The cost of equity of the Irish methodology is founded on the CAPM model. This methodology proposes a range between 4.92% and 6.99%, with a point estimate of 5.81%. These figures were obtained based on the following parameters:

a) Concerning the RFR, the Irish methodology proposes *“a single Eurozone RFR based on the average real yields of 10-year German bonds for the period of 2000-2013 and 2000-2007 and UK regulatory precedent for 2011-2012”* (Europe Economics, 2015). This approach reflects the absence of currency exchange risk and the current high degree of capital integration within the Eurozone. Additionally, there is a converging downward trend on the sovereign bonds in the Eurozone. (Outcome: range between 1.75 and 2.1, midpoint at 1.9).

b) The MRP was obtained from the lower bound of the arithmetic mean of the Irish historical market returns published by DMS; however, these values were adjusted in order to reduce the impact of the high variations during the crisis period. (Outcome: range between 4.6 and 5.0).

c) The beta is computed using the peer group of utilities previously selected; however, this methodology proposed to estimate the regression directly rather than take values provided by other sources (e.g. Bloomberg). Daily observations were taken from 2-year periods. Furthermore, an important recommendation of this methodology is to dismiss the Bayesian adjustment proposed by many regulators since it is considered arbitrary and inappropriate. Finally, the levering process was performed, as already mentioned in previous methodologies. (Outcome: range between 0.69 and 0.98; midpoint 0.82).

The cost of debt is estimated as the risk free rate plus the debt premium. The latter parameter is calculated as the average spot spread between the yields of corporate bonds (debt issuances) against the yields of 10-year German government bonds. The criteria used for selecting the bonds were the following:

i. Bonds belonging to the utilities of the peer group.
ii. Bonds with a credit rating above BBB- / Baa3.
iii. Bonds denominated in euro (with the exception of UK bonds denominated in GBP).

iv. Bonds with a maturity ranging between 8 and 12 years.

v. Spreads are calculated based on their appropriate benchmark: European bonds against German government bonds, while UK bonds against UK Gilts.

Therefore, two results are highlighted. European bonds ranged between 90-126 bps, while Irish bonds ranged between 64-100 bps. Based on these two value ranges, the expected debt premium is found between 75-115 bps, with a point estimate of 100bps. Hence, the cost of debt resulted in 2.90% given the debt premium (1.0%) and the Eurozone risk free rate (1.9%). Furthermore, this methodology does not recommend the indexation of the cost of debt with respect to inflation. Reasons behind this suggestion could be found in (Europe Economics, 2015).

Finally, the WACC formula is applied bearing in mind the abovementioned parameters. On one hand, resulting WACC (pre-tax) ranges between 3.90% and 5.38%; however, focusing on the mid-point, the WACC is 4.58%. On the other hand, EirGrid and ESBN – two network Irish utilities – made a WACC proposition of 5.14% and 4.90% respectively.

It is worth mentioning that this methodology recognizes the principle of aiming up since it is assumed that the costs of underestimating the WACC are higher – in overall – than those of overestimating it; therefore, "choosing a value for the WACC that is above the regulator's expected value for the EACC has been standard practice for regulators for many years" (Europe Economics, 2015).

The Netherlands

In addition to the abovementioned similarities between the Dutch and the Spanish regulation, more related features are found in their remuneration schemes. For instance, the Dutch regulator uses the nominal pre-tax WACC when estimating the allowed rate of return[45]. However, the economic situation of the Netherlands varies considerably from the one experienced by the peripheral economies. Figure 5.1 shows the different realities among peripheral economies and safe heavens economies[46] based on the yields of their sovereign bonds. The analysis of this methodology[47] corresponds to the one used by the Dutch regulator (ACM) by estimating the WACC for the years 2011, 2012 and 2013 separately.

As previously done, general WACC parameters are described:

a) Analysis through peer utilities (peer group) is used to estimate the beta of the regulated activity and the appropriate gearing ratio of the industry. This methodology requires at least 10 peers performing pure network activities in the energy sector (gas and electricity) and having revenues above €100 million. The first attempt when building up the peer

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[45] http://www.ey.com/GL7/en/Industries/Power---Utilities/Mapping-power-and-utilities-regulation-in-Europe
[46] Countries with a credit rating AAA: Germany, Netherlands, Austria, Finland.
[47] The analysis of this methodology (2010) is based on (The Battle Group, 2014)

group only involves the inclusion of European firms, however – in the case that not enough pure-European firms are found – US firms could also be added. The breakdown of utilities by country is the following: Italy (2), Spain (2), Portugal (1), UK (1), Belgium (1) and US (3). Additionally, it is noteworthy that a liquidity test is carried out in order to identify those firm's shares with not sufficient trading activity[48].

b) The leverage and the gearing ratio are estimated based in the average of observed values from the peer utilities for each year. Data is obtained as following: Net debt is gotten from book values while the value of Equity is gotten from market values (market capitalisation). Outcome: Average level (by year) fall within the range 45%-50%. Finally, the gearing ratio was rounded to 50% rather than take the exact average gearing for the sector; the effect of this decision has an insignificant effect on the overall result (less than 0.05%). This figure complies with the criteria set by Moody's: "a gearing within the range of 45%-60% qualifies for an A rating"[49].

c) This methodology considers the Dutch corporate tax rate that applies to every year; in this case, the tax was the same for the three years (25.0%).

Like previous methodologies described, the cost of equity of this methodology is based on the CAPM model. Therefore, the main three parameters – RFR, Beta and MRP will be described as follows:

a) The RFR in this methodology is computed as the simple average yield of the 10-year German and Dutch government bonds for the last 3 years prior to the year concerned. It means that the estimated RFR of 2011 was the average from 2008 to 2010. By doing this, a trade-off between choosing a truly risk-free rate (German rate) and considering the extra information that Dutch bonds give about its country-risk is conceived. It is important to note that Germany and Netherlands have the same credit rating and they both could be considered as safe heaven economies; however, the German rate is even lower than the Dutch, as it has been more preferred by very risk-averse investors. Finally, the use of the three year trailing average reduces the effect of the falling interest rates. (Outcome: RFR 2013 is found 2.57%)

b) This methodology suggests the use of a "European Market Risk Premium" computed as the (simple and weighted) average between the mean of the geometric excess returns and the mean of the arithmetic excess return of Eurozone indices. It is stated that these indices are the correct reference point for measuring the systematic risks of the activity. The source of data is the yearly publication of DMS, since it is considered the best source of data on long-term excess return of stocks over bonds. Regarding the weighted average of the excess return of European indices, it is based on the market capitalisation of each country.

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[48] Sufficient trading activity refers to more than 90% trading days.

[49] Moody's Global Infrastructure Finance, "Regulated Electric and gas Networks", August 2009, p.20

Therefore, “the MRP of larger markets are given more weight, assuming that typical investors would have a larger share of their portfolio in countries with more investment opportunities” (The Battle Group, 2014). Finally, the Dividend Growth Models is dismissed as it is considered less reliable than the DMS data approach. (Outcome: 5% is selected for the three year periods).

c) Betas are estimated based on the peer group previously selected. A three year daily sampling of raw betas is collected from Bloomberg (based on a Eurozone index). Also, the levering process already mentioned in previous methodologies was performed. Two features are highlighted in this methodology: 1) the Bayesian adjustment is not carried on; 2) additionally statistical adjustments are performed (e.g. Dimson adjustment, Vasicek Correction, Adjustment for financial crisis, etc.). Finally, additional statistical tests and corrections were implemented: White’s test (heteroscedasticity)[50] and Durbin-Watson test (auto-correlation)[51]. However, corrections applied to solve these conditions did not have a significant impact on the results.

The cost of debt is estimated as the sum of RFR and the spread of A-rated utilities; such spread is obtained as the average spread of the debt of European A-rated[52] regulated network utilities (yields of debt bonds) over the RFR on the 3-year period – before the WACC is applied. Then, an additional premium (15 bps) is added by way of issuances fees and other non-interest costs of debt. (Outcome: Spread of utilities 2013 = 1.12%; Cost of debt 2013 = 3.84%).

Finally, the WACC formula is applied taking into consideration the abovementioned parameters; the nominal after-tax WACC applied to 2013 is 4.2%, while the Nominal pre-tax WACC in 2013 is 5.7%. Taking into account the expected inflation (2.2%) – computed as the average between the German and Dutch forecasts - the real pre-tax WACC is 3.3%.

[50] There is heteroscedasticity justified by the volatility around the heart of the crisis.
[51] Auto-correlation was found since it reflects the crisis and market volatility.
[52] According to the rating agency S&P

5.2 Estimation of WACC parameters

This section will be devoted to describe the procedure for the proposed methodology. It includes four main stages based on the procedure aforementioned in section 2.4 and section 4.1. The first stage starts with the definition of common features which will be used to estimate the parameters of the WACC, for instance: source of data, period of study, investment horizon and definition of the peer group of utilities. The second stage will describe two key parameters that are used in the estimation of following parameters: optimal gearing ratio and tax rate. Finally, last two sections will propose a computation for the cost of equity and cost of debt, respectively. It is important to note that general recommendation from financial experts were included in each section.

It is also important to recall that the aim of this thesis research is to propose a methodology to approximate the spread on the 10-year Spanish government bond, throughout the approximation of the WACC of the electricity network industry for the next regulatory period – starting in 2020. Therefore, two concerns must be considered:

1) This research aims to propose a methodology that will be replicated in 2018; so, numerical results derived from this study will not be conclusive since they would be obtained based on current data – up to April 2016. Hence, data within two years will be updated and only then, conclusive numerical results could be offered to be applied for the next regulatory period.

2) Based on the concern previously described and assuming that a conclusive numerical result for the next regulatory period should be defined now, the allowed rate of return – based on the average yield of the 10-year Spanish bond in the last 24 months – would be 1.80%[53] plus a spread. This spread will be calculated from the difference resulting between this average yield (1.80%) and the allowed rate of return based on the WACC of the industry (see Table 5.2).

Estimation of the spread	
Allowed rate of return based on WACC	WACC / (1-Tax)
Average yield of 10-year Spanish Bond	1.8%
Proposed spread	[WACC / (1-Tax)] - 1.8%

TABLE 5.2 Estimation of the spread to be added to the allowed rate of return

Finally, according to (Glachant, et al., 2013) “the economic studies aiming to assess the actual cost of capital of a TSO give a range of possible values; [therefore,] it is up to the regulator to decide if the regulated value should be closer to the lowest range values or to the highest range values”. Hence, numerical results from this research will be suggested thought ranges; however, a recommendation regarding the regulated value will also be provided.

[53] Value obtained from daily observations taken from 29/April/2014 to 29/April/2016

5.2.1 Key steps to identify the relevant features of the methodology

Step 1: Identifying a suitable Peer Group of utilities

The identification of a suitable peer group of utilities is critical when proposing a methodology to approximate the allowed rate of return of a given industry. The correct choice of peer utilities will enhance the relevance of the methodology for the desired purposes. It is important to remind that the utilities of the peer group should have a similar risk-profile – as explained in Section 4.1.1 – in order to correctly approximate the risk involved in the industry under research.

There are two main reasons explaining the necessity of a set of peer groups:

1. The quantity of electricity T&D utilities in a given country is not enough to carry out an exhaustive analysis (e.g. minimize the error of the analysis).
2. The methodologies to value the utilities, and therefore to value a given industry (e.g. T&D network industry in Spain) are based on market values. These market values are usually got from stock markets data; however; not all the utilities within a country are listed. Hence, the group of companies would not be sufficient to perform the required analysis.

Regarding the optimal number of utilities, (The Battle Group, 2014) argues that “there is a trade-off when determining the number of utilities in the peer group”. At first glance, it would be desirable to add as many utilities as possible to the peer group in order to reduce the statistical error in the estimate; however, as more peers are added, there is a risk to include non-related utilities to the group (e.g. different systematic risk).

On the other side, specific criteria must be defined beforehand regarding the characteristics of the utilities which are relevant for the study. The proposed criteria used for the selection of peer utilities are based on benchmarking of other European methodologies, the aforementioned methodology of (CNE, 2008) (see Chapter 4) and current concerns of the regulatory body. In general terms, the selected criteria emphasize the type of industry, the concerned regions and the relevant regulatory frameworks. These criteria will ensure the right choice of utilities in order to represent a similar systematic risk among utilities.

a. Relevant energy network industries: The proposed methodology recognizes the similarities between the electricity and the gas networks at European level, such as their natural monopoly condition and the requirement of large investment for fixed assets; hence, both sectors were taken into account in the selection of the peer utilities despite the fact their regulatory framework might be different among both industries, and these differences should be addressed at a later stage when setting the allowed rate of return. Conversely, utilities belonging to different network industries (e.g. telecommunications, water, sewage) shall be excluded from the list.
b. Relevant network activities: Contrary to the Spanish regulatory framework of previous regulatory periods, the current framework entails a methodology that does not make difference

between transmission and distribution activities. It is important to recall that these regulated network activities have a slightly different remuneration schemes among themselves (see Section 3.2); however, the allowed rate of return is a common feature that applies for both activities at the same extent (see Section 3.2.1). Therefore, the peer group list will include both T&D utilities, while utilities performing only other activities – generation, retail, trading – should be excluded.

c. Relevant regulated network undertakings: The firms composing the peer group list are required to comply with a relevant level of revenues originated from regulated activities. The reasoning behind this statement relies on the fact that utilities performing regulated undertakings are proved to have a lower systematic risk than unregulated ones. (Norton, 1985)

d. Relevant size of network utilities: Additionally, the current regulatory framework does not recognize any difference between large utilities and small utilities regarding the allowed rate of return. Therefore, the proposed methodology aims to include both types of utilities into the peer group, although lack of market data from small utilities might result in non-inclusion.

e. Relevant regulatory framework: Spanish regulation clearly states the financing costs of comparable well-managed T&D European companies should be taken into account[54]. Moreover, the risk-profile of network utilities is usually constrained by the regulatory framework in which they operate; therefore, peer utilities are required to operate in a similar regulatory framework as a mean of connection among them. The suggestion of this methodology entails the selection of peer utilities belonging to countries under the regulatory framework of the EU due to its relevancy and its enforcement in Spain. Additionally, it is assumed that EU members share a similar strategic vision regarding energy matters due to their interdependency among member states. For this reason, countries with different regulatory framework should not be considered into the peer group.

f. Relevant region: Spanish economy shares many similarities with Western European countries; hence, only this region will be considered in the selection of peer utilities. However, this methodology is intended to focus only on those countries with relevant size since investments on the electricity system are impacted by the total area where they are built; therefore, countries with smaller area to 20,000 km^2 should be not be included into the peer group.

g. Relevant economic situation: Utilities belonging to countries with an economic situation that roughly differs from the Spanish's should not be taken into account. The proposed measurement from this criterion is through countries' ratings. Then, countries with worse ratings than "BB- / Ba3" – depending on the scale – should be excluded from the peer group.

h. Relevant market data: As previously explained, market data are usually obtained from stock market sources (e.g. Bloomberg). However, data availability might also constraints the methodology. Therefore, utilities with insignificant market data should be excluded from the peer group.

