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"Financial structure, capital costs and investment risks for European
Transmission System Operators"

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Abstract- Historical power companies being split in many entities 15 years ago, each European country has a regulator for the transport and distribution of electricity. The transport is carried on by a regulated monopoly called a transmission system operator (TSO). Those companies are either state or publicly owned and this ownership has an impact on the WACC of a company. In this research, the different costs of financing used for CAPEX are analysed and it is shown that publicly owned companies have average costs above state-owned companies.

Keywords: Regulation, TSO, Ownership, Investments

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List of abbreviations

ACER – Agency for the Cooperation of Energy Regulators
CAPEX – Capital Expenditure
CAPM – Capital Asset Pricing Model
CEER – Council of European Energy Regulators
DEPR – Depreciation allowance
DSO – Distribution System Operator
ENTSO-E – European Network for Transmission System Operators for Electricity
EP – European Parliament
EU – European Union
GWh - GigaWatt-hour
IEM – Internal Energy Market
ISO – Independent System Operator
ITO – Independent Transmission Operator
NRA – National Regulatory Authority
OpEx – Operational Expenditure
OU – Ownership Unbundling
RAB – Regulatory Asset Base
RoE – Return on Equity
RoR – permitted Rate of Return
TotEx – Total Expenditure
TSO – Transmission System Operator
WACC – Weighted Average Cost of Capital

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Part I: Introduction

Among all the types of energy used in Europe, electricity is the one we are most depending on. Since 2010 more than 3,1 million GWh are produced each year¹. Although the total amount of power generated is stable, the consumption in the EU has never reached a higher level. This is due to the technological environment in Europe as electricity is required for many reasons in the everyday life; to have light, to heat or cool food or rooms, for electronic devices, communication, comfort... To have access to electricity almost everywhere in Europe is a great chance and an attractive feature for international companies. But only a few people know the way that electricity uses from its generation until it reaches its final use.

Historically, each European country had a national company for energy, a monopoly, which role was to produce, transport and deliver electricity to every consumer. With the liberalisation of the market for energy in the early 2000, the system has changed. There are actually four dominant actors: the generator, the transporter, the distributor and the retailer. Generators are companies which produce electricity from different resources like oil, gas, coal or uranium for thermic or nuclear power plant. There are also sustainable energy² production technologies like windmills, hydroelectric power plants, solar panels or geothermal energy. After electricity is produced it is sent to the grid through a transformer. Those power lines belong to a Transmission System Operator (TSO). A TSO is in charge of transporting high voltage electricity (around 70 kV to 380 Kv) through a country or a region and to satisfy supply and demand. After its transport, electricity has to be distributed. That is the role of a Distribution System Operators (DSO). They carry power through lines of medium and low voltage (110 kV and lower). Finally, there are the retailers who take the electricity from grids and supply it to final consumers. Generators and retailers are in a competitive market while transporters and distributors are regulated monopolies. For this research, the focus is set on the transport part of the chain with TSOs.

In all European countries except the UK and Germany, transporting electricity is still carried out by a monopoly. As this practice is in contrary to what the EU aspires to create, the European Parliament (EP) voted laws in 1996 that would set up a regulator for each country.

¹ Eurostat, "Production et consommation d'électricité, aperçu du marché"

² "Sustainable energy is the form of energy obtained from non-exhaustible resources, such that the provision of this form of energy serves the needs of the present without compromising the ability of future generations to meet their needs" Wikipedia

For many countries, the transposition (or ratification) into national law occurred in the late 1990s, with liberalization directives passed in 1996 and were established from 2000 onwards.

Further to this initial regulatory law, the IEM, set up by the European Commission, produced the Third Energy Package in 2009. The main elements of the Package were the protection of consumers; the “unbundling” of Transmission and Production/supply activities and the increased power and independence of National Regulatory Authorities (NRAs). In addition to these measures, two other entities were created to improve and monitor the speed with which the single market for energy³ was established: the so-called Agency for the Cooperation of Energy Regulators (ACER) and the European Network of Transmission System Operators for Electricity (ENTSO-E). The Agency for the Cooperation of Energy Regulators has as an overall mission “*to complement and coordinate the work of the national energy regulators at the EU level and work towards the completion of a single EU energy market for electricity and gas*”⁴. The second mission of the entity is to maintain a safe and reliable transmission network, promote the development of an interconnected European grid, create the basis for a transparent and integrated market for electricity and finally, give better access to sources of renewable energy to help attain the objectives for greenhouse gas reduction set by the EU⁵.

With a liberalized and fully-integrated energy market, consumers across Europe have been predicted to save up to €13 billion⁶ a year in energy costs. However, to achieve this, many challenges have still to be faced. The European Union (EU) side has already fulfilled its part of the work as regards legislation and goal-setting. Now the time had come for TSOs and governments to take on their part of the job.

Under the conditions of the new legislation, each Member State of the European Union has to appoint an independent regulator to monitor the domestic and internationally-linked electricity and gas markets. NRAs were granted specific powers, which are regularly strengthened by EU guidelines and legislation. Regulators are not only the watchdogs of a single market - they also shape it. Part of their remit is to give advice and information to governing bodies and to their own consumers on the energy market in general. They make sure every entity concerned applies and respects the laws, rules and provisions of the

³ European Commission, *The entry into force of the EU third energy package*, http://ec.europa.eu/energy/gas_electricity/legislation/doc/20110302_entry_into_force_third_package.pdf

⁴ ACER http://www.acer.europa.eu/The_agency/Mission_and_Objectives/Pages/default.aspx

⁵ ENTSO-E <https://www.entsoe.eu/about-entso-e/inside-entso-e/mission-and-vision/Pages/default.aspx>

⁶ European Commission, *Citizen's summary on Single Market for Gas & Electricity*, http://ec.europa.eu/energy/gas_electricity/doc/20121115_iem_citizens_summary_en.pdf

legislation. They are also required to guarantee competition and independence among the operators in the supply and production chain. A further objective of the regulator is to secure a constant and equal supply of energy and provide fair access to everyone. By extension therefore, the NRAs is also required to manage and control both the transportation and the cost of distribution of its electricity supply.

Moreover, regulators have the power to fine companies who do not abide by the law or demonstrate sufficient use of their capacity to do so.

To ensure fair competition and independence, the Third Energy Package requires an ‘unbundling’ of the transport of electricity and its production or supply. This particular provision contained in the Package was intended “*to create incentives for the necessary investments and guarantee the access of new market entrants*”⁷. Historically, there has often only been one operator in any given country. Even after liberalization and the breakdown of parts of the chain, some parts still remained inextricably linked.

Currently only three kinds of ‘unbundling’ are allowed by the EU⁸ under this specific ruling. By far the most popular is Ownership Unbundling (OU), where less than 25% of the shares of a Transmission System Operator (TSO) come under the control of any other operator on the market. This is the main choice among the principle TSOs (Elia, operating in Belgium, is a good example of this).

The second possibility, which is also the second most often used a kind of unbundling, is the setting up of an Independent Transmissions Operator (ITO). Companies often resort to this measure when a company has been organised vertically since its inception. . A good example of ITO is in the French market. Before liberalization, the national state company, Electricité de France (EDF) was responsible for all four areas of production, transport, distribution and the supply of electricity. Now, due to the ‘unbundling’ regulation, EDF ensures the production of electricity; while in terms of supply, EDF is in competition with many other newly formed companies. As for transporting electricity, it is the Réseau de Transport d’Electricité (RTE) who is responsible, while Electricité Réseau Distribution France (ERDF) is the main distributor with 95% of the network under their management. Importantly, both of

⁷ Electricity Directive 2009/72/EC

⁸ CEER (2013), Unbundling Models in the EU and certification of TSOs in Germany, http://www.ceer.eu/portal/page/portal/EER_HOME/EER_INTERNATIONAL/EU-US%20Roundtable/10supthsup%20EU-US%20Roundtable/10th%20EU-US_Session%20V_Groebel%20-%20unbundling.pdf

these companies are 100% owned by EDF. For a complete 'unbundling' under the terms of the legislation, each of the companies has to maintain a separate accounting system from EDF and have a different management team, working independently of each other. This principle or practice is also known as Legal Unbundling.

The third possibility of unbundling is to set up an Independent System Operator (ISO). In this particular case, the transmission network remains under the ownership of the parent company but the operation and the day-to-day control of operations becomes the responsibility of an independent systems operator. This particular option is used in Latvia, for example, but otherwise is not widely in use.

As mentioned above, the unbundling operated within this sector has led to a cut-off in the electricity supply chain across Europe. This has had a positive effect because it has brought about more competition in the market and has led to lower prices for consumers. Whereas there was only one company responsible for the chain 20 years ago, there are at least four today. With the "creation" of these new entities, a new phenomenon has been introduced, which had not been the practice earlier, namely that the arrival of companies into private ownership in a market had hitherto only been managed by state-run companies.

The arrival of private shareholders follows the trends of privatization triggered in the early 1980's in the UK. At that time the British government of Margaret Thatcher had an important necessity of cash and wanted to reduce the intervention of the state on the economy. Many world-wide know companies like British Petroleum and Rolls-Rolls went public.

The next years many Europeans countries caught the train and also started to privatize. This wave lasted more than 15 years emphasized by the European Union which led a policy of wider market competition and fewer stranglehold of governments on their national economy.

The impact of this policy is mitigated depending on the sector. For governments it has led to a reduction of costs but also a drastic reduction of revenues. The sale of companies was good for the budget on the short run but is not a long run solution. Especially in England, the privatization of health care, railways, etc... led to a very important increase of the prices charged to consumers due to the position of natural monopoly.