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[54] Article 14 of Royal Decree 1047/2013

Index components - Utilities	Country	Official Website	Bloomberg (BUTP)
A2A SpA	Italy	X	X
ACEA SpA	Italy	X	X
AREVA SA	France	-	X
CENTRICA PLC	United Kingdom	X	X
CEZ AS	Czech Republic	X	X
DRAX GROUP PLC	United Kingdom	X	X
E.ON SE	Germany	X	X
EDF - Électricité de France SA	France	X	X
EDP - Energias de Portugal SA	Portugal	X	X
EDP RENOVAVEIS SA	Portugal	X	X
ELIA SYSTEM OPERATOR SA	Belgium	X	X
ENAGAS SA	Spain	X	X
ENDESA SA	Spain	X	X
ENEL GREEN POWER SpA	Italy	-	X
ENEL SpA	Italy	X	X
ENGIE SA	France	X	X
EVN AG	Austria	-	X
EYDAP SA	Greece	X	X
FORTUM OYJ	Finland	X	X
GAS NATURAL SDG SA	Spain	X	X
HERA SpA	Italy	X	X
IBERDROLA SA	Spain	X	X
IREN SpA	Italy	X	X
NATIONAL GRID PLC	United Kingdom	X	X
PENNON GROUP PLC	United Kingdom	X	X
PUBLIC POWER CORP	Greece	X	X
RED ELECTRICA CORP SA	Spain	X	X
REN - Redes Energéticas Nacionais	Portugal	X	-
RUBIS SCA	France	X	X
RWE AG	Germany	X	X
SEVERN TRENT PLC	United Kingdom	X	X
SNAM SpA	Italy	X	X
SSE PLC - Scottish & Southern Energy	United Kingdom	X	X
SUEZ ENVIRONNEMENT CO	France	X	X
TERNA ENERGY SA	Greece	X	X
TERNA SpA - Terna Rete Elettrica Nazionale	Italy	X	X
THESSALONIKI WATER SUPPLY & SEWAGE CO SA	Greece	-	X
UNITED UTILITIES GROUP PLC	United Kingdom	X	X
VEOLIA ENVIRONNEMENT SA	France	X	X
VERBUND AG	Austria	X	X

TABLE 5.3 Components of the STOXX® Europe TMI Utilities

As explained in section 4.1.1, it is recommended to include companies belonging to a given stock index since the use of market data – with enough liquidity – will be desirable; therefore, the main group proposed was the **STOXX® Europe TMI Utilities**.

This index is mostly composed by utilities from Western Europe (and Czech Republic) from different sectors; hence, not only energy utilities are included. Nevertheless, the composition of this index disagrees among its main two sources of information. On one side and according to its official webpage[55], the index is composed by 36 utilities[56]; on the other side, Bloomberg (code: BUTP) includes a total of 39 utilities, comprising only 35 utilities of the preceding official list. For the sake of convenience, both group lists were taken into account since the inclusion of additional utilities was considered beneficial for the research. Thus, the provisional list which corresponds to the index is composed of 40 utilities (see Table 5.3).

Moreover, the peer group of the proposed methodology was enriched by adding utilities that were not included in the abovementioned stock index but they might be relevant for the research. These supplementary utilities were obtained throughout a filtering data process in Bloomberg based on the **Product Segments of the utilities**; the process followed is down below:

EQS: Equity Screening function

> *Product Segments*: Utilities

> *Utilities Networks*: Electricity Distribution + Electricity Transmission + Gas Distribution + Gas Transmission and Storage

> *Latest FY Product Segment Revenue Percent:* Greater than or equal to 0.1

> *Country of domicile*: Western Europe (except: Andorra, Cyprus, Faeroe Island, Gibraltar, Guernsey, Isle of Man, Jersey, Liechtenstein, Luxembourg, Malta, Monaco, Reunion, San Marino, Svalbard and Jan Mayen Islands, Switzerland).

As it can be noted, the filters considered in this process are in line with the abovementioned conditions; for instance, unlike the excluded countries – Andorra, Malta, Cyprus, etc. – which do not comply with the size criterion, Switzerland was excluded due to its different regulatory framework in comparison with the one applying in the EU. On the other side, despite the fact that Norway is not a member state of the EU, it was kept in the provisional list since Norway is closely connected with the EU – and its directives – through its involvement in the EEA and EFTA[57].

Also, it is important to highlight that the size of the company was not considered as a criterion since the proposed methodology aims to include both large and small publicly traded utilities. Results from this process leaded to 36 utilities; list of these utilities is shown in Table 5.4.

[55] See: http://www.stoxx.com/index-details?symbol=BUTP
[56] As of date: 18/April/2016
[57] See: http://www.eu-norway.org

Product Segment - Utilities	Country	Sector
ABENGOA YIELD PL	Spain	Energy
ACEA SpA	Italy	Energy
ACSM - AGAM SpA	Italy	Energy
ANDES ENERGIA PL	United Kingdom	Energy
ASCOPIAVE SpA	Italy	Energy
COMPAGNIE PARISIENNE DE CHAUFFAGE	France	Steam
EDF - Électricité de France SA	France	Energy
EDP - Energias de Portugal SA	Portugal	Energy
ELECTRICITÉ DE STRASBOURG	France	Energy
ELIA SYSTEM OPERATOR SA	Belgium	Energy
ELVERKET VALLENTUNA AB	Sweden	Energy
ENAGAS SA	Spain	Energy
ENDESA SA	Spain	Energy
ENEL SpA	Italy	Energy
EYDAP SA	Greece	Water
FINTEL ENERGIA GROUP	Italy	Energy
FLUXYS BELGIUM	Belgium	Energy
GALA SpA	Italy	Energy
GAS NATURAL SDG SA	Spain	Energy
GAS PLUS	Italy	Energy
GELSENWASSER AG	Germany	Water
HAFSLUND ASA SHS	Norway	Energy
HERA SpA	Italy	Energy
IREN SpA	Italy	Energy
JERSEY ELECTRICITY	United Kingdom	Energy
LECHWERKE AG	Germany	Energy
LUXFER HOLDINGS	United Kingdom	Equipment
MAINOVA AG	Germany	Energy
NATIONAL GRID PLC	United Kingdom	Energy
PUBLIC POWER CORP	Greece	Energy
RED ELECTRICA CORP SA	Spain	Energy
REN - Redes Energéticas Nacionais	Portugal	Energy
SNAM SpA	Italy	Energy
SSE PLC - Scottish & Southern Energy	United Kingdom	Energy
TERNA SpA - Terna Rete Elettrica Nazionale	Italy	Energy
VERBUND AG	Austria	Energy

TABLE 5.4 Product Segment – Utilities (Bloomberg)

Finally, the proposed methodology also targeted to enlarge the provisional list of peer utilities by adding relevant Spanish small distribution utilities in order to properly represent this cluster of utilities in the peer group (see Table 5.5). The selection of the relevant small utilities was based on their relative importance – according to their total regulated revenues – within the cluster they belong to (electricity or gas sectors). Nevertheless, these utilities did not offer relevant market data – although some of them could be found in Bloomberg; consequently, they were not included in the provisional list of peer utilities.

Distribution utility	Country	Sector
VIESGO DISTRIBUCIÓN ELECTRICA SI	Spain	Electricity
BEGASA	Spain	Electricity
SUMINISTRADORA ELÉCTRICA DE CADIZ SA	Spain	Electricity
ESTABANELL I PAHISSA	Spain	Electricity
REDEXIS GAS	Spain	Gas
MADRILEÑA RED DE GAS	Spain	Gas

TABLE 5.5 Spanish small utilities – Electricity and Gas

Up to this point, it is possible to identify 3 groups of utilities – Table 5.3, Table 5.4 and Table 5.5 – with a total of 63 peer utilities (aka Provisional peer group); it is important to note that there are utilities belonging to both Table 5.3 and Table 5.4.

Next step consisted in the evaluation of each utility in order to determine their fulfilment with the abovementioned criteria (subparagraphs a. to h.); utilities complying with the totality of such criteria remained in the Final peer group; on the contrary, any utility failing any criterion was removed from the list. Table 5.7 shows the list of utilities that were excluded from the final list of peer group and the reason of such exclusion (based on the subparagraphs).

Two conclusions might be roughly drawn from this process: 1) Greece was the only country – from the Provisional peer group of utilities – which did not comply with the criterion "g. Relevant economic situation" since its credit rating was below the threshold proposed (see Table 5.6); and, 2) there are utilities which failed with more than one criterion (e.g. TERNA ENERGY SA).

Country	Moody's	S&P	Fitch
Austria	Aaa	AA+	AA+
Belgium	Aa3	AA	AA
Finland	Aaa	AA+	AA+
France	Aa2	AA	AA
Germany	Aaa	AAA	AAA
Greece	Caa3	B-	CCC
Italy	Baa2	BBB-	BBB+
Norway	Aaa	AAA	AAA
Portugal	Ba1	BB+	BB+
Spain	Baa2	BBB+	BBB+
Sweden	Aaa	AAA	AAA
United Kingdom	Aa1	AAA	AA+

TABLE 5.6 Countries' ratings – Provisional peer group

Peer utility	Country	Reason of exclusion
ABENGOA YIELD PL	Spain	b. No regulated network activity
ANDES ENERGIA PL	United Kingdom	e. No relevant activity within the region
AREVA SA	France	b. No regulated network activity
BEGASA	Spain	h. No relevant market data
CENTRICA PLC	United Kingdom	b. No regulated network activity
CEZ AS	Czech Republic	e. No relevant activity within the region
COMPAGNIE PARISIENNE DE CHAUFFAGE	France	b. No regulated network activity h. No relevant market data
DRAX GROUP PLC	United Kingdom	b. No regulated network activity
EDP RENOVAVEIS SA	Portugal	b. No regulated network activity
ELECTRICITÉ DE STRASBOURG	France	a. No energy industry b. No regulated network activity
ENEL GREEN POWER SpA	Italy	b. No regulated network activity
ESTABANELL I PAHISSA	Spain	h. No relevant market data
EYDAP SA	Greece	a. No energy industry g. Country with low rating profile
FINTEL ENERGIA GROUP	Italy	h. No relevant market data
FORTUM OYJ	Finland	b. No regulated network activity
GALA SpA	Italy	b. No regulated network activity
GELSENWASSER AG	Germany	a. No energy industry
JERSEY ELECTRICITY	United Kingdom	h. No relevant market data e. No relevant activity within the region
LUXFER HOLDINGS	United Kingdom	a. No energy industry
MADRILEÑA RED DE GAS	Spain	h. No relevant market data
MAINOVA AG	Germany	h. No relevant market data
PENNON GROUP PLC	United Kingdom	a. No energy industry
PUBLIC POWER CORP	Greece	g. Country with low rating profile
REDEXIS GAS	Spain	h. No relevant market data
RUBIS SCA	France	b. No regulated network activity
SEVERN TRENT PLC	United Kingdom	a. No energy industry
SUEZ ENVIRONNEMENT CO	France	a. No energy industry
SUMINISTRADORA ELÉCTRICA DE CADIZ SA	Spain	h. No relevant market data
TERNA ENERGY SA	Greece	b. No regulated network activity g. Country with low rating profile
THESSALONIKI WATER SUPPLY & SEWAGE CO SA	Greece	a. No energy industry g. Country with low rating profile
UNITED UTILITIES GROUP PLC	United Kingdom	a. No energy industry
VEOLIA ENVIRONNEMENT SA	France	a. No energy industry
VIESGO DISTRIBUCIÓN ELECTRICA SI	Spain	h. No relevant market data

TABLE 5.7 Utilities excluded from the Final peer group of utilities

As a result of the previous analysis, the Final peer group was obtained resulting in a total of 30 utilities (see Table 5.8). It is noteworthy that most of the peer utilities belong to either one of the two main European energy groups of utilities – ENTSO [58] or EDSO for smart grids, which suggests the relevancy of these utilities in the European framework. Moreover, the country which contributes with more utilities to the final list is Italy (10 utilities), followed by Spain (5 utilities) and Germany (3 utilities). Lastly, it is remarkable that 17 out of the 30 utilities belong to the so-called "Southern peripheral economies"[59] in the Eurozone (Spain, Portugal, and Italy); then, it can be concluded that the proposed methodology leads to a Final peer group of utilities which is a good proxy to the current Spanish economic situation.

Utility	Country	ENTSO / EDSO
A2A SpA	Italy	-
ACEA SpA	Italy	-
ACSM - AGAM SpA	Italy	-
ASCOPIAVE SpA	Italy	-
E.ON SE	Germany	EDSO
EDF - Électricité de France SA	France	ENTSO
EDP - Energias de Portugal SA	Portugal	EDSO
ELIA SYSTEM OPERATOR SA	Belgium	ENTSO
ELVERKET VALLENTUNA AB	Sweden	-
ENAGAS SA	Spain	ENTSO
ENDESA SA	Spain	EDSO
ENEL SpA	Italy	EDSO
ENGIE SA	France	-
EVN AG	Austria	EDSO
FLUXYS BELGIUM	Belgium	ENTSO
GAS NATURAL SDG SA	Spain	EDSO
GAS PLUS	Italy	-
HAFSLUND ASA SHS	Norway	-
HERA SpA	Italy	-
IBERDROLA SA	Spain	Both
IREN SpA	Italy	-
LECHWERKE AG	Germany	-
NATIONAL GRID PLC	Great Britain	ENTSO
RED ELECTRICA CORP SA	Spain	ENTSO
REN - Redes Energéticas Nacionais	Portugal	ENTSO
RWE AG	Germany	EDSO
SNAM SpA	Italy	ENTSO
SSE PLC - Scottish & Southern Energy	Great Britain	ENTSO
TERNA SpA - Terna Rete Elettrica Nazionale	Italy	ENTSO
VERBUND AG	Austria	ENTSO

TABLE 5.8 Final peer group of utilities

[58] For the sake of simplicity, the term "ENTSO" is used indifferently for both ENTSO-e and ENTSO-g
[59] See: http://www.cnbc.com/2014/10/21/are-these-countries-the-new-pheriphery-in-europe.html

Utility	Country	ENTSO
ELIA SYSTEM OPERATOR SA	Belgium	X
ENAGAS SA	Spain	X
FLUXYS BELGIUM	Belgium	X
NATIONAL GRID PLC	Great Britain	X
RED ELECTRICA CORP SA	Spain	X
REN - Redes Energéticas Nacionais	Portugal	X
SNAM SpA	Italy	X
TERNA SpA - Terna Rete Elettrica Nazionale	Italy	X

TABLE 5.9 Final peer group of pure utilities

Apart from the aforementioned analysis, the proposed methodology conceived a supplementary analysis based on a peer group composed by utilities performing only energy regulated activities (also known as "Pure utilities"). Taking the Table 5.8 as base, only pure utilities were kept in order to build the Final peer group of pure utilities (see Table 5.9).

A total of 8 utilities were found performing only-regulated activities in either energy sector (gas or electricity). The selection procedure involved an exhaustive and complete analysis of all utilities included in the Final peer group of utilities; hence, utilities carrying out liberalised activities (generation, retailing, wholesale, etc.) were excluded from this complementary peer group. It is important to highlight that all the pure-utilities (5 utilities) proposed in the CNE's methodology (see Section 4.1) are found within this proposed list.

The purpose of this supplementary analysis is justified by the necessity to obtain further results based on utilities with a more-homologous and conservative risk profiles; in other words, utilities that are not affected by the inclusion of liberalised activities – which normally involve a higher risk – within their financing needs.

Results from this supplementary analysis shall be expected to suggest a lower allowed rate of return than results obtained from the main analysis (Final peer group of utilities - 30 utilities); this is supported by the fact that pure utilities have lower risk than non-pure utilities; however, it is worthy to mention that results from this supplementary analysis will only be regarded as – floor – reference values as they will not be used to approximate the spread of the allowed rate of return. The reasoning behind this decision is due to the fact that relevant utilities in the Spanish framework (see Section 3.1) –Iberdrola, Endesa, and Gas Natural – are not included in this supplementary list.

Step 2: Identifying the relevant periods of study

As introduced in section 4.4.1, the period of study refers to the term used when getting the observations; therefore, the selection of this parameter influences the result of the overall research since important assumptions must be defined during this stage.

One of the important concerns when defining the period of study is related to the purpose of the methodology itself. In this particular case, it is important to recall that the proposed methodology will allow estimating the spread of the allowed rate of return for the regulated network activities of the regulatory period from 2020 to 2025 (6 years); furthermore, it must not be forgotten that, based on the principle of *stability* (see Section 2.2) and the Spanish regulatory framework (see Section 3.2.1), the regulated allowed rate will remain constant during the entire regulatory period. Therefore, the proposed period of study for the methodology has to be aligned with the period of application of the allowed rate of return.

Generally speaking, the period of study may range from minutes (data in real time) to centuries (very long-term). As mentioned in previous chapters, a shorter period of time involves the assumption that current market conditions will prevail for the next years (e.g. constant volatility), while longer periods of time assumes different market conditions (e.g. smoothed volatility) for the expected future.

Although some financial experts (e.g. Bloomberg) use real time data when computing the WACC of equities – since their goal is to estimate the most-recent value of the underlying parameter, regulatory agencies are keen to use longer periods of time (months, years) based on their specific purposes (e.g. estimate the allowed rate of return of a given period).

On the other hand, the period of study is related to the frequency of data retrieval (see Section 5.2.1: Step 3) since the number of observations depends upon these two elements; however, assuming that most of the parameters will be based on a frequency of daily[60] or weekly basis, it can be concluded that any period of study has enough data to perform an unbiased analysis (see Table 5.10).

		Frequency			
		Daily	Weekly	Monthly	Yearly
Period of study	1 year	260	52	12	1
	3 years	780	156	36	3
	6 years	1560	312	72	6
	12 years	3120	624	144	12

TABLE 5.10 Expected number of observations (per utility) in different timeframes

[60] Daily basis comprises only business days; thus, there are 5 business days within a week, and 260 business days within a year.

			Overview	GDP growth rate (%)			
				Mean	Max	Min	Spread
Period of study	1 year	2015-2016	Medium stability	0,85	1,0	0,8	0,2
	3 years	2013-2016	Recovery trend	0,55	1,0	-0,3	1,3
	6 years	2010-2016	Downwards - Upwards	0,01	1,0	-1,0	2,0
	12 years	2004-2016	High stability - Crisis - Recovery	0,20	1,1	-1,6	2,7

TABLE 5.11 Analysis of the proposed study periods

Moreover, the availability and completeness of data[61] also constraints the selection of the period of study given that insufficient data might jeopardize the analysis and lead to statistical errors. This conclusion was obtained by experience while conducting this research (See: Appendix B).

Finally, an important remark must be recognized: coherency shall be pursued when proposing an orthodox methodology; hence, the use of a period of study must remain constant throughout the whole analysis and it should be applied to most of the parameters involved in the methodology.

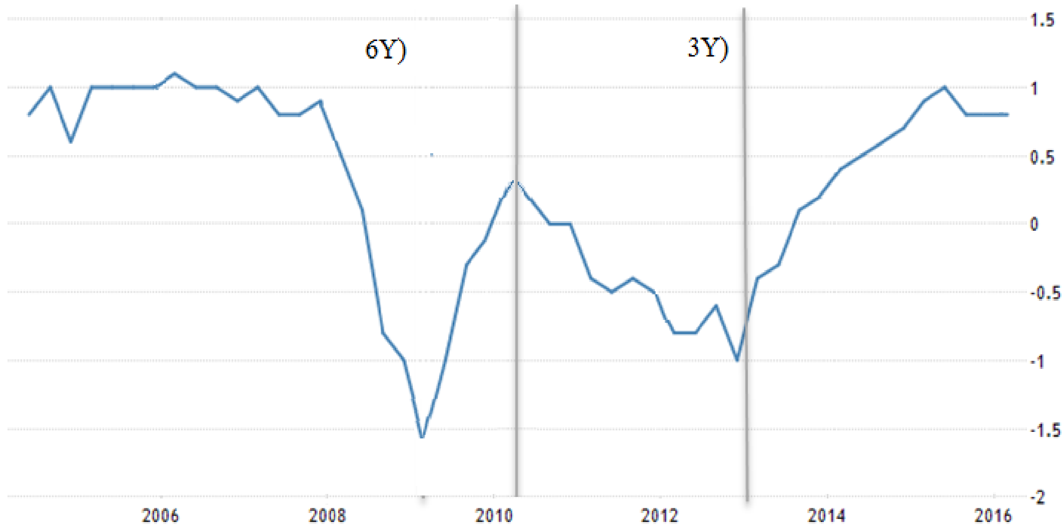
That said, concerning the proposed methodology, four periods of study were analysed in terms of annualized GDP growth rate. Table 5.11 summarizes the periods of study chosen along with a general overview regarding the Spanish economic situation[62] of each timeframe. By doing this, it is possible to compare each of these scenarios against the expected markets conditions for the next regulatory period in order to identify the most suitable period(s) of study to be used in the methodology.

It is also important to highlight that the proposed methodology suggest a reporting date up to the last business day of April of the present year; consequently, all data until 29/April/2016 were considered in this research. Periods of time were also adapted to this date; for instance, a 1-year period included data from 29/April/2015 to 29/April/2016.

Inferences regarding the data of each period can be drawn. For example, the 6-year period gives the impression to be the one with the worst economic performance (lowest GDP growth rate mean); however, it also suggests being the most prudent scenario since it considers both downwards and upwards trends.

On the other side, 1-year period shows a more stable environment (lowest spread between maximum and minimum observation); this can be explained since no downturns in the economy are found within this period (see Figure 5.2) [63]. Nevertheless, this period of study seems to suggest an extremely positive scenario – assuming constant stability and no negative economic growth – for the upcoming years (next regulatory period), with some of the parameters that take part in the WACC formula at their lowest levels of the past 10 years.

[61] Source of data: Bloomberg
[62] Data taken from Figure 5.2
[63] http://es.tradingeconomics.com/spain/gdp-growth



Source: Trading economics

FIGURE 5.2 GDP growth rate (%) in Spain (2004-2016)

With this in mind, two periods of study ended up being irrelevant for the proposed methodology:

1. 12-year period has incomplete data for the most relevant parameters of the methodology (see Appendix B); therefore, assuming that missing data of this period might lead to errors in the estimation, it is not recommended to use this period of study for the purposes of this methodology.
2. 1-year period shows an optimistic scenario in which nowadays economic conditions are kept forward; additionally, it is not well linked with the 6-year period of application of the allowed rate of return (the purpose of this methodology). For these reasons, this period should be dismissed from the analysis.

Hence, 3-year period and 6-year period are proposed as relevant periods to be analysed, supported by the fact that their relationship with the period of application of the allowed rate of return (2020-2025) is directly observable. 6-year period matches the duration of the next regulatory period (6 years), while 3-year period correspond to half of it. After numerical analysis (see Chapter 6), a conclusive proposal between these two study periods might be given.

Finally, it is recalled that the abovementioned economic conditions correspond to the periods of study based on a hypothetical analysis conducted in 2016; however, the real purpose of the research stems the fact that this methodology shall be replicated in 2018 (when setting the rate of return for the next regulatory period); by that moment, the economic conditions of each period will have changed (e.g. year 2004 will be no longer relevant).

Step 3: Identifying the relevant frequency of observations

As introduced in Section 4.1.1, the frequency of observations refers to the regularity that observations are taken within the period of study selected. Therefore, a highly frequency (daily data) comprises more observations which enhance the statistical analysis; however, the availability of data might be a problem.

As indicated in previous section, there is a strong relationship between the period of study and the frequency of observations (see Table 5.10). However, since the proposed periods of study have been already designated (3-year period and 6-year period), the selection of the frequency turns to be a simple task.

On the other side, the proposed frequency does also depend on the nature of the parameters; in other words, not all parameters have relevant daily data. For instance, the data regarding the gearing ratio of a given utility is relevant only on a quarterly basis since information regarding utilities' debt is updated every 3 months (according to Bloomberg's practices). Consequently, there is no reason to consider a frequency on a daily basis in this parameter since the same observation will be found every 90 days. Table 5.12 displays the relevant frequencies of some parameters.

Regarding the proposed methodology, four different frequencies were analysed; they can be inferred from Table 5.10: Daily, Weekly, Monthly and Yearly. The proposed methodology suggests the exclusion of Yearly frequencies based on the few observations that can be retrieved. However, for some parameters – mainly those related to book values – the use of yearly data would be required, in order to ensure the availability of audited data.

Lastly, researches about this topic supports the use of weekly frequencies as an appropriate feature for most of the WACC parameters; for example, (The Battle Group, 2014) argues that "using weekly returns to calculate the beta mitigates the problem of not correlation between firm's value and the market; since it is more likely that firm's shares will be traded in the week. However, using weekly returns have other disadvantages, such as providing fewer 80% less data point over any given period".

Parameters	Relevant frequency
Gearing ratio	Quarterly
Sovereign Bonds	Daily
IRS	Daily
Betas	Daily
CDS	Daily
Utilities Bonds	Issue date
Debt records (Book values)	Yearly

TABLE 5.12 Relevant frequencies based on the nature of the parameters

Step 4: Identifying the relevant horizon

Based on the three approaches introduced in Section 4.1.1, the investor horizon (medium-long term) is proposed for the methodology. Hence, market instruments with a maturity around 8-12 years will be preferred over the rest; specifically, instruments with horizon of 10-year will be primarily sought.

The reasons that justify this decision are explained as following: 1) 10-year horizon is related with the expected horizon of medium-long term investors (e.g. investors of network industries); 2) the use of this horizon is a common practise among European regulators; 3) market liquidity of instruments with this horizon is appropriate enough in order to reflect the right market value of the financial instruments (Gandolfi, 2009); and 4) this horizon is in line with the methodology to estimate the allowed rate of return according to the Spanish regulation (see Section 1.2). Table 5.13 shows the relevant horizon for some market instruments – according to investor's horizon – that will be later introduced.

Instrument	Relevant horizon
CDS - Credit Default Swaps	10 years
Utilities' Bonds	8-12 years
Sovereign Bonds	10 years
ISR - Interest Swap Rate	10 years

TABLE 5.13 Relevant horizons of some market instruments

Step 5: Identifying the relevant source of information

In order to be coherent with the methodologies previously analysed, the market values shall be preferable over book values. Additionally, as it can be inferred from previous sections, the use of Bloomberg – as the main source of data – will be a key feature of the present research.

Most of the regulators and financial analysts select Bloomberg over other sources due to its expertise regarding up-to-date market data around the world and useful financial and economic analysis functions (e.g. financial models, forecasts, etc.); in addition to this, book value data can be found from a vast universe of utilities worldwide.

Finally, data available from public sources was also used in order to include information that Bloomberg might not include (e.g. financial reports of non-listed utilities).

5.2.2 Defining the general parameters

Optimal gearing ratio

The optimal gearing ratio is a key parameter to define beforehand since it will be directly applied in the levering process of beta. Additionally, regulator's objective is related to the estimation of the capital structure for an efficiently financed company since a right balance between tax benefits of higher debt and the potential financial costs associated with higher debt should be found.

There are several sources of evidence regarding the optimal gearing ratio for a company; one approach could be the assumption that companies optimize their level of debt since they are first interested to do so. On the other hand, (OXERA, 2015) argues that the observed gearing ratio does not necessarily represent the optimal ratio to be achieved; therefore, regulatory precedents must be borne in mind, or guidance from credit agencies must be preferred.

The proposed methodology aims to find a consensus between both approaches.

First, the observed gearing ratios for the peer group of utilities were estimated. Data were obtained from market values, taking into account that the market capitalisation represents the equity of the company, while the Net Debt is computed as the difference of Total Debt minus Cash and Cash equivalents. Gearing ratio refers to the proportion of the Net Debt over the Net Debt plus Market capitalisation; therefore, a gearing ratio for each peer utility was found. However, atypical values were detected (e.g. negative ratios) so the "two standard deviation approach"[64] was applied in order to remove those outliers; finally, the average of the remaining ratios was obtained (see **Equation 5.1**).

$$\frac{\sum_{\forall\, ut} \frac{Net\ debt_{ut}}{Net\ debt_{ut} + Market\ cap_{ut}}}{\#\, utilities} \qquad \mathbf{5.1})$$

It is important to highlight that this formulation implies the same weight to all the peers; however, an alternative method was also explored. **Equation 5.2** recognizes the different weights of all the utilities; therefore, data of small utilities does not have a significant impact on the overall result.

$$\frac{\sum_{\forall\, ut} Net\ debt_{ut}}{\sum_{\forall\, ut} Net\ debt_{ut} + Market\ cap_{ut}} \qquad \mathbf{5.2})$$

Finally, these two formulations were also performed for the peer group of pure utilities; as formerly explained, these values will be only regarded as reference values. It is important to remind that this methodology will provide results for the three relevant periods of study (see Section 5.2.1)

[64] Utilities with values above or below two standard deviations were removed

Observed gearing ratios				
	Peer utilities		Pure-peer utilities	
	Equation 1	Equation 2	Equation 1	Equation 2
1 year	45%	47%	47%	44%
3 years	47%	48%	48%	46%
6 years	49%	50%	51%	48%
12 years	Not relevant			

TABLE 5.14 Results of observed gearing ratios of peer group of utilities

Results from aforementioned developments are shown in Table 5.14. It can be observed that differences between **Equation 1** and **Equation 2** are really insignificant (less than 5% of variation) in both groups. It can be concluded that the optimal gearing ratio of peer utilities ranges between 45% and 50%, being the 6-year period the one with higher ratios.

On a final step, the observed range (45%-50%) was compared against the European regulatory precedents[65] (see Table 5.15). As it can be noted, the observed values are lower than those used by most of European regulators (55%-60%). Therefore and for the sake of coherency with the European standards, the proposed methodology suggests going for the upper value of the observed range (50%) in all the cases.

Finally, this decision is supported by the methodology proposed by the Netherlands (see Section 5.1.2) which decided not to take the exact observed value, but rather selected the upper value from its range; results showed that the effect of such decision was insignificant on the overall outcome.

Regulatory precedents

Country	Gearing ratio	Year	Regulatory period
Austria	60%	2012	5
Germany	60%	2011	5
Finland	60%	2012	4
NL	55%	2010	3
Ireland	55%	2010	5
Italy	44%	2012	4
Portugal	55%	2015	-

Source: CEER

TABLE 5.15 Gearing ratios used by the European regulators - CEER

[65] Based on (CEER, 2016)

Tax rate

Section 4.1.4 introduces the alternatives that can be used when selecting the tax rate to be applied in the WACC methodologies: 1) Effective tax rate (observed values from peer utilities), or 2) Statutory tax rate (according to the current legislation). However, after the analysis of several methodologies, it was found that the statutory tax rate is typically used as a parameter in the WACC computation.

Also, the use of the effective tax rate was not taken into account in order to allow companies to retain the tax benefits derived from their fiscal strategies. Moreover, there is no optimal effective tax rate to be paid, so it would make no sense to force other companies to pursue a given fiscal strategy. Thus, the statutory tax rate that has more relevance to the approximation of the allowed rate of return for regulated network utilities is the “Corporate income tax rate”.

One of the most important sources of information where updated and trustworthy data are normally found is the OECD. Table 5.16 shows the corporate tax rates applicable during 2016 for the relevant countries of this methodology; it can be observed that tax rate in Spain is 25%.

Finally, it is important to remind that tax rates are also used in the levering process of betas; therefore, tax rates of the countries involving the peer group of utilities of this methodology will be brought into use in later sections (e.g. France, Italy, Norway, Germany, Portugal, etc.).

Country	OECD 2016
Austria	25,0%
Belgium	33,0%
United Kingdom	20,0%
Finland	20,0%
France	34,4%
Germany	15,8%
Greece	29,0%
Ireland	12,5%
Italy	27,5%
Netherlands	25,0%
Norway	25,0%
Portugal	28,0%
Spain	25,0%
Sweden	22,0%

TABLE 5.16 Corporate income tax rates of relevant European countries - OECD

5.2.3 Cost of equity

The proposed methodology is based on the CAPM model like almost all European regulators do; moreover, this approach is also in line with the jurisprudence used by the CNMC in other sectors. As previously introduced, this model is composed by the RFR, CRP, Beta and MRP (see **Equation 4.1**). These parameters will be explained in subsequent sections.

Risk free rate (RFR)

The proposed methodology recommends the simple average yield of the 10-year Spanish government bond based on daily observations as the best alternative to approximate the Risk free rate of investors. This approach (Approach 1) already takes into consideration the Country Risk Premium of Spain. Depending on the selected period of study, the values of the proposed RFR varies within a range of 1.80% and 3.97% (see Table 5.17). It is important to note that 6-year period displays the higher figure since it comprises some years of the financial and economic crisis.

		Spain	**Germany**	**Netherlands**	**Finland**	**Austria**
1 year	Mean	1,80%	0,53%	0,70%	0,73%	0,78%
	Std Dev	0,23%	0,22%	0,23%	0,17%	0,23%
3 years	Mean	2,64%	1,00%	1,23%	1,19%	1,27%
	Std Dev	1,11%	0,57%	0,66%	0,61%	0,64%
6 years	Mean	3,97%	1,57%	1,84%	1,81%	2,01%
	Std Dev	1,62%	0,84%	0,89%	0,89%	0,98%
12 years		Not relevant				

TABLE 5.17 Average nominal yields of 10-year sovereign government bonds

Also, it can be noted that the spread between Spain and the other countries (Eurozone rated-AAA countries) has been decreasing with time. For example, the Germany-Spain average spread since 2010 (taking into account the 6-year period) is 2.4%, while the average spread in the last year is 1.27%. As illustrated in Figure 5.3, over the last few years the government bond yields in Eurozone countries have decreased significantly, and have tended to come together; therefore, convergence of Spanish bonds to Eurozone is becoming more evident.