Seeing what happened in the past, the European Union had another reason to set up a national regulator when the electricity supply chain was cut off, transmission and distribution companies being monopolies.

1.1 Summary

The Transmission System Operators (TSOs) are the companies that are responsible for the transport of high voltage electricity and the security surrounding the supply of electricity. Their key role lies between the initial stage of production and the final distribution of electric power to businesses, public institutions, homes etc. Most of these companies are still state-owned, largely for historical reasons, but some have taken the advantage of the liberalized market to become partly publically owned. As these are natural monopolies, the EU has set out to regulate them. Prices charged by the TSO must be approved by the NRA and a full unbundling with the companies working on the power chain is required. Therefore, the creation of national regulators for the energy market received a favorable vote in the European Parliament.

Regulators work with their affiliated companies to determine the prices charged and the returns that electricity transmission companies can expect over the next years depend on the regulatory policy in the country concerned.

1.2 The core of the study

We now have a situation in Europe that is clear and well based; Regulators have learnt how to deal with their affiliated company, they can rather accurately estimate the effective costs of the TSO and provide them enough return to be sustainable. It will be shown *infra* how the revenues of a TSO are calculated. Seeing this, one can notice that the formulae used do not take into account the diversification of the ownership. Many people know that the ownership of a company has an important role for the business, state-owned companies being more social welfare oriented while publicly owned companies seek rather profit. The costs, the risks, the strategy and many other parameters change depending on the ownership of a company.

This study analyses a sample of TSOs in Europe to verify some hypothesizes: A state-owned company is less risky than a privately-owned one which means that the first one has to pay less for its indebtedness. Private investors seeking profit, mainly privately-held companies should pay more their shareholders and have then a higher cost of equity. To compare both

factors the Weighted Average Cost of Capital (WACC) is used as it offers a global vision of the different costs.

The goal of this study is to explain the different WACC factors of a TSO depending on its ownership.

1.3 The Limits of this present Study and its Primary Focus

This present study is limited in several areas, primarily by its focus. The overall intention of this study is to examine the European Transmission System Operators specifically for the electricity sector. This is a choice driven by two reasons: both a personal attraction to the electricity sector as opposed to the gas sector; and on the appraisal that the gas and electricity sectors are too different in terms of their supply and distribution and their implications to be examined together in one study. In terms of examples, very few TSOs deal with both the electricity and gas markets in their particular country or across Europe. Moreover, the consumption of gas is more elastic than the market for electric power. It was felt that a similar study of gas TSOs could be treated with more interest separately.

The used database is constituted of 16 European TSOs, of which nine are public and seven are private. This database combines the biggest companies in this particular utility sector. The drawback to focusing on this particular sample of companies is that the ENTSO-E - the European Network of Transmission System Operators for Electricity - counts 41 members, including this sample included. The data originates from annual reports for the period 2011-2013, with perhaps a margin of error allowed for different currency conversions, as every figure was converted into euros. The difference or change in accounting standards among companies in the database may also have had a slight but only a very limited impact on the accuracy of the figures given. Another reason to choose this 3 years period is the relative stability of the companies. Before 2011 many mergers and acquisitions or change in the capital structure occurred which could lead to several bias.

The focus is set on the different aspect of the WACC. So the regulation approach is tackled with some financial support like ratings and financial reports. Among the expenditures of a TSO only CAPEX is analysed here, OPEX being left out of the scope. A short analysis of the ownership structure will help to determine if it has an impact on the WACC. Physical and

logistic aspects are also left aside. Grids are supposed homogenous which means that only the size of the lines matter and not the different voltage supported.

There is no extensive literature on the subject of specific ownership structures and related issues. Although this is not the primary focus of this study, further research is called for, to explore related themes. These will be given in the conclusion below.

Part II: Methodology

2.1 Literature Review

The literature used for the study deals principally with the ownership, regulation and investments made by Transmission System Operators. A majority of authors focus on the utility sector and specifically on the US market but there are some concepts and practices that are also relevant for the utility sector across Europe, both in the EU Member States and in non-EU countries. In addition to the concepts and practices that have already been explored in the introduction, several more will be developed here.

2.1.1 CAPEX Regulation

The literature on the features of capital expenditure (CAPEX) regulation is relatively limited, although it is an important feature for TSOs and their private shareholders. It is important for TSOs to maintain steady levels of investment to keep their grid reliable increase their efficiency and even expand in size, both in terms of capital and infrastructure. Investors may be reluctant to put money into these projects if they know they could be exposed to *ex post* expropriation by government or even by the regulator. This is what Helm, Hepburn and Mash (2004) calls ‘the time-inconsistency problem’. To counter this risk a number of measures have been introduced by regulators, among which the Regulatory Asset Base (RAB) is the most widespread. Helm (2006) defines the RAB as “the investors’ stake in the business, for which a return is required and its depreciation represents the eventual return of capital”. Those assets allow investors to recover their investment capital fully and enjoy an average level of remuneration. However, while this method may give an incentive to existing investors to retain their investment at a higher rate of return, this is still not enough to attract new investors.

The usefulness of adding assets under construction to the RAB is arguable because, on one side users pay for a future service; moreover investors are given the incentive to allow construction to take longer because they receive dividends on their investment even though

the asset is not yet usable. On the other hand, by not adding assets under construction prices will rise for consumers just when assets are included in the regulatory asset base.

CAPEX can thus be seen as a key factor in the utility sector, which has to be taken into account before deciding on various policy strategies because the risks for a TSO have important financial implications. Investing in research & development to reduce loss of power or costs become sunken costs until the point when they lead to innovation. Grid expansion is also a risky area of strategy, but this is dependent on the regulations in place. If consumer tariffs do not take into account the overall cost of new infrastructure before construction has been completed, investors will have to wait a considerable time before earning anything in return.

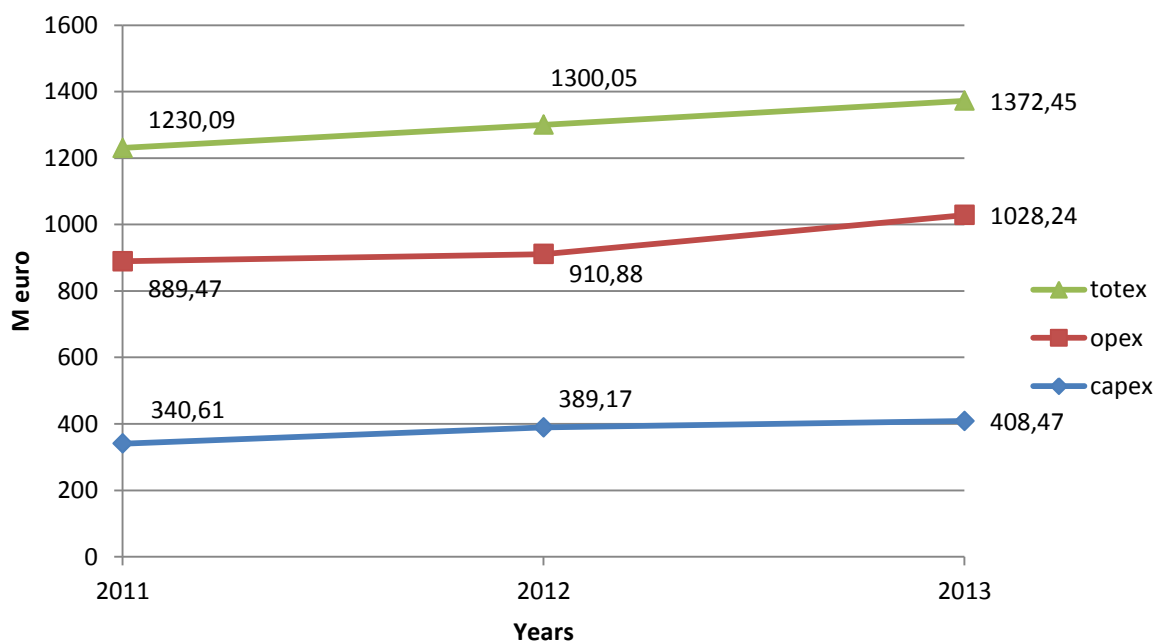


Figure 1: Evolution of CAPEX, OPEX and TOTEX over the period 2011-2013

The graphic above shows the average CAPEX and OPEX of our sample over the period 2011-2013. The TOTEX line is the addition of both lines under. During the period 2011-2012 the CAPEX increased more than OPEX with respectively +14.26% and +2.41%. Over the period 2012-2013 the trend changed and OPEX variation was higher with +12.88% than CAPEX with +4.96%. Over the whole period 2011-2013 CAPEX increased more than OPEX, +19.92% against +15.6%. Due to the high amount of investment required by TSOs to meet the EU objectives it is normal to see CAPEX increasing faster than OPEX.

2.1.2 Global Costs of a TSO

To keep their businesses running, TSOs need the regulated prices to cover at least their running costs. However, regulators make a distinction between operational costs and investment costs. Operational costs are often called Opex or Operational Expenditure, which includes the day-to-day running costs of the company such as the wages, maintenance costs, taxes, insurance etc. Most Opex costs can be anticipated and accounted for in the annual budget. Depending on the levels of national regulation, these costs can also be recovered by the cost of electricity or the price charged to the consumer. The second set of costs is known as CAPEX, or Capital Expenditure. From a regulatory point of view, CAPEX may vary from one country to another. Nevertheless, basic capital costs⁹ are covered by price and recovered by the depreciation of assets¹⁰. They also allow a pre-determined return on the Regulatory Asset Base (RAB)¹¹.