Moreover, as described by (OXERA, 2015) in previous sections, the reality of AAA-countries is not coherent with the economic theory since they have reached very low levels; hence, it is believed that both Spanish and AAA-countries might find an equilibrium point in the upcoming years.

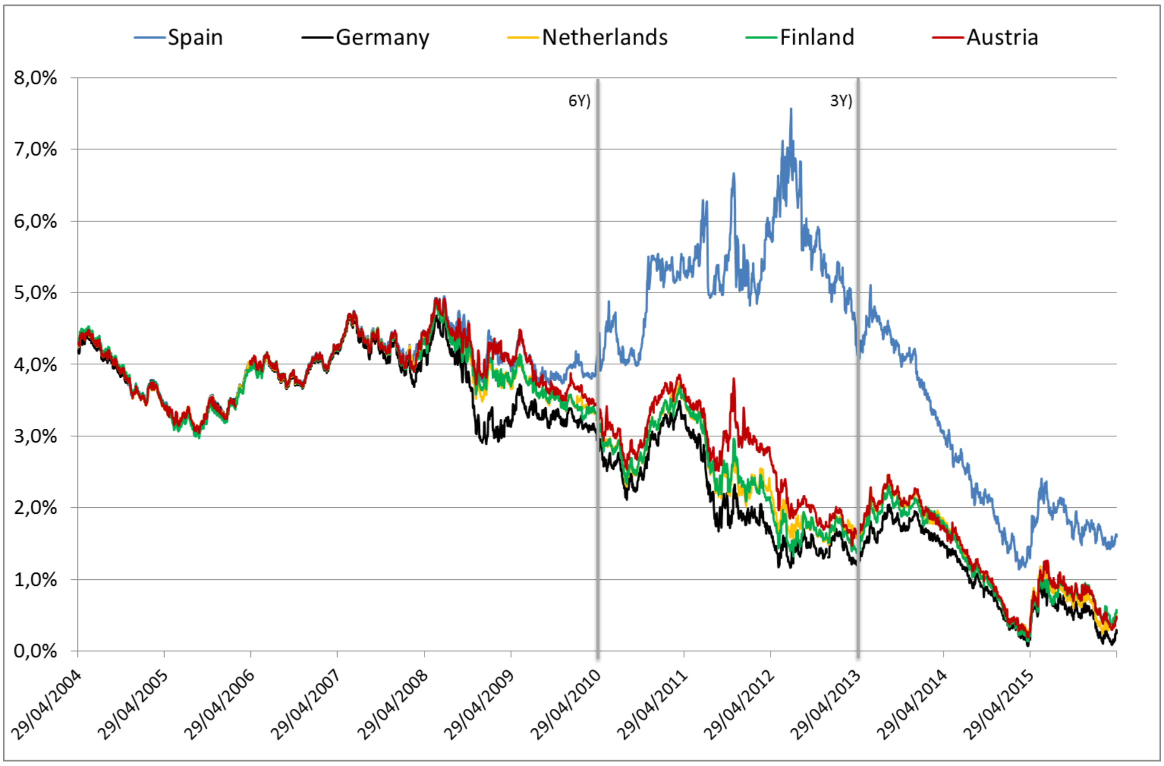


FIGURE 5.3 Nominal yields of 10-year Eurozone government bonds, 2004-16

Grey division lines[66] that are seen in Figure 5.3 set the data cut-off point for the different study periods considered in this methodology. Therefore, it is comprehensible that volatility at 6-year period is higher than other periods since it comprises a stressful phase in the Spanish economy that is not seen in other periods.

Finally, it is noteworthy that this approach (Approach 1) is in line with the methodology proposed in 2008 and the methodology used in the Telecom sector; thus, consistency with the CNMC practices is achieved.

Country Risk Premium (CRP)

An additional approach (Approach 2) can also be followed; thus, the CRP shall be separated from the RFR in order to understand both values in a more comprehensible way. However, it will be demonstrated that both approaches bring up to the same outcome.

Following this approach (Approach 2) and according to the theoretical definition of risk free rate, the RFR should be represented by pure risk free assets in the market, in this case it refers to those rated-AAA countries in the Eurozone (Germany and Netherlands)[67] – as other peripheral countries

[66] They will also be found in successive figures
[67] Only these two countries are rated-AAA by the 3 rating agencies: Moody's, S&P and Fitch

do. Therefore, the simple average yields of the 10-year German and Dutch government bonds shall be approximated.

On the other side, the CRP is normally estimated as the spread between the AAA countries with respect to the Spanish bond. Later, spread between Spanish bond and average of German and Dutch government bonds is computed. According to Table 5.18, the spread (CRP) ranges between 1.19% and 2.26%, depending on the period of study selected.

	Approach 1	**Approach 2**		
	RFR	RFR	CRP	RFR + CRP
	Spain	AAA countries	Spain - AAA Spread	
1 year	1,80%	0,61%	1,19%	1,80%
3 years	2,64%	1,12%	1,53%	2,64%
6 years	3,97%	1,71%	2,26%	3,97%
12 years		Not relevant		

TABLE 5.18 Comparison of RFR approaches

Results regarding CRP are compared against those proposed by (Damodaran, 2016). According to this universally recognized financial expert, the CRP of Spain[68] based on its credit rating and based on its CDS should be around 2.84% and 1.41%, respectively. Consequently, it is important to note that ranges obtained from this analysis are in line with ranges proposed by Damodaran[69].

Finally, it is observed that results from both Approach 1 and Approach 2 are exactly the same (see Table 5.18). It is possible to conclude that the selection of any approach does not represent any change. Therefore, Approach 1 is still preferred over Approach 2 due to its simplicity.

Beta coefficient

From the two options provided in section 4.1.1 regarding the computation of beta, the approach based on universally known financial sources (e.g. Bloomberg) was selected. Additionally, beta of the Spanish energy network industry cannot be measured directly due to the scarcity of listed Spanish pure-utilities; thus, the peer group of utilities obtained in Step 1, table 5.8 (see Section 5.2.1) will be useful in order to determine a proxy of the beta of this industry.

The regression for each utility was build based on weekly observations of their shares with respect to their local indices. On the one hand, (Damodaran, 2015), (OXERA, 2015), and (Wright, et al.,

[68] As date as: January 2016
[69] Methodology used by Damodaran can be found at: www.stern.nyu.edu

2003) argues that weekly observations reduce the non-trading bias generated by the use of daily observations; this criterion is also supported by Bloomberg since it considers weekly observations in its methodology for computing its betas. Additionally, using weekly returns to calculate beta mitigates the problem of illiquidity, since it is more likely that a firm's shares will be traded in a week. However, weekly return comprises the disadvantage that it provides fewer 80% less data points over any given period (The Battle Group, 2014).

The period of estimation will be selected in accordance to the period of study selected for the methodology as a whole (see Section 5.2), however it should be recalled that there are certain standards regarding this parameter which are typically used by financial experts: based on (Damodaran, 2015), Bloomberg applies a 2-year period while Value Line[70] and Standard and Poor's[71] (S&P) use a 5-year period. Hence, both approaches are in line with our main periods of study (3 and 6 years).

One of the main contributions of this methodology is the estimation of a "Single spot beta" for every peer utility (computed on the last day of the research[72]), which is more appropriate than the estimation based on average betas[73].

In other words, the "Single spot beta" is estimated as the single linear regression of the historic observations (stocks and market returns) up to the last day of the period (e.g. 6-year period: single linear regression based on 312 weekly observations of market data from 29/April/2010 up to 29/April/2016). Conversely, the estimation based on average betas is computed as the mean value of a beta collection (e.g. 6-year period: mean value of 312 weekly betas[74] from 29/April/2010 up to 29/April/2016); however, please note that beta obtained on 29/April/2010 was estimated from observations from the previous two years.

It can be concluded that the "Single spot beta" approach is more accurate since it only takes into account observations from the appropriate period, so this approach was considered in the proposed methodology. Nonetheless, it is important to mention that the difference found between both approaches – single spot beta and average beta - was less than 0.1 points.

Consequently, once single raw betas were estimated for each peer utility, the levering process[75] [76] was carried out based on the following criteria: the deleveraging process took into consideration the average observed levering ratios of each utility and the current statutory taxes of their own countries (see Table 5.16). Examples of levering process of four utilities are shown in Table 5.19.

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[70] Independent investment research and financial publishing firm: http://www.valueline.com
[71] Financial services company: http://www.standardandpoors.com
[72] 29/April/2016
[73] This approach was used in the methodology adopted in 2008 by the CNE
[74] Weekly betas are estimated (by Bloomberg) from the linear regression of weekly market data from the former 2 years
[75] Largely discussed in sections 4.1.1, 5.1.1 and 5.1.2
[76] Example is shown

Moreover, the unlevered beta for the industry was estimated throughout the mean value of unlevered betas from the peer group; and finally, that value was later re-levered using an optimal gearing ratio of 50% (see Section 5.2.2) and the Spanish statutory tax in 2016 (25%). Results are shown in Table 5.20.

Peer utility	Reference index	Country	Tax	Leverage ratio (D/E)	Levered beta *	Unlevered beta **
EDF - Électricité de France SA	CAC	France	34%	1,59	1,05	0,51
EDP - Energias de Portugal SA	PSI20	Portugal	28%	1,47	0,92	0,45
ENDESA SA	IBEX	Spain	25%	0,25	0,54	0,45
ELIA SYSTEM OPERATOR SA	BEL20	Belgium	33%	1,09	0,37	0,21

* Raw beta from regression

** After Modigliani – Miller formula

TABLE 5.19 Example of levering process applied to the peer group of utilities

Finally, it is important to highlight that no Bayesian adjustment was performed. It was found that such adjustment is not used by the European regulators (based on the benchmarking analysis); more importantly, some methodologies (e.g. Ireland) considered such adjustment as arbitrary and inappropriate.

Period	Levered beta	Unlevered beta	Re-levered beta	Optimal gearing ratio	Relevant tax
1 year	0,53	0,33	0,57	50%	25%
3 year	0,58	0,35	0,61		
6 year	0,63	0,37	0,64		
12 years	Not relevant				

TABLE 5.20 Betas of the industry based on peer group of utilities

As a final step, the same methodology was applied to the peer group of pure utilities (see Table 5.21). Thus, it was possible to obtain the risk profile of utilities that are not affected by non-regulated activities; as it was expected pure utilities comprise lower betas due to its less risky nature. Spread between both groups is around 15 points as average.

Period	Levered beta	Unlevered beta	Re-levered beta	Optimal gearing ratio	Relevant tax
1 year	0,37	0,22	0,39	50%	25%
3 year	0,47	0,28	0,48		
6 year	0,46	0,27	0,47		
12 years	Not relevant				

TABLE 5.21 Betas of the industry based on peer group of pure utilities

Market Risk Premium (MRP)

There are several ways to compute the Market Risk Premium, therefore, this methodology aims to analyse the most relevant sources of information based on the findings of the benchmarking.

In section 4.1.1, it was stated that historical analysis is preferred over expectations polls since it is the most frequently approach used by the regulators; this statement is supported after the analysis carried out to the Report of Investment Conditions (CEER, 2016). It could be also concluded that most of the European energy regulators based their methodologies on the yearly report released by Credit Suisse in accordance to the data published by DMS; however, within this report, different approaches could be followed.

First of all, there are two main values highlighted in the report regarding the market premium: arithmetic mean and geometric mean of the excess of market returns with respect to sovereign bonds. It is important to recall that the historical analysis carried out by DMS (Credit Suisse, 2016) is constructed upon market data – from different countries – since 1900. Therefore, these results include a period from 1900 up to the most recent year (e.g. 2016 report comprises a study period from 1900-2015). Thus, a key decision relies on the selection between the arithmetic and the geometric mean.

Following this research, it was found that there is no consensus between regulators and financial experts on whether to use one or another approach. According to (Cooper, 1996), the arithmetic mean ignores the estimation error and the serial correlation, while the geometric mean shall be preferred when correlation between years exists; therefore, he concludes that "In all the cases, the… discount rates are closer to the arithmetic than the geometric mean". On the other hand, (Damodaran, 2015) argues that in longer time horizons (e.g. 10-year horizon) the returns are correlated, so it would be advisable using the geometric mean. Taking into account no-consensus on this matter, it is understandable that Germany and Netherlands select the average of these two values for their methodologies by arguing lack of reasons to focus on either alternative.

Source	**Year**	**Spain**	**Weighted European**
DMS - Geometric mean	1900-2013	2,20%	3,66%
DMS - Avg. Arithmetic & Geometric	1900-2013	3,20%	4,85%
DMS - Arithmetic mean	1900-2013	4,20%	6,05%
Pablo Fernandez - Surveys	2016	6,20%	5,49%
Damodaran - CDS	2016	7,71%	7,93%

Source: Several sources

TABLE 5.22 Pool of alternatives for the MRP

Finally, the selection of either the Spanish or the European DMS data is a matter of relevance. The former one refers to the market premiums observed in Spain while the latter approach refers to the average of European countries[77]; however, the European approach can also be understandable throughout two methods: 1) the single average of European countries (applied in the CNE 2008 methodology described in section 4.1.1), and 2) the weighted average of European countries based on their relative size[78] (applied in the Dutch methodology described in section 5.1.2). The latter approach was considered more suitable for the proposed methodology, so it was selected among these two options (see Table 5.22).

After analysing the alternatives, the proposed methodology suggests the DMS average of the arithmetic and geometric mean as the Market Risk Premium due to the justifications abovementioned and to be consistent with the findings derived from the European Benchmarking. On the other hand, regarding the Spanish and European approach, the selection will depend upon the assumptions regarding the expected investors on the Spanish framework; however, based on other countries' regulations and the globalisation, the European approach would be advisable since global investors would probably base their investments decisions on network utilities at European level.

5.2.4 Cost of debt

The cost of debt refers to the interest paid to financial lenders. It is important to recall that, in case of bankruptcy, debt lenders have priority over investors when getting their money back; therefore, the risk assumed – as the interest demanded – by debt lenders is lower than the one assumed – and demanded – by investors.

Normally the debt assets with the lowest default risk are those belonging to governments, followed by the banks and then the utilities. Figure 5.4 shows that the German reality complies with this concept: the German government (red line) is getting financed cheaper than banks (blue line) – presented by the Interest Swap Rate – and utilities (orange marks) – represented by their debt issuances. Please note that these three asset rates are based on a (long-term) 10-year horizon.

However, the current reality in the Spanish context (as other countries) is not consistent with the economic theory since it has been observed that – since 2010 – Spanish utilities have been getting financed cheaper than the Spanish government in debt markets. Figure 5.5 shows the 10-year Spanish bond (green line) compared against the long term bonds[79] issued by Spanish utilities[80] since 2004; nevertheless, interbank rate (blue line) has stayed under debt cost of utilities.

[77] According to the criteria used in the selection of the peer group of utilities (European Union + Norway)
[78] Market capitalisation
[79] Horizon of 8 to 12 years
[80] Utilities belonging to the peer group

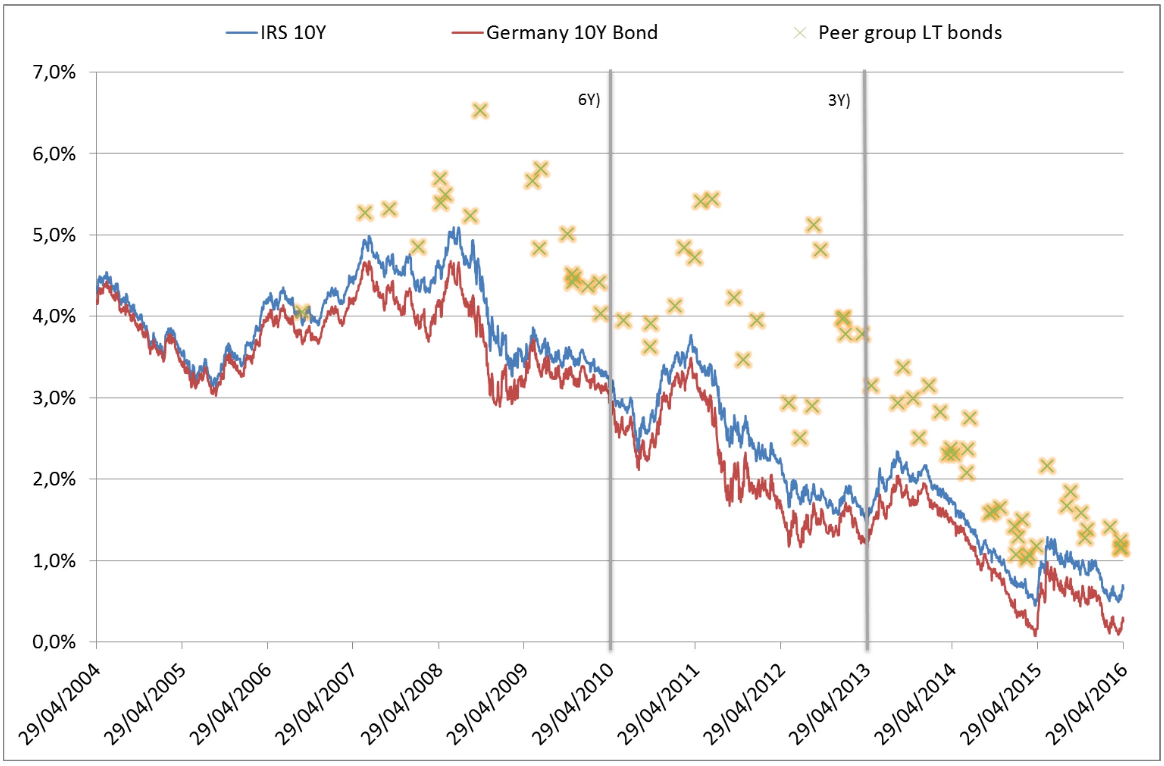

FIGURE 5.4 Comparison between German LT bond, IRS and Peer utilities LT bonds

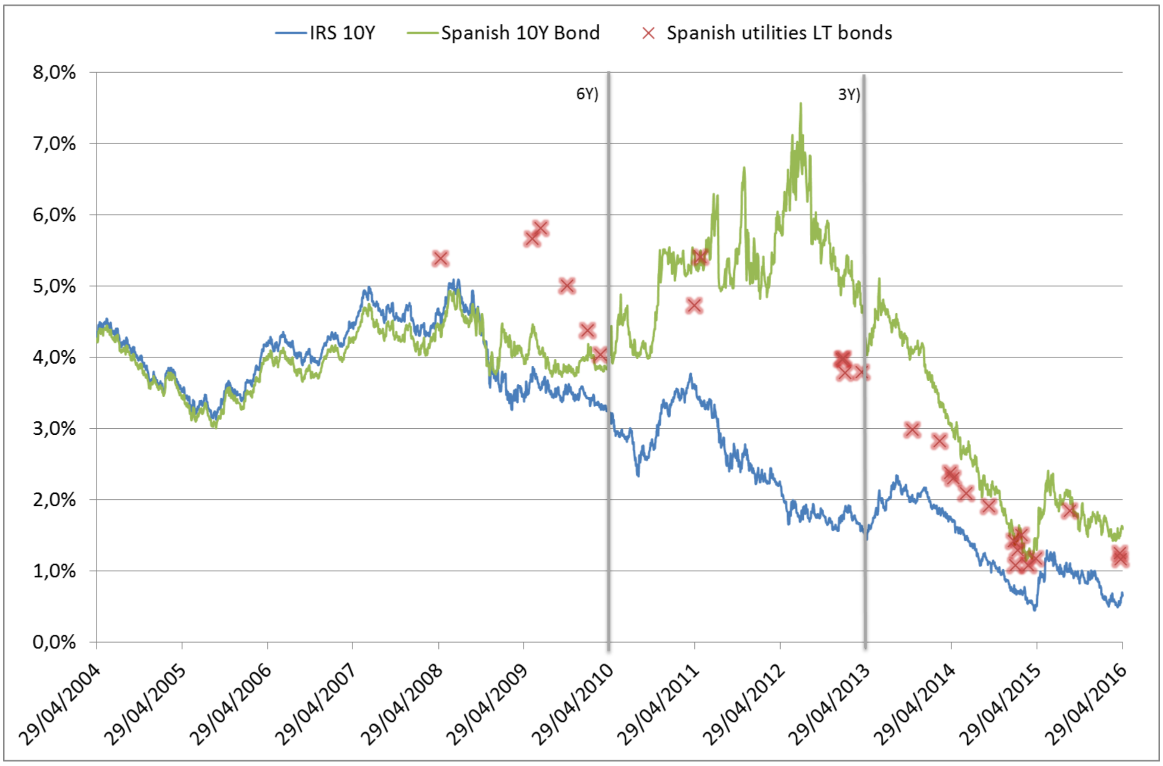

FIGURE 5.5 Comparison between Spanish LT bond, IRS and Spanish utilities LT bonds

The proposed methodology suggests two approaches regarding the estimation of the cost of debt: Approach 1: The average yield at issue of debt bonds belonging to the peer group of utilities; and Approach 2: The sum of a risk free rate plus a debt premium. Later, results from these approaches will be compared against 3 additional debt references: European benchmarking and book values.

Approach 1: Debt bonds of peer group of utilities

Companies listed in stock markets are able to issue debt bonds as a way of raising funds; the yield at issue (internal rate of return) of these bonds represent straightforwardly the cost at which utilities are getting financed in debt markets. This approach is in line with previously analysed methodologies carried out by other regulators; for instance, Irish methodology (see Section 5.1.2).

Although the issuance of debt bonds is a really common practise among companies[81] and despite the fact that some regulators use this approach in their methodologies, the analysis of debt throughout debt issuances has a couple of drawbacks to take into account: a) they are discrete subjective events which are highly influenced by the financial strategies of companies (they decide the most appropriate time when issuing debt), and b) debt bonds are issued at unstandardized horizons (different maturities).

Analysis of Approach 1 was based on debt bonds issued by the peer group of utilities for every period of study. Criteria used at the selection of bonds are explained as following:

a. Issuer: Bonds issued by both the parent company of the peer utilities, and its subsidiaries were taken into account.
b. Date: Bonds issued until 29/April/2016 (in accordance with the period of study).
c. Region: Bonds issued in countries different from Western Europe were excluded in order to be coherent with the criteria used in the selection of the peer group of utilities (see Section 5.2.1).
d. Currency: Corporate bonds issued only in euros (€) were taken into account; then, bonds in other currencies were excluded.
e. Maturity: Bonds with a 10-year horizon were taken into account; hence, bonds with a maturity falling outside the 8-12 years range were excluded.
f. Companies rating: Corporate bonds with a lower credit rating[82] than the Spanish rating were excluded. Four utilities were found within this circumstance:
    - A2A SpA
    - EDP – Energias de Portugal SA
    - REN – Redes Energeticas Nacionais
    - RWE AG

[81] Bonds from 26 utilities out of 30 (from the peer group of utilities) were obtained
[82] Due to the existence of rating discrepancies between the 3 universally recognized rating agencies (Moody's, S&P and Fitch), the 2/3 criteria was used when comparing ratings. In other words, 2 out 3 credit ratings must not be lower than the Spanish one.

g. Bond rating: Quality of bonds is also measured through credit ratings; therefore, previous criterion was applied to each bond: bonds with a lower credit rating than the Spanish one were excluded (no matter if the company by itself complies with the rating criteria).

h. Completeness of information: Three cases regarding incomplete information were found: companies without bonds, companies without credit rating[83], and bonds without information about yield at issue. Bonds falling in one of these circumstances were excluded.

After collecting the relevant bonds – based on the previous criteria – the average yield at issue for each period of study was computed. Results from this analysis are displayed in Table 5.23. As it can be observed, an overall downward trend regarding the cost of debt is easily acknowledged. Data from Table 5.23 are supported by their chronologically results (peer group LT bonds) displayed in Figure 5.4.

Moreover, taking into account the 12-year period (only for reference purposes), there were found 79 debt bonds belonging to 18 utilities from the peer group of utilities. The average yield from the total bonds is 3.22%; the maximum yield at issue is 6.53% belonging to ENGIE SA (France) and issued in October 2008, while the minimum is 1.01% issued also by ENGIE SA (France) but 6 years after (March 2015).

Period	**1 year**		**3 years**		**6 years**		**12 years**	
#	13		39		59		79	
Avg. Yield		1,47%		1,88%		2,62%		3,22%
Std. Dev.		0,30%		0,68%		1,27%		1,54%
Max		2,16%		3,37%		5,44%		6,53%
Min		1,14%		1,01%		1,01%		1,01%
Germany	0	-	0	-	0	-	2	5,50%
Sweden	0	-	0	-	1	4,23%	1	4,23%
Austria	0	-	1	1,65%	1	1,65%	1	1,65%
UK	1	1,67%	2	2,08%	2	2,08%	2	2,08%
Belgium	4	1,64%	4	1,64%	5	2,09%	5	2,09%
France	2	1,37%	6	1,78%	14	2,72%	19	3,38%
Spain	4	1,36%	17	1,75%	23	2,41%	30	3,01%
Italy	2	1,34%	9	2,28%	13	3,14%	19	3,61%
Portugal	0	-	0	-	0	-	0	-

TABLE 5.23 Summary of corporate bonds issued by the peer group of utilities

[83] Fluxys Belgium was excluded because this reason.

Finally, results were disaggregated by country in order to perform a deeper analysis regarding their cost of debt. It can be roughly concluded that – in average – Spanish utilities are getting financed cheaper than utilities from remaining countries; however, it is important to highlight that more than 1/3 of the bonds in each period were issued by Spanish utilities.

Approach 2: RFR + Debt Premium

According to the European benchmarking analysis performed beforehand, it was found that this approach – summing a RFR asset and a debt premium – is a common practise among regulators when estimating the cost of debt (e.g. Irish and Dutch methodologies, etc.); moreover, this approach is also in line with the jurisprudence of the Spanish regulator given the fact that it correspond to the same methodology proposed by (CNE, 2008) (see Section 4.1.2), and the second best option proposed by the Telecom methodology (see Section 5.1.1).

Results from this research suggest the estimation of debt premium in two ways: 1) CDS of peer utilities, or 2) Spread between Spanish utilities bonds and AAA-countries utilities bonds. From these two alternatives, the latter one was dismissed since it was not possible to approximate a trustworthy spread due to the lack of significant bonds from AAA-countries' utilities[84] (see Table 5.23). Thus, the first alternative – approximation of the cost of debt through CDS – will be deeply analysed.

The approximation of the cost of debt through CDS was already introduced in Section 4.1.2 since this approach was used in (CNE, 2008) methodology. According to this approach, the RFR is computed from the 10-year Interest Rate Swap, while the debt premium is obtained from the 10-year CDS from the peer group of utilities.

Regarding the first parameter, the Interest Rate Swap (IRS) could be understood as the interbank rate at which banks got financed among themselves; however, this rate cannot be applied straightforwardly to utilities since they are riskier entities than banks. Henceforth, an appropriate spread representing this additional risk is required.

In relation to the second parameter, the Credit Default Swaps (CDS) represent the hedging cost of investors derived from the credit risk exposure involved when acquiring debt (the higher the credit risk, the higher the hedging cost). So it can be concluded that the cost of debt of a company is directly related to its credit worthiness, and this could be approximated through the cost of its CDS (the higher the credit worthiness, the lower the CDS cost). Finally, it can be concluded that CDS are a good proxy of the debt premium that companies need to offer to their financial lenders (the lower the CDS cost, the lower the debt premium).

[84] Germany, Sweden and Austria

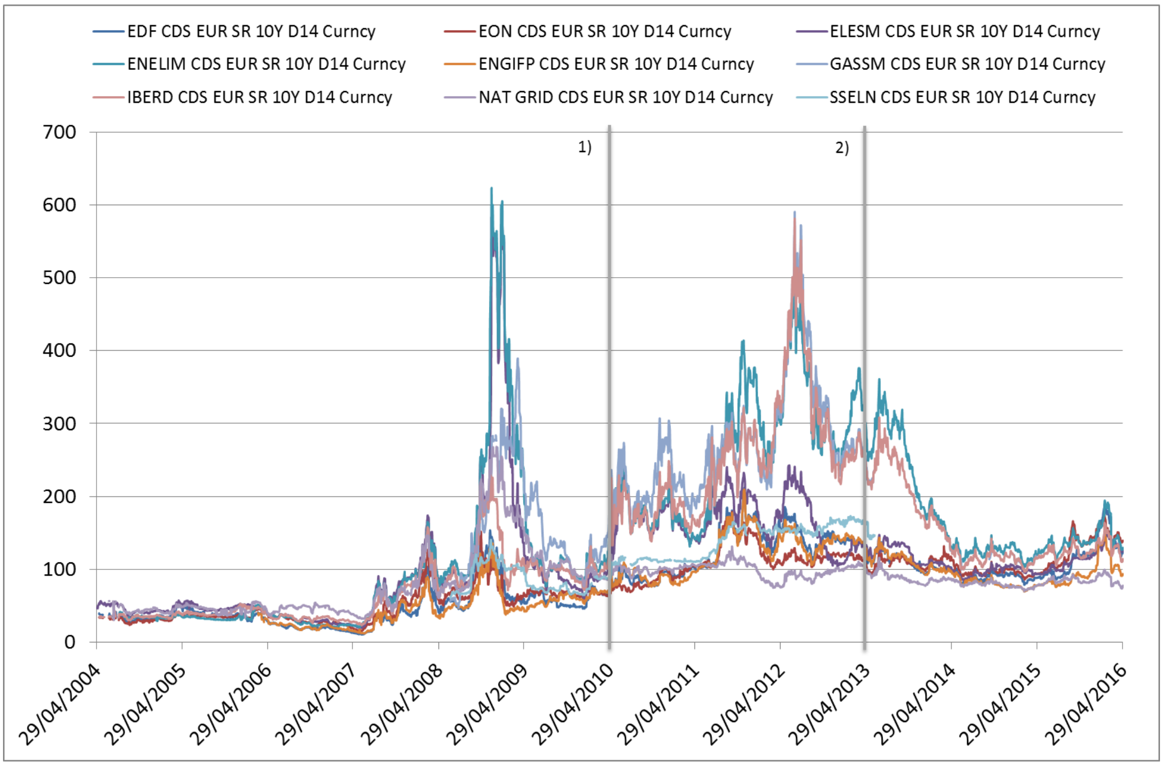

FIGURE 5.6 CDS 10-year of peer group of utilities since 2004

An important advantage concerning this approach (Approach 2) compared to the Approach 1 refers to the fact that IRS and CDS are continuous measurements which can project estimations at any period of time and they are not influenced by the subjective decisions derived from financial strategies, additionally, horizons regarding these assets are normally standardized (1-year, 5-year, 10-year). On the other hand, there are some drawbacks that need to be highlighted: a) the market of CDS is mainly composed by big utilities with a liquid level of debt issuances; hence, only few companies among the peer group of utilities (11 utilities[85] out of 30) have CDS[86]. Additionally, although the liquidity of CDS is not questioned, it is noteworthy that CDS 5-year horizon is more liquid than CDS 10-year.

Figure 5.6 shows the cost of CDS 10Y since 2004. As it can be observed, maximum levels are found within 2008-2009 and 2012-2013; coincidently, highest values correspond to the Spanish and Italian utilities. Although Spanish CDS have been normally above German CDS (rated AAA country), this tendency has been reversing in the last year where Endesa SA and Iberdrola SA have had lower values than E.ON SE; however, this analysis might be insignificant since there is only one German utility[87] that can be compared.