In sum, these costs can be regrouped into two formulae¹². As a TSO requires its costs to be covered, so it can be deduced that:

$$(1) \quad RR = OPEX + CAPEX$$

Where CAPEX can be defined as:

$$(2) \quad CAPEX = DEPR + (ROR * RAB)$$

Where, RR = Required Revenue

DEPR = Depreciation Allowance

ROR = Permitted Rate of Return

RAB = Regulated Asset Base

⁹ The formulae and the following comments are taken from the IERN 2010 study “*Overview of European Regulatory Framework in Energy Transport*”

¹⁰ The NRA fixes for each class of assets a rate for the depreciation.

¹¹ In IERN 2010: One of the challenges of regulating utilities is ensuring an appropriate level of incentive for investment and reassuring investors that they will not be exposed to *ex post/postiori* expropriation by politicians and regulators thereafter. This problem is commonly referred to as a time-inconsistency problem (Helm, 2009 p.5). One measure to deal with such a problem is the RAB concept, which implies the full recovery of investor’s capital investment with a fair level of return. As such, RAB serves as a safeguard for investors and incentivizes further investments by existing or new investors. Helm (2009) defines RAB as the set of assets within the regulated entity that are necessary to carry out the normal functions of a business.

¹² See footnote n°8

The purpose of these formulae is to illustrate that the rate of return permitted in the CAPEX equation forms the base of this current research.

2.1.3 Focus on the Return

To attract investors and retain existing ones, regulators have to ensure a “fair return”, as provided in the ROR calculation above. This return must give enough incentive to investors so they will commit funds to a project or company. Assessing an expected return of a TSO is not an easy task as the regulator has to reward the investor with the same return as he would have received if he had invested in another company with the same evaluated risk.

The Weighted Average Cost of Capital (WACC) is a key factor that is used by many European TSOs. It has many advantages as it is easy to compute and it is not volatile by nature so the rate does not lose within the year. However, the WACC is sensible to variation of the capital structure of a TSO unlike what Modigliani and Miller affirmed in 1958. They actually claimed that, under certain conditions¹³, the value of a firm, and thus its assets, is independent of the capital structure of the company. By extension, the purchase of a significant asset either by debt or equity will not impact the firm value. But the reality is different because their assumptions are not realistic and because the capital structure has an impact on the riskiness of a company and thus its value. If a company needs to do CAPEX then funds will be required, either by debt or equity, and it will directly impact the WACC. Krüger, Landier and Thesmar (2011) claim that the WACC should not be used to determine whether or not a firm should invest because “firms should value any project using a discount rate determined by the risk characteristics of the project”¹⁴. Nevertheless, TSOs use it to determine what would be a fair and permitted rate of return. Mitra (2011) writes that the WACC should be adapted to each project, as risk varies from company to company. He proposes a revisited WACC formula that takes both market and book value into account. In 1993, Bierman led a survey that came to the conclusion that 93% of companies keep the same WACC for all their projects. For Miles & Ezzel (1980), the only way to have a correct valuation with the WACC is to keep up a constant gearing through time.

¹³ In a world without taxes, transaction costs and where markets are efficient.

¹⁴ Krüger *et al* (2011)

As for firms which are regulated, there are two approaches¹⁵ to dealing with the cost of debt incurred under the WACC on the one hand, and the return on equity based on the Capital Asset Pricing Model on the other. These differences are noticeable when comparing the French and Belgian regulatory approaches. In France, the approach towards the WACC is rather basic, in that the cost of equity is added to the cost of debt. In Belgium, however, the approach is different. Here, the cost of the debt part of the WACC equals zero. The Belgian regulator took the decision to encourage an ‘embedded debt’ approach as a less costly option for consumers, but only as long as the Belgian TSO kept the level of its current rating (A- in the long term). The embedded debt approach offsets the nil cost of debt, by passing off these costs through tariffs or consumer prices.

From a financial perspective, the easiest way to determine this return is to use the Weighted Average Cost of Capital (WACC). The WACC also constitutes the minimum return a company requires in order to invest in a project and develop or maintain its existing value. If you take into account the fact that the firm has two possibilities of financing - either by equity or by debt the WACC can be calculated as a balance between the cost of debt and the cost of equity regarding the capital structure.

In mathematical terms, this can be described as:

$$(3) \quad WACC = \frac{R_E E}{E + D} + \frac{R_D D}{E + D}$$

Where, R_E = cost of equity

R_D = cost of debt

E = market value of the firm’s equity

D = market value of the firm’s debt

The left (right) part of the sum is the percentage of financing that constitutes equity (debt).

The removal of the tax element is done on purpose as this is not relevant for this study, which intends to focus primarily on pre-tax WACCs.

As can be seen, this formula is used to calculate returns but does not take into account the structure of ownership. As such, a company that is either publicly or state-owned and presents the same risk and financial structure are likely to have the same returns.

¹⁵ Oxera (2013) discusses these approaches further

To understand this, it is important to establish what is behind the cost of debt and equity so as to ensure minimal or no impact of the business owner on the WACC of a TSO.