[85] Although 2 utilities were dismissed due to not compliance with rating criteria
[86] CDS with a 10-year horizon
[87] RWE AG (Germany) was excluded due to not compliance with rating criteria

Period	1 year	3 years	6 years	12 years
# obs	1.836	5.447	12.414	23.523
Average (bps)	116,15	119,09	148,95	112,10
Std. Dev.	25,60	43,64	74,62	80,20
Max	194,46	360,97	589,73	621,25
Min	73,80	69,66	66,61	10,58
Germany	130,85	112,69	111,46	80,41
E.ON SE	130,85	112,69	111,46	80,41
France	106,95	101,05	112,22	81,69
EDF - Électricité de France SA	118,68	106,48	115,82	80,59
ENGIE SA	95,21	95,63	108,62	82,79
UK	104,75	116,74	115,33	101,38
NATIONAL GRID PL	85,18	84,26	91,85	84,60
SSE PLC - Scottish & Southern Energy	124,32	149,23	138,81	118,17
Spain	127,54	136,86	199,94	156,49
ENDESA SA	115,31	111,00	140,45	111,62
GAS NATURAL SDG SA	140,72	150,31	258,18	223,10
IBERDROLA SA	126,59	149,27	201,19	134,76
Italy	140,74	167,39	214,78	153,91
ENEL SpA	140,74	167,39	214,78	153,91

TABLE 5.24 Summary of CDS 10Y of peer group of utilities

Analysis of Approach 2 was based on daily observations[88] of CDS – with a 10-year horizon – belonging to the peer utilities. Criteria used at the selection of CDS were similar to the ones used in the selection of bonds:

a. Currency: CDS issued in euros (€) were taken into account.
b. Companies' rating: CDS belonging to utilities with a lower credit rating[89] than the Spanish rating were excluded. The same four utilities abovementioned were found within this circumstance. However, only two utilities were relevant (EDP – Energias de Portugal SA, and RWE AG) since the other two did not have CDS.
c. Completeness of information: Two cases regarding incomplete information were found: companies without CDS and CDS without updated information. CDS falling in one of these circumstances were excluded.

Summary from CDS are displayed in Table 5.24. Values regarding averages and standard deviations are measured in basis points. As it was stated before, the continuous nature of CDS allows having much more observations compared to discrete observations from Approach 1. Furthermore, a stable period can be recognized in the last year – supported by a low standard deviation (25.6 bps). Therefore, debt premium can be found ranging from 1.16% and 1.48%.

[88] Until 29/April/2016
[89] Same criterion (2/3) was used when comparing ratings

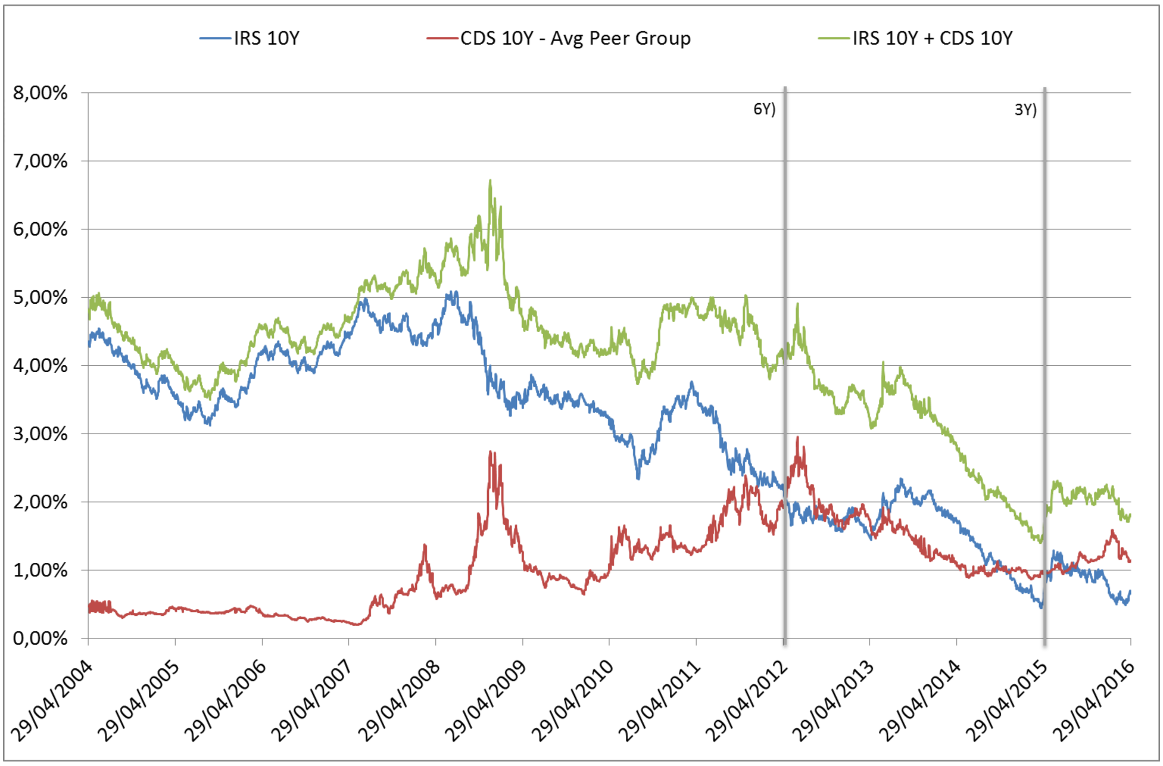

FIGURE 5.7 Cost of debt according to Approach 2: IRS + CDS

Results from Approach 2 are displayed in Figure 5.7. IRS 10Y (blue line) has been following a downward trend since mid-2008; current values are found around below 1.0%. On the other hand, average of CDS (red line) has followed an upward trend, showing important peaks during the financial and economic crisis; however, last years have been characterised by stability with values around 1.0%. Finally, results from the sum IRS + CDS (green line) are more volatile; it reached its maximum level during the financial crisis in 2008, while its minimum point was reached in 2015 (1.5%). Figures in more detail are shown in Table 5.25. It is important to note that among these CDS only National Grid PLC belongs to the peer group of pure utilities.

	Approach 1	**Approach 2**			**Mid-point**
	Corporate bonds	RFR IRS 10Y	Debt premium CDS 10Y	IRS + CDS	Average
1 year	1,47%	0,88%	1,16%	2,04%	1,76%
3 years	1,88%	1,30%	1,19%	2,49%	2,18%
6 years	2,62%	1,91%	1,48%	3,39%	3,00%
12 years	Not relevant				

TABLE 5.25 Summary of both approaches (Cost of debt)

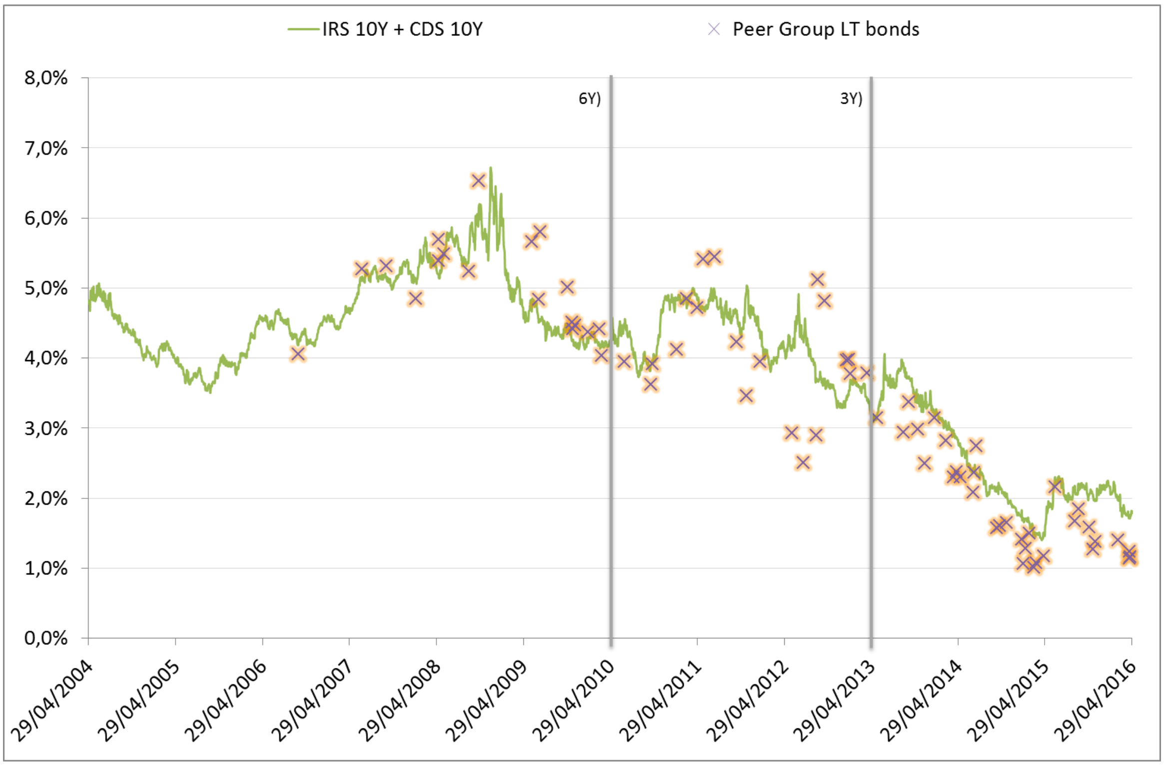

FIGURE 5.8 Summary of both approaches (Cost of debt)

Finally, results from both approaches regarding the cost of debt are summarized in Table 5.25 and Figure 5.8. As it can be observed in the graph, corporate bonds issued by the utilities are really close to the IRS+CDS approach; therefore, it can be concluded that both approaches might be complementary among themselves. However, corporate bonds have been issued at levels below the IRS+CDS (green line) since 2008; this perfectly justifies the difference in numbers from both approaches that are highlighted in Table 5.25.

For instance, taking as reference the 3-year period, the cost of debt – according to both approaches – ranges between 1.88% and 2.49%; the spread between lower and upper bound is around 0.70%. Thus, a plausible suggestion from this proposed methodology would refer taking the mid-point of these two values as the cost of the debt of the industry (2.18%). Next section will compare the results obtained in both approaches against the book values of the peer utilities.

Reference values

A supplementary analysis was conducted based on the book values from the peer utilities; however, since the proposed methodology is clearly based upon market values, result from this analysis will be taken only as reference values.

This analysis takes into consideration the historic debts of peer utilities. One of the main drawbacks of book values refers to the lack of correspondence with current market debt values; for instance, it could be possible that a given company is still paying nowadays an interest expense from a credit from 25 years ago, where economic situation and debt costs differs from the current conditions. From the regulatory point of view, it would not be acceptable to include in the allowed rate of return for the next regulatory period a cost of debt that does not reflect expected economic conditions.

Moreover, an additional drawback regarding the use of book values refers to the lack of reliable information. Book values are affected by the different financial strategies carried out by the parent companies; then, information of subsidiaries (e.g. utilities) are not relevant since they might get financial resources from the parent company at non-realistic and subjective interest rate which are highly affected by the specific goals of the group. Therefore, book values from the parent company shall be preferred over utilities' no matter the fact that these may include information regarding its regulated network business, and other non-regulated activities.

Data were mainly obtained from Bloomberg and corporate annual reports. Cost of debt was computed by dividing 1) Interest expense over 2) Total debt. Due to lack of information, the collection of data of interest expense was based on the "Best available data" as explained as follows: first, the Interest Expense (IS_INT_EXPENSE) was sought after, if the value was not available – according to Bloomberg standards – then, the Total Interest Expense[90] (TOT_INT_EXP) was taken; the difference between these two functions is that the latter one includes the capitalized interests. Once the cost of capital for every peer utility was found, the average of the industry was estimated; nevertheless, similar criteria were taken into account when selecting the appropriate companies that represent the cost of debt of the industry:

a. Companies' rating: Data belonging to utilities with a lower credit rating[91] than the Spanish rating were excluded.
b. Completeness of information: Two cases regarding incomplete information were found: companies without credit rating and companies without information. Utilities falling in one of these circumstances were excluded.

Moreover, atypical values were removed from the analysis throughout the "two standard deviation approach"[92]- previously applied in the analysis of the Optimal gearing ratio. Thus, 15 utilities remained (out of 30 utilities). Results can be seen in Table 5.26; as it was expected, cost of debt based on book values turned to be higher than values found – and proposed – in previous approaches.

Additionally, it is interesting to note that Spanish cost of debt (based on book values) is in line with the other analysed countries.

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[90] Total Interest Expense = Interest Expense + Capitalized interest
[91] Same criterion (2/3) was used when comparing ratings
[92] Utilities with values above or below two standard deviations were removed

Period	1 year		3 years		6 years		12 years
# utilities	15		15		15		Not relevant
Avg. Yield		3,84%		3,86%		4,02%	
Std. Dev.		1,33%		1,26%		1,45%	
Max		5,71%		6,58%		7,17%	
Min		1,59%		1,96%		2,14%	
Austria	1	5,56%	1	4,83%	1	4,81%	
Sweden	1	5,38%	1	4,83%	1	4,58%	
Belgium	1	3,36%	1	3,89%	1	4,33%	
France	2	3,04%	2	3,71%	2	3,96%	
Spain	5	3,98%	5	3,95%	5	4,37%	
Italy	5	3,46%	5	3,43%	5	3,36%	

TABLE 5.26 Summary of cost of debt of peer group of utilities (based on book values)

Finally, reference values from the European benchmarking were also taken into account. Table 5.27 shows the results from the most relevant countries of the analysis. From the side of the peripheral economies (excluding Portugal) the cost of debt is around 3.0%. Coincidentally, this value matches with the mid-value proposed – derived from the two previous approaches – corresponding to the 6-year period of time (see Table 5.25). Moreover, these results also support the idea previously introduced regarding that the cost of debt based on book values can also be used as a reference value but it does not necessarily has to be equal – or closer – to the debt cost applied in the WACC methodology.

Regulatory precedents

Country	Year	RFR	Year	Debt Premium	Cost of Debt
Austria	2013	1,25%	2013	1,45%	2,70%
Germany	2010	2,24%	real costs		-
Finland	2015	0,69%	2012	1,69%	2,38%
Ireland	2010	1,90%	2010	1,20%	3,10%
Italy	2014	2,56%	2012	0,45%	3,01%
NL	2010	2,36%	2010	1,50%	3,86%
Portugal *	2014	2,41%	2015	2,00%	4,41%

** Portugal: Nominal RFR*

TABLE 5.27 Cost of debt applied by the European regulators - CEER

5.3 The application of this methodology in other regulated activities

This section will be dedicated to analyse the different issues to be addressed in the application of the methodology on 1) smart-grid investments, 2) renewable energy sources (RES), and 3) generation at isolated systems (islands). It is important to recall that this analysis is in line with the secondary objectives of this thesis research. According to the existing regulation, a spread has to be estimated for each of these activities, which will be later added to the average yield of the 10-year Spanish bond in the last 24 months[93].

The first consideration is related to the regulation that applied for each of these regulated activities; there will be laws and processes that might apply differently to these activities. Therefore, regulatory framework will have to be re-examined in order to identify the specifics regarding their financial remuneration. On the other hand, it is important to consider the different risk-profiles involved on these activities despite the fact they are regulated activities.

In the light of the above, it will be required to readapt some parameters of this methodology and its estimation process.

Regarding 1) the smart-grid investments it is important to acknowledge the higher risk involved on these kinds of activities compared to the regulated network activities. Smart-grids are highly dependent on technology and R&D[94]; hence, additional risks such as obsolescence and unsuccessful projects should be considered in the methodology. Therefore, the selection of peer group of utilities (Step 1) should be readjusted into a peer group based on technological and industry research companies sharing a similar risk profile. One option would be taking into consideration the utilities belonging to the STOXX® Europe 600 Technology Index[95]. By changing the peer group of utilities, other parameters will be changed consequently: optimal gearing ratio, beta coefficient of the industry, and cost of debt (since corporate debt bonds and CDS are based on the peer utilities). Moreover, due to technology obsolescence risk, investment horizon (Step 4) should be reduced. Technology investors demand shorter payback periods, so 10-year horizon is no longer an option; thus, it might be reasonable to consider a 3-year or 5-year as relevant investment horizons. By doing this, the following parameters will change correspondingly: RFR, CDS, Corporate debt bonds.

Similarly, the methodology concerning 2) RES activities should share some connections regarding the one proposed for smart-grids since technology plays a significant role in both activities. However, technology lifespan and obsolescence risk in RES activities might not be as critical as the one existing in smart-grids. Therefore, peer group of utilities and horizon might be also adjusted.