2.1.4 Cost of Debt

To fund new investments, companies need to either borrow money from financial institutions or issue bonds. The interest rate paid on borrowing depends on the credit rating of the TSO.

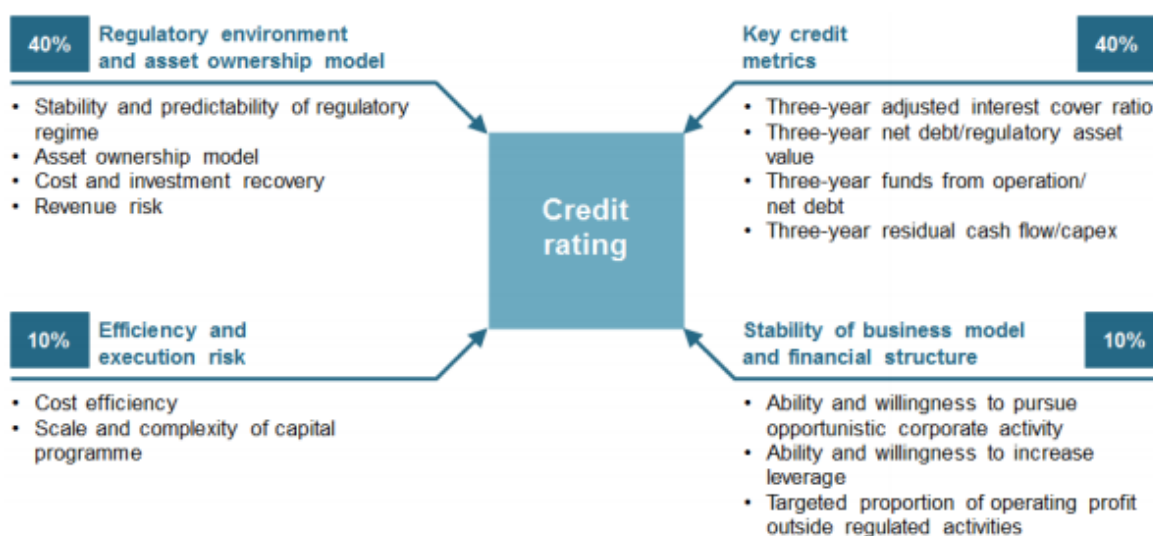


Figure 2: Credit Rating Factors and Weighting (Source: Moody's)¹⁶

The Roland Berger study (2011) shows that most TSOs, except for those that are state-owned, have a determined credit rating. Others have “no meaningful rating or no rating at all”. As a result, the sovereign rating can be used as the main indicator. Ratings are of vital importance in raising funds. Without a credit rating, a TSO can only borrow money from a bank that offers a low volume with a high rate. However, a notation does have the added advantage of allowing easier access to the bond market and, in consequence, to “a theoretically unlimited source of funds” with better interest rates. This study also shows that TSOs should not encounter difficulties in borrowing and repaying as long as their rating is in the “investment grade” range (i.e. A rating at the level of BBB- (S&P, Fitch) or Baa3 (Moody's)).

¹⁶ Figure found in Roland Berger (2011)

Theoretically, 2 companies with the same credit rating should pay the same interest rate on their borrowing as they show same similarities. The reality is different because the ownership structure has a direct impact on interest rates. Therefore it is highly probable that a state-owned company enjoys a lower interest rate than a privately-owned company of the same credit rating.

2.1.5 The Cost of Equity

Shareholders are individual investors, or private or public entities who support a company by acquiring stocks or bringing assets to the company. Like any other investor, they require a monetary return on the risk they take by investing in that company. This return is known as a dividend; and is paid out quarterly or annually, and varies according to any profits the company may have made over the period. In Europe's utilities sector, the NRAs use the CAPM to calculate the cost of equity:

$$(4) \quad R_E = R_F + \beta_E (R_M - R_F)$$

Where, R_E = Cost of Equity

R_F = Risk free rate¹⁷

β_E = Beta of equity¹⁸

R_M = Expected market return¹⁹

The cost of equity can vary considerably depending on the specifics of each country. This is due to the fact that the risk-free rate is different for each TSO. TSOs are generally considered low risk companies because they have highly predictable cash flows, where beta is lower than 1. Finally, the market premium is calculated as the difference between the expected market return and the risk free rate.

¹⁷ The risk free rate is the minimum return an investor can accept by which he can lend his money with no risk. For any additional risk the investor requires a higher potential return on his investment. In this instance, the sovereign bond interest rate is often used as the reference for calculating this return.

¹⁸ The beta of equity is the volatility of an equity compared to a its benchmark. A beta that equals 1 means that security moves along the benchmark. A beta greater (lower) than 1 means that the security is more (or less) volatile than the benchmark.

¹⁹ The expected market return is the return that investors can expect from the market (i.e. the expected return of the S&P 500 or the EuroStoxx50).

As can be expected, there is no impact of the ownership structure on the cost of equity. This is because it is the national regulator that fixes the rates applied, which prevents the company from recovering the total cost of the equity.

2.1.6 Summary of the different costs

The formulae above are intended to demonstrate that in the European transmission of electricity sector, the kind of shareholders has no impact on the return allowed by regulators. Levels of regulation being so different between countries, state-owned companies receive sometimes higher rates of return than public companies. Nevertheless, to ascertain whether a company's ownership structure does or does not play a role in the various components of the WACC, companies need to be put to the test. The question can be asked as to whether state-owned companies have lower than average costs because of the increased opportunities it has to acquire cheaper debt? If this is the case then the ownership structure can be taken into consideration when establishing the rate of return allowed. This also implies that the regulatory conditions are working efficiently. If this is not the case, then the reasons for this inefficiency will have to be further investigated.

Since the arrival of the Internal Energy Market, Transmission System Operators are required to invest in so-called grid growth. This could also be expressed as the capacity of the network to be improved and the countries more interconnected. Much research has shown that the financial capabilities in the sector are weak in the face of the investments required. Some regulators already give incentives with added returns depending on CAPEX but this is not enough. As underlined by Glachant, Saguan, Rious and Douguet (2014), setting a higher return on equity in order to attract investors is preferable than offering incentives for investments. This is because TSOs face a greater financing problem than finding investors with sufficient will to invest. For this reason, the authors recommend balancing both these factors. Nowadays, investors are reluctant to put money into these businesses, specifically because returns are low. To find fresh money for investments, however, TSOs are obliged to borrow on the financial markets. The problem with borrowing money is that it increases the part of debt in the capital structure which implies higher risk for investors and a risk for the company to see its credit rating downgraded. Therefore regulators set a limit to the gearing in order to avoid such problems and keep their regulated company within the investment grade category of credit rating.

To create an efficient IEM, the European Union needs to maintain a fair level of competition among its members. One aspect of this mechanism is for the EU to secure financial competition in an integrated market. Both costs and returns should reflect the reality of a company's profile depending on its ownership structure. It would not be fair for a state-owned company to enjoy a high level of return and maintain low levels of capital and debt costs, while a public company with higher costs sees its return limited by the regulator.

In a nutshell, on the one side TSOs are limited in terms of debt and are limited on the other side by their need for money that can be generated through equity. If a TSO succeeds in balancing both sides, their gearing will come down and they can be in a position to be able to borrow money again. If, however, investors find the rate of return too low the regulators will need to provide them with new incentives. One of those incentives could be to include the ownership structure and give additional returns in proportion to the quantity of privately owned shares or otherwise provide new incentives to attract new shareholders.

2.1.7 Regulations governing TSOs

TSOs are regulated by a wide range of regulations²⁰, of which three are considered the most important and most widely-used across Europe: the Rate of Return (RoR) regulation; price/revenue cap regulation; and benchmarking regulation.

CAPEX and TSO regulations are inter-linked because regulatory policies affect investment decisions in respect to their type, whether they are cost-reducing or infrastructure-based (Armstrong and Sappington 2006; Guthrie 2006). In the case of a RoR regulation, firms tend to (over-)invest in infrastructure on the premise this investment will increase their overall profit with a guaranteed rate of return. Furthermore, these firms are seen as less risky due to their continuous income cash-flows. Firms are reluctant to invest in long term cost-reducing infrastructure because they will not make any profit from this. Cases illustrating this have been presented and discussed by Averch and Johnson (1962). However, this kind of regulation is rarely used in Europe nowadays, as regulators prefer to give TSOs sufficient incentive to invest in both types of investment, both in new infrastructure and with a cost-reducing effect on overheads.

²⁰ Further explanations on the different regulation approaches are given in Jamasb and Pollitt (2000)

The Price Cap Mechanism, first addressed by Littlechild (1983), is one of the first responses to RoR regulation. Here the National Regulatory Authority (NRA) looks at the different costs, controllable or otherwise, borne by a firm, that have an influence on the upper limits to price-setting. As regulators tend to set the maximum price possible for a product this method invites firms to invest in cost-reducing activities. By contrast, Cambini and Randi (2009) say that price-setting in such a way “may weaken the incentive to invest in new infrastructure”. It is also important to set a fair ceiling to prices. Burns and Riechmann (2004) explain that prices that are set too low could lead to an excessive need to reduce operating expenses (OPEX) which thus entail a long term and perhaps costly deterioration of the grid network. The solution they propose in this regard is to introduce a Comparative Efficiency Analysis, best known as benchmarking regulation.