[93] Outcome: 1.8% - assuming current values.
[94] Research & Development
[95] http://www.stoxx.com/index-details?symbol=SX8P

First, the peer group of utilities should take into consideration generation utilities with relevant activity on renewables. The same index[96] used in Step 1 might be a starting reference point as long as the selection criteria are modified. For instance, EDP Renovaveis SA (see Table 5.7) should be included in this list, while other utilities without RES activities should be excluded. Moreover, alternatives sources to find suitable peer utilities are: a) Bloomberg EQS function based on Product Segments: Alternative Power Generation, and b) STOXX® Europe TMI Alternative Energy[97]. Secondly, the selection of the investment horizon should be based on the lifespan of the technology involved (e.g. solar panels and wind generators have in average a lifecycle of 20-25 years); therefore, it might be appropriate to keep 10-year horizon unchanged.

Finally, concerning generation at isolated system, the methodology should consider only power generation utilities located on islands as peer utilities. Reference countries to support such analysis could be: Denmark, Iceland, Italy, France and Greece; although, Greece might not comply with the credit rating criterion. Other parameters should remain the same (e.g. 10-year horizon) since they do not involve major changes regarding regulated network activities.

Spreads resulting from these activities are expected to be higher than the one resulting from network activities due to the higher risk involved and the shorter investment horizon. The reason why these activities are regulated is that they need to be incentivized since the market itself does not promote these activities.

[96] STOXX® Europe TMI Utilities
[97] http://www.stoxx.com/index-details?symbol=T0580P

Chapter 6

Results through case studies

6.1 Numerical application of the proposed methodology

Results of this research are in line with the final proposition of WACC and its transformation to an allowed rate of return in accordance to the methodology developed in Chapter 5. Within this chapter, two scenarios will be analysed based on different assumptions regarding the potential expected investors; therefore, since one of the most important and critical parameters refers to the expected market premium for investors, the first scenario will consider only international investors focusing on European market returns, while the second scenario (based on the home bias effect) will only assume Spanish investors, so Spanish market premium should be considered.

Among the periods of study proposed, 3-year and 6-year periods will be analysed in order to give a conclusive proposal for the methodology. However, although 1-year period is not a choice (see Section 5.2.1), it is important to note that it reflects the current financing situation of utilities, so it might be useful as a reference. Finally, results will be compared against reference values also estimated based on the peer group of pure utilities in order to provide a better understanding of the achieved results.

6.1.1 Main scenario: International investors (no home-bias assumption)

This first scenario assumes the expectation of international investors – no home bias effect – in the Spanish industry; therefore, the European market risk premium is chosen in this first step. It is important to recall that the average of European market risk premiums has been implemented by The Netherlands (see Section 5.1.2) and the (CNE, 2008) (see Section 4.1.1); additionally, Germany was also found to use this approach[98].

[98] According to the analysis of the (CEER, 2016) Report on Investment Conditions in European Countries

The reasoning behind this assumption is that investors around the world are motivated by market premiums of the whole region since there are no significant investment barriers among the EU countries. However, it is noteworthy that when investors invest in a particular country (e.g. Spain), they demand a higher rate justified by its country risk (already included in the proposed RFR).

According to the proposed methodology, two approaches to estimate the cost of debt were suggested; however, there was no conclusive decision whether to use one or another. Therefore, numerical results using both approaches will be analysed in Table 6.1 and Table 6.2, respectively; Tables[99] display results for 1-year, 3-year and 6-year periods of study, and the procedure followed to get the *Nominal post-tax WACC*, *pre-tax allowed rate of return* and *spread* that need to be added to the *base rate* of return proposed settled by the (Real Decreto 1047/2013, 2013).

The cost of equity is shared by both analyses (explanations for each parameter were already discussed in previous sections). The [1] RFR corresponds to the average yield of the 10-year Spanish bond. As it was already explained, it can also be represented by the 10-year German and Dutch bonds plus a CRP which leads to the same result; hence, for the sake of simplicity, this approach is used. The [2] Beta coefficient is obtained from the unleveraged and re-leverage process (subject to the tax rate and the optimal leverage) after the regression (single spot approach) of raw betas. Finally, the [3] MRP (4,85%) corresponds to the Dutch approach based on DMS sources; this approach relates to the weighted average of the European market returns based on the mean value between the geometric and the arithmetic means of market premiums.

		1-year	3-years	6-years	Notes	Section
Risk Free Rate	[1]	1,80%	2,64%	3,97%	10-year Spanish bond	5.2.3
Beta	[2]	0,57	0,61	0,64	Single Spot / Re-levered [8] [10]	5.2.3
Market Risk Premium	[3]	4,85%	4,85%	4,85%	DMS - Dutch Approach	5.2.3
Nominal after-tax Cost of Equity	[4]	4,57%	5,62%	7,08%	[1] + ([2] x [3])	-
Risk Free Rate	[5]	-	-	-	-	5.2.4
Debt premium	[6]	1,47%	1,88%	2,62%	Corporate bonds of utilities	5.2.4
Pre-tax Cost of Debt	[7]	1,47%	1,88%	2,62%	[5] + [6]	-
Tax Rate	[8]	25%	25%	25%	Spanish Corporate Tax Rate	5.2.2
Gearing ratio (D/A)	[9]	50%	50%	50%	Proxy based on observed ratios	5.2.2
Leverage (D/E)	[10]	100%	100%	100%	[9] / (1-[9])	-
Nominal Post-tax WACC	[11]	2,83%	3,51%	4,52%	([4] x (1-[9])) + ([7] x (1-[8]) x [9])	-
Pre-tax Allowed Rate of Return	[12]	3,78%	4,68%	6,03%	[11] / (1-[8])	-
Base rate - BOE	[13]	1,8%	1,8%	1,8%	10-year Spanish bond (last 24 months)	5.2
Spread (bps)	[14]	198	288	423	[12] - [13]	-

TABLE 6.1 Numerical results from the first scenario - Corporate bonds of utilities

[99] Layout of tables is based on (The Battle Group, 2014)

Regarding the cost of debt, the first approach [6] is based on the average of the corporate bonds issued by the peer utilities within a maturity range between 8-12 years; as it can be seen, RFR does not apply into this context. The [8] tax rate (25%) corresponds to the Spanish corporate tax in force during 2016, while the [9] optimal gearing ratio (50%) refers to the proposed ratio based on the observed gearing data of the peer group.

Lastly, the [11] Nominal post-tax WACC was estimated by applying the WACC formula (see **Equation 2.2**) which was later divided over the residual[100] of the Tax Rate in order to estimate the [12] pre-tax allowed rate of return. Furthermore, the proposed [14] spread – main objective of this methodology – results from the difference between the pre-tax allowed rate of return and the [13] base rate (1.8%) computed from the average yield of the 10-year Spanish bond in the last 24 months.

Thus, the allowed rates of return estimated for the two relevant periods of study – 3-year and 6 year periods – are 4.68% and 6.03%, respectively. The spread between these two figures is 1.35%, which almost matches the cost of debt[101] at which the companies are currently getting financed; it is important to understand this spread as a consequence generated by the economic downturns suffered from 2010 to 2013.

Additionally, in accordance to the 1-year period the proposed allowed rate of return is 3.78%; however, this approach is not significant since the underlying assumption – of economic stability along with low interest rates for the next regulatory period – could be extremely optimistic taken into account that current market conditions are at the lowest levels of the past ten years. Still, this figure actually represents the current rate of return that companies should receive based on their financing costs if there was an annually updated allowed rate of return.

Hence, as introduced in section 5.2.1, the choice among periods of study should be related to the expected economic conditions during the next regulatory period; moreover, it seems plausible to use the 6-year period for the following reasons: 1) it assumes a moderate and cautious approach regarding the economic perspective; 2) it corresponds exactly to one regulatory period (an ex-post assessment of the former regulatory period allows to correct the inaccuracy error and reduce the overestimation or underestimation of the allowed rate of return), and 3) average length of economic cycles – in the last 65 years – is around 70 months (almost 6 years)[102].

Thus, the 6-year period is the final proposition by this methodology, taking into account the current economic expectations; nevertheless, it is highly recommended to perform an economic analysis when the replication of this methodology takes place. Finally, other two periods should be still regarded as reference parameters.

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[100] (1-Tax Rate)
[101] 1-year period
[102] http://www.nber.org/cycles.html

Once the period of study has been defined, another analysis regarding the second approach of the cost of debt was carried out. Here, the cost of debt is based on the sum of a Risk Free Rate and a Debt Premium. The [5] first parameter is obtained from the average yield of the 10-year Interest Rate Swap of Euro; inferred as the interbank interest rate, while the [6] debt premium is gotten from the average cost of the CDS belonging to the peer group of utilities; inferred as the premium measuring the risk of the firms. Other parameters – cost of equity, tax rate and optimal gearing ratio – remained the same as previous analysis.

Outcomes from this analysis are 4.99% and 6.42% respectively for the allowed rate of return for 3-year and 6-year periods; spread between these two values is 1.43%, which is in line with the spread found in the former analysis. Nevertheless, taking into account the selection of the 6-year period of study, the key figure derived from this analysis is 6.42%.

		1-year	3-years	6-years	Notes	Section
Risk Free Rate	[1]	1,80%	2,64%	3,97%	10-year Spanish bond	5.2.3
Beta	[2]	0,57	0,61	0,64	Single Spot / Re-levered [8] [10]	5.2.3
Market Risk Premium	[3]	4,85%	4,85%	4,85%	DMS - Dutch Approach	5.2.3
Nominal after-tax Cost of Equity	[4]	4,57%	5,62%	7,08%	[1] + ([2] x [3])	-
Risk Free Rate	[5]	0,88%	1,30%	1,91%	10-year Interest Rate Swap	5.2.4
Debt premium	[6]	1,16%	1,19%	1,49%	Credit Default Swaps	5.2.4
Pre-tax Cost of Debt	[7]	2,04%	2,49%	3,40%	[5] + [6]	-
Tax Rate	[8]	25%	25%	25%	Spanish Corporate Tax Rate	5.2.2
Gearing ratio (D/A)	[9]	50%	50%	50%	Proxy based on observed ratios	5.2.2
Leverage (D/E)	[10]	100%	100%	100%	[9] / (1-[9])	-
Nominal Post-tax WACC	[11]	3,05%	3,74%	4,81%	([4] x (1-[9])) + ([7] x (1-[8]) x [9])	-
Pre-tax Allowed Rate of Return	[12]	4,07%	4,99%	6,42%	[11] / (1-[8])	-
Base rate - BOE	[13]	1,8%	1,8%	1,8%	10-year Spanish bond (last 24 months)	5.2
Spread (bps)	[14]	227	319	462	[12] - [13]	-

TABLE 6.2 Numerical results from the first scenario – IRS+CDS

Taking into account both approaches, it is possible to identify a range of the pre-tax allowed rate of return based on the 6-year period; the lower bound is found around 6.03%, while the upper bound around 6.42%. Since both approaches seem to be appropriate for the methodology and they represent the different financing costs of the corporations, this methodology proposes the mid-point of this range – 6.22% – as the best estimation of the pre-tax allowed rate of return; however, it is up to the regulator to decide if the regulated value should be closer to any of these two sides – as previously stated by (Glachant, et al., 2013).

Pure utilities

Once the pre-tax allowed rate of return has been proposed at 6.22% (spread on base: 442 bps), it will be compared against the allowed rate of return (reference value) obtained from the peer group of pure utilities. Parameters and criteria from earlier analysis will remain constant, highlighting the following: a) 6-year period of study; b) market risk premium [3] as the DMS – Dutch Approach; and c) cost of debt [6] as the mid-point between studied approaches. Results from both peer groups are shown in Table 6.3.

		All utilities	Pure utilities	Notes	Section
Risk Free Rate	[1]	3,97%	3,97%	10-year Spanish bond	5.2.3
Beta	[2]	0,64	0,47	Single Spot / Re-levered [8] [10]	5.2.3
Market Risk Premium	[3]	4,85%	4,85%	DMS - Dutch Approach	5.2.3
Nominal after-tax Cost of Equity	[4]	7,08%	6,24%	[1] + ([2] x [3])	-
Risk Free Rate	[5]	-	-	-	-
Debt premium	[6]	3,01%	2,59%	Mid-point between both approaches	5.2.4
Pre-tax Cost of Debt	[7]	3,01%	2,59%	[5] + [6]	-
Tax Rate	[8]	25%	25%	Spanish Corporate Tax Rate	5.2.2
Gearing ratio (D/A)	[9]	50%	50%	Proxy based on observed ratios	5.2.2
Leverage (D/E)	[10]	100%	100%	[9] / (1-[9])	-
Nominal Post-tax WACC	[11]	4,67%	4,09%	([4] x (1-[9])) + ([7] x (1-[8]) x [9])	-
Pre-tax Allowed Rate of Return	[12]	6,22%	5,46%	[11] / (1-[8])	-
Base rate - BOE	[13]	1,8%	1,8%	10-year Spanish bond (last 24 months)	5.2
Spread (bps)	[14]	442	366	[12] - [13]	-

TABLE 6.3 Numerical results from both peer groups – All utilities and Pure utilities

Two main differences between these groups are observed: [2] beta coefficient of the industry and [7] pre-tax cost of debt. Results from pure utilities group are lower than the group comprising all the utilities; still, this result was expected due to their lower riskier nature. Hence, pre-tax allowed rate of return based on pure utilities is 5.46%.

Main scenario: International investors							
		Corp. bonds		IRS+CDS		Mid-point
All utilities	(	6,03%	-	6,42%	)	6,22%
Pure utilities	(	5,34%	-	5,57%	)	5,46%

TABLE 6.4 Ranges and mid-points from both peer groups – Main scenario

Summary of results (mid-points) and ranges are shown in Table 6.4[103]. Spread between final results from all utilities (6.22%) against pure utilities (5.46%) is 76 bps. Although the pure-utilities approach would be more consistent with the purpose of this methodology[104], it is not taken into account since relevant Spanish utilities are not included within this group; therefore, the proposed methodology suggests taking the result obtained from the all-utilities approach.

6.1.2 Sensibility analysis: home bias assumption

The purpose of this supplementary scenario is to provide a sensibility analysis with regard to the main scenario assuming the existence of the home bias effect in the Spanish investment framework. It is important to recall that this effect[105] refers to the fact that investors tend to invest in securities from their same country due to their market knowledge and the existence of transactions costs. Thereupon, the following two assumptions will be considered: 1) only Spanish investors are expected to invest in Spanish networks utilities, and 2) they are not interested to place their money outside Spain. Table 6.6 shows the numerical results from both scenarios.

It is important to note that the only difference between both analyses is found on the [4] MRP; since only Spanish investors are expected according to this scenario, the Spanish market risk premium (3.20%) shall be considered, while the European weighted average (4.85%) – Dutch approach is rejected. Then, changes in cost of equity were anticipated, decreasing around 1% from the first scenario to the second one. However, the overall result from the analysis – focusing only on the allowed rate of return – differs 0.7% from one scenario (6.22%) to another (5.52%).

Furthermore, according to this supplementary – home bias – scenario, the rate of return considering the peer group of pure-utilities would be around 4.94%; again, this approach is also considered only as a reference to understand the allowed rate of return that pure utilities should get. Table 6.5 shows the relevant ranges considering both approaches: All utilities and pure utilities.