NRAs tend to use benchmarking more and more as part of their regulation. Haney and Pollitt (2009) illustrate that more than the half of regulators use benchmarking, or at least try to implement it in their regulations. They add that TOTEX and OPEX are the main benchmarked features. In Europe many NRAs cooperate to assess the most efficient costs and “develop an international sample of comparative companies”²¹. Depending on the size of the sample, different techniques can be used, such as Data Envelopment Analysis; activity benchmarking; and Stochastic Frontier Analysis, among others. Burns and Riechmann (2004) assert that benchmarking regulation provides balanced incentives over time. This helps to avoid ‘cyclical investment’, whereby investment is spread unevenly over a period of time. They insist upon giving equal treatment to OPEX and CAPEX; and advise regulators to avoid rules that would give incentive to increase or adjust both the inputs (costs) and the outputs (quality of service) simultaneously.

The main drawback of this method of regulation is the difficulty in being able to compare different characteristics with low quantities of data²².

Finally, and most importantly for a TSO shareholders and money lenders require a consistent and stable regulatory framework in order to invest and keep their position. This is due to the fact that TSOs are far-reaching companies in terms of investment and life-span.

²¹ See E3GRID2014 for more information

²² See Glachant, Saguan, Rious and Douguet (2014).

2.1.9 Ownership Issues

The utility sector in Europe has been partially liberalized and privatized over the last few years, with the exception of the UK which began earlier. Indeed, only a few TSOs in Europe remain in private hands. Theory suggests that privately-owned companies should invest more than state-owned companies if there is no *ex post* intervention, because of the higher commitment on the part of the regulator (Sappington and Stiglitz 1987). Cambini and Rondi (2010) think that managers in private companies have a greater incentive to invest in cost-reducing activities with the intention of securing more profit. However, their study sums up this point by saying that: “although the theory predicts that private ownership boosts investment incentives, we found no empirical evidence on this issue within the European energy industry”. They also found that privately-owned companies have a higher profitability ratio and a less X-factor costs (cost-efficiency factors). They conclude with the suggestion that privately-owned TSOs are the exception and not the rule. For precisely this reason, regulators to take ownership concerns into account.

A further issue regarding ownership is the European requirement for TSOs to be fully ‘unbundled’. Under this requirement, power generation, transmission, distribution and supply must be managed separately and not interfere in or overlap with each other’s activity. However, there are only limited sources of literature on this topic. Nevertheless, the early part of a research paper by d’Arcy and Finger (2012) show that only a fully unbundled utility sector can prevent market imperfection. They suggest that it would be a huge challenge for corporate governance to mitigate any of these imperfections resulting from incomplete unbundling. They say that only the regulator or the legislator can help in this task.

2.1.10 Conclusion

High voltage grid operators work in an evolving, ever-changing sector. Over the last ten years, regulation has changed and evolved with the objective to have a more efficient market for energy at all levels. The situation is still not perfect and Europe has yet to create all the conditions for a full Internal Energy Market.

Furthermore, the Regulatory Asset Base isn’t still a well determined concept, with little or no harmonisation in terms of regulation. Indeed, while one country might still depend on national

preferences another might have already integrated other elements. This still remains an important factor in CAPEX evaluation and will no doubt receive further attention from regulators. For the purposes of this study, however, this lack of harmonisation in the current market regulation has little or no influence, as the study emphasises on the Weighted Average Cost of Capital (WACC).

The WACC has the advantage of being a basis for fair return with which all regulators are in agreement, even if they each have their own way to compute it. Authors such as Fernandez criticise this factor considerably but National Regulatory Authorities continue to use it and have no obvious reason to abandon it. However, what can be criticised is the way in which it is computed. What is the risk-free rate, the market premium, the fair cost of capital etc. are valid questions. However, choosing the right level for a parameter is not easy. Sometimes regulators have to update their rates to fit reality more accurately, as in Norway in 2012²³. Further situations come to mind: Are regulators behaving in an economically efficient manner when setting up their rates? As the WACC does not take the ownership structure into account, do regulators include this parameter implicitly when setting rates? The last question constitutes the heart of this research and will be developed later.

Depending on who owns the business, TSOs may face issues such as the ability or capacity to finance projects or simply how to finance their business. Generally speaking, state-owned companies have easier access to credit with, at least theoretically, a lower cost of debt. By contrast, a TSO with private shareholders in a country in economic difficulty such as in Greece, companies struggle to find financing and the state cannot afford to back up the company. The temperament of the shareholders and the economic environment in which the TSO develops have a considerable impact on the credit facilities of a particular company.

²³ The Norwegian NRA updated its rate in 2012 because the national bond return offered too low rate and the market risk premium

2.2 Model

2.2.1 Differences among TSOs

The European Union is currently aiming for harmonisation in the energy market, which includes TSOs. To reach this objective it is important that the differences within the sector are low. This aspect, as explored here, will focus particularly on the costs related to ownership structure.

As stated earlier, the WACC is the rate used by regulators to calculate a fair return on both the cost of capital and the cost of debt. Each company differs in how they put these regulations into practice, largely because of the various factors that have already been explored such as credit ratings, gearing²⁴, varying tax rates²⁵, shareholders expected returns.

In addition, the cost of debt is driven by a number of different risks, the principal risks being credit