Sensibility analysis: Home bias assumption

		Corp. bonds		IRS+CDS		Mid-point
All utilities	(	5,32%	-	5,71%	)	5,52%
Pure utilities	(	4,82%	-	5,06%	)	4,94%

TABLE 6.5 Ranges and mid-points from both peer groups – Home bias assumption

[103] Approach 1: Corporate bonds;Approach 2: IRS+CDS
[104] Computing the allowed rate of return for regulated network utilities
[105] Introduced in section 4.1.1

Notes	Main scenario				Home bias assumption	Notes
10-year Spanish bond	3,97%	[1]	Risk Free Rate	[1]	3,97%	10-year Spanish bond
Single Spot / Re-levered [8] [10]	0,64	[2]	Beta	[2]	0,64	Single Spot / Re-levered [8] [10]
DMS - Dutch Approach	4,85%	[3]	Market Risk Premium	[3]	3,20%	DMS - Spain
[1] + ([2] x [3])	7,08%	[4]	Nominal after-tax Cost of Equity	[4]	6,02%	[1] + ([2] x [3])
-	-	[5]	Risk Free Rate	[5]	-	-
Mid-point between both approaches	3,01%	[6]	Debt premium	[6]	3,01%	Mid-point between both approaches
[5] + [6]	3,01%	[7]	Pre-tax Cost of Debt	[7]	3,01%	[5] + [6]
Spanish Corporate Tax Rate	25%	[8]	Tax Rate	[8]	25%	Spanish Corporate Tax Rate
Proxy based on observed ratios	50%	[9]	Gearing ratio (D/A)	[9]	50%	Proxy based on observed ratios
[9] / (1-[9])	100%	[10]	Leverage (D/E)	[10]	100%	[9] / (1-[9])
[4]x(1-[9]) + [7]x(1-[8])x[9]	4,67%	[11]	Nominal Post-tax WACC	[11]	4,14%	[4]x(1-[9]) + [7]x(1-[8])x[9]
[11] / (1-[8])	6,22%	[12]	Pre-tax Allowed Rate of Return	[12]	5,52%	[11] / (1-[8])
10-year Spanish bond (last 24 m.)	1,8%	[13]	Base rate - BOE	[13]	1,8%	10-year Spanish bond (last 24 m.)
[12] - [13]	442	[14]	Spread (bps)	[14]	372	[12] - [13]

TABLE 6.6 Numerical results from both scenarios – Main scenario and Home bias assumption

6.2 Summary of results

Up to this point, several analyses were carried out taking into consideration the following key issues: 1) Period of study, 2) Cost of Debt, 3) Type of utilities, and 4) Scenarios based on assumptions. Table 6.7 shows the process followed when obtaining the conclusive outcomes for each relevant issue.

Regarding the first point, 3-year and 6-year periods were analysed for both cost of debt alternatives: approach 1 refers to corporate bonds; approach 2 refers to IRS + CDS. It was found that spreads between both periods were 1.35% and 1.43% respectively for each approach. The conclusive outcome regarding the period of study was 6-year period based on a number of reasons explained in section 6.1.1. However, it is important to bear in mind that if very stable periods are expected, then the 3-year period of study might be preferred, and that the 1-year period should always be considered as a reference.

Additionally, both approaches from the cost of debt were compared. As it cannot be possible to select one over another (since both approaches seem to properly represent the cost of debt of the industry at stake) the methodology proposes the mid-point (6.22%) from the range obtained as the conclusive outcome; moreover, the spread (0.39%) between both alternatives is reduced so the mean value can be considered as a good proxy.

Later, an additional analysis concerning the type of utilities provides insights regarding the relevant allowed rate of return that pure utilities should receive (5.46%); due to their lower risk profile, their rate of return should correspondingly be lower. However and as previously announced, this value is only considered as a reference and cannot be taken into account since the peer group of pure utilities used for this analysis excluded relevant Spanish utilities (e.g. Iberdrola, Endesa, and Gas Natural Fenosa). Thus, the value estimated using the peer group of (all) utilities (6.22%) remained as the conclusive outcome for the practical purposes of this methodology.

Finally, a supplementary exploration (sensibility analysis) was carried out regarding different scenarios concerning the expectations on the potential investors in the Spanish electricity network during the next regulatory period (2020-2025); while the main approach (used in previous analysis: 6.22%) considers global investors who evaluates their investment projects at European level, the sensibility approach – supported by the home bias effect – assumes that only local (Spanish) investors will be relevant for the industry. Outcome (considering the Spanish MRP) was 5.52%. Nonetheless, since the main scenario (global investors) seemed to be more robust based on European experience; the conclusive outcome also remained on 6.22%.

Issue	Alternatives			Spread on alternatives	Conclusive outcomes	Considerations
Period of study	3-year	vs	6-year		6-year	
	4,68%	-	6,03%	1,35%	6,03%	Approach 1 / All / Main
	4,99%	-	6,42%	1,43%	6,42%	Approach 2 / All / Main
Cost of debt	Approach 1	vs	Approach 2		Mid-point	
	6,03%	-	6,42%	0,39%	6,22%	6-year / All / Main
Type of Utilities	Pure	vs	All		All	
	5,46%	-	6,22%	0,77%	6,22%	6-years / Mid-point / Main
Scenarios	Sensibility	vs	Main		Main	
	5,52%	-	6,22%	0,71%	6,22%	6 years / Mid-point / All

TABLE 6.7 Conclusive outcomes derived from the analyses performed

Where:

- **Approach 1**: Cost of debt based on average of corporate debt bonds of peer utilities.
- **Approach 2**: Cost of debt based on the sum of IRS plus average CDS.
- **All**: All utilities comprising the peer group of utilities (see Table 5.8)
- **Pure**: Utilities comprising the peer group of pure utilities (see Table 5.9)
- **Main**: Main scenario where global investor are expected.
- **Sensibility**: Supplementary analysis based on the home bias assumption. (Only Spanish investors are expected).

As it can be noted, from all the possible alternatives the conclusive outcome (6.22%) in any case is found in the upper region of the ranges; therefore – based on the assumptions previously described – utilities will be sufficiently remunerated, although other criteria (e.g. pure utilities, 3-year period of study) might argue setting a lower allowed rate of return. However, the conclusive outcome is in line with the fact that this methodology embraces the idea that the costs of underinvestment are higher in the long term that the costs of overinvestment.

Finally, the conclusive outcome is in line with the mandates of the current regulation (see Section 1.2) since the proposed retribution is consistent to a low risk activity and the cyclical situation of the Spanish economy. Additionally, the proposed allowed rate of return is equivalent to efficient and well-managed electricity utilities in Spain and the European Union, having its basis on a peer group of European utilities. Lastly, it is in line with the necessities of investment for the next regulatory period (according to the evolution of the demand) since it can be approached based on the ranges previously proposed; so, in case of any additional remuneration due to an increasing expected demand, the remuneration could be approximated to the upper range of the value provided in Table 6.7.

Chapter 7

Conclusion and future work

7.1 Conclusion

In this work a methodology is proposed to estimate the spread to be added in the allowed rate of return for the next regulatory period (2020-2025) in Spain. It was found that the approximation of the WACC is one of the most common techniques when estimating the allowed rate of return for regulated network activities. Therefore, the procedure of this thesis research was based on such standard: first, the WACC of the Spanish regulated electricity network industry was estimated; then it was transformed into the allowed rate of return at which Spanish network utilities should be remunerated; and finally, the spread was estimated from the average yield of the 10-year Spanish bond (according to the Spanish regulation). These steps are in line with the achievement of the main objective of this research.

Although the estimation of WACC is based on a simple formula – where both types of costs (equity and debt) are weighted average based on the industry financing structure – the calculation of its parameters is not as straightforward as it might be assumed; hence, it was required to perform a benchmarking analysis on different methodologies in order to understand the common practices used by network regulators and the reasons behind their decisions. Besides, theoretical evidence – from academics and financial experts – provided insights regarding principles and concepts that helped during the decision stages.

Also, the proposed methodology took into account the jurisprudence of the Spanish regulator (CNMC). The methodology used in the Telecommunication sector and the methodology proposed by the (CNE, 2008) were analysed. Some important computation methods resulted to be valid for this proposed methodology, although a different approach was selected for others.

Similarly, the Spanish regulation (regarding the network remuneration) played a key role in this thesis research; mandates regarding the considerations to take into account constrained certain decisions regarding the proposed methodology. For instance, the use of "efficient and well managed" electricity utilities in Europe was an important starting point at the selection of the peer group of utilities (see Section 5.2.1).

It is important to remark that the current Spanish regulation entails some characteristics that made this research different from other countries.

The most important one is the fact that the allowed rate of return set at the beginning of the next regulatory period is intended to last unchangeable for the whole regulatory period (6 years); although this could be justified in order to keep a low regulatory risk level (predictability on the rate of return), it is a challenging task to predict the economic conditions for the next 6 years in advance. The main drawback turns to be the mechanisms that might be used in case the economic conditions follow unexpected trends: the modification and publication of an "urgent" rate of return in order to be consistent with the new circumstances is not considered in the current regulatory framework. Therefore, it represents a latent regulatory risk that utilities would like to anticipate.

Thereupon, the proposed methodology considers a longer period of study (6-year) in order to be able to assume different and conservative economic situations and being coherent with the foreseeable reality (neither very pessimistic, nor very optimistic). However, this decision implies giving the same weight to historic and current market data.

Consequently, one of the main recommendations that may result interesting to offer to the Spanish regulator is the application of mid-term reviews and the definition of economic triggers that might activate the examination of the allowed rate of return, and if required, the updating of critical parameters (e.g. Risk Free Rate and Tax rate) if unexpected circumstances appear (this practise is implemented by other European regulators; e.g. Italy and Ireland).

Another characteristic of the Spanish regulation is in line with the application of the same allowed rate of return for both large and small companies, under the premise that consumers should only pay a reasonable and efficient rate of return no matter the size of the utility. As previously analysed, small utilities do not have the same financing possibilities as large utilities do (access to stock and debt markets). Hence, it can be concluded that mergers and acquisition of small companies might be expected in the case that they cannot get financed at the cost of capital ensuing in the proposed methodology.

Lastly, the application of the same allowed rate of return for both existing and new facilities is also a concern that must be taken into account since the revaluation (via URVs) of the existing assets as at 31/December/2014 has already given an extra remuneration to utilities (RAB increased). Recommendations concerning this topic will be discussed as part of further research (see Section 7.2).

On the other hand, one of the main positive features of the Spanish regulation is the ex-ante approval of investment plans since it reduces the risk of disallowances at the estimation of the

RAB. This is important to highlight due to the important concern of the Spanish regulation to reduce the risks involved in the investment process; hence, the expected allowed rate of return for investors should be lower compared to those countries without this ex-ante mechanism.

Regarding the parameters, it was found that the RFR based on the 10-year Spanish bond is equivalent to the RFR plus CRP based on the 10-Year rated-AAA countries plus a Spanish spread. Also, there is no much difference between both ways to estimate beta: average betas or “Single spot beta”. The MRP should be obtained from the average between the arithmetic and geometric means since lack of consensus among experts and regulators was found. The cost of debt could be estimated using either corporate debt bonds or IRS plus CDS, although book values of debt were also obtained as a reference. The tax rate that should apply is the statutory tax rate of Spain. Lastly, the optimal gearing ratio can be gotten from an approximation of observed ratios (average of peer utilities) and reference values from regulatory precedents.

Finally, concerning the conclusive result obtained (range: 6.03% - 6.42%; midpoint: 6.22%), it was interesting to find that this range is in line with the current allowed rate of return (6.503%) in force until 31/December/2019; however, it must be highlighted that the current allowed rate of return is still higher than the upper part of the proposed range assuming that this range should be applied for the next six years[106]. Therefore it might be concluded that, according to the data and the methodology proposed by this research, Spanish network utilities will be slightly over-remunerated (0.08%) in accordance to the upper value of the proposed range (6.42%) for the remaining years of the current regulatory period (3 years). Nevertheless, this regulation decision cannot be judged straightforwardly based only on these figures; it is also important to understand and analyse the investment necessities in Spain in 2013, when the current allowed rate of return was set and the economic and industry contexts that prevailed at that time.

Moreover, if strictness was enhanced regarding the critical companies that should only be taken into account due to their high network component - pure utilities), the allowed rate of return would be lowered and the spread between the current allowed rate of return and the proposed by this methodology would be increased. Nevertheless, pure utilities methodology might not represent the reality of the Spanish industries since only two utilities would be included (REE and ENAGAS).

7.1.1 Limitations of the proposed methodology

One of the most important limitations of this paper refers to the little representation of small distribution utilities in the proposed methodology due to lack of market data. The actual cost of debt of small utilities can only be approximated throughout book values; however, this proposed methodology – as most of other regulators – suggests the use of market data. Hence, this methodology gives a higher value to market data over the accurate representation of small

[106] The proposed range is based on the analysis performed with data until 29/April/2016 so it would be reasonable to think that this proposed allowed rate of return should apply for the next 6 years.

companies. This is based on the assumption that consumers should pay only a reasonable and efficient rate of return no matter the size of the utility.

Additionally, it is noteworthy that this methodology can also be applied to the gas sector since the peer group of utilities involves both industries; however, it cannot be directly used since its remuneration scheme (regulation) is different from the one used to achieve this methodology. Therefore, the regulation of the gas sector should be reviewed in order to adapt a new proposed methodology.

7.2 Future work

Although this methodology embodies by itself a big step regarding an orthodox estimation of the spread to be added to the allowed rate of return, there are certain pending issues that could be further developed in order to endow the proposed methodology with more significance when tackling supplementary objectives and concerns in the near future; thus, three issues will be presented in this section.

First, section 5.3 provides a qualitative analysis regarding the application of this methodology in the allowed rate of return estimation for other regulated activities in Spain; specifically, smart grids investments, RES generation and generation at isolated systems. Even though the qualitative analysis contributed with important clues regarding the factors that should be readapted due to the different nature of these regulated activities, it would be interesting assessing the numerical outcomes after a quantitative analysis would be carried out; therefore, three separately methodologies (for each regulated activity) should be developed based on this research. Nevertheless, huge variations from this proposed methodology are highly inadvisable since methodologies to estimate the allowed rate of return in the Spanish energy industry should try to be consistent among them.

A second interesting analysis is related with the additional remuneration acquired by the utilities derived from the revaluation of their existing assets as at 31/December/2014; as previously mentioned in section 3.2.3, utilities got an extra compensation since their RAB increased in real terms. Therefore, it could be advised to approximate the extra remuneration that utilities obtained from this process in order to properly estimate their total retribution once the allowed rate of return is applied to their RAB. However, this analysis might only be regarded as a reference figure since Spanish regulation stipulates the application of the same allowed rate of return indifferently to both existing and new facilities. In other words, it would be more preferable and more reasonable applying a lower rate of return to the existing assets (as their RAB increased) and a higher rate of return for new facilities (in order to incentivise investments).

Finally, it could also be remarkable performing an analysis of the expected investment needs for the next regulatory period subject to demand forecasts. This would give a better understanding regarding the appropriate incentives that must be deployed to achieve these goals. It is important to recall that an allowed rate of return closer to the upper part of the range would be advisable if many investments are required; conversely, a lower rate of return would not properly incentivise network reinforcements and new developments, so the security of supply could be jeopardised.

Appendices

Appendix A

Logos of Spanish utilities

Utility	Parent company	Subsidiary
Red Eléctrica de España	RED ELÉCTRICA CORPORACIÓN	RED ELÉCTRICA DE ESPAÑA
Endesa Distribución Eléctrica (former)	Enel; endesa	endesadistribución
Endesa Distribución Eléctrica (new)	enel endesa	endesa Distribución
Iberdrola Distribución Eléctrica	IBERDROLA	IBERDROLA Distribución Eléctrica S.A.U.
Unión Fenosa Distribución	gasNatural fenosa	UNION FENOSA
Hidrocantábrico Distribución Eléctrica	edp	edp hc energía
Viesgo Distribución Eléctrica	viesgo	viesgo DISTRIBUCIÓN

TABLE A.1 Logos of Spanish utilities

Appendix B

Completeness test

This test was performed in order to get an estimation regarding the data that has complete data. The Table B.1 below shows the percentages of companies which hold the totality of the data with reference to the main parameters of the methodology – Leverage, Book values, Betas – in each period of study proposed in Section 5.2.1.

As it can be noted, 12-year period turned out to have the worst results compared to the other periods. This can be justified by the missing information regarding long periods of time and the few stored records in the data source (Bloomberg). Additionally, the longer the period, the bigger the chances that relevant utilities were not listed since the beginning of the period of study. For instance, **REN – Redes Energéticas Nacionais** was listed in the stock market for the very first time on 09/July/2007[107]; therefore, it is explainable that all market data previous to this date are missing.

		Gearing ratio	**Book values**	**Betas**
1 year	2015-2016	85%	70%	80%
3 years	2013-2016	84%	70%	80%
6 years	2010-2016	83%	69%	80%
12 years	2004-2016	54%	50%	63%

TABLE B.1 Proportion of utilities with complete information for each period of study according to relevant WACC parameters

[107] According to its IPO date (Initial Public Offerings): http://www.ren.pt/en-GB/investidores/informacao_da_sociedade/

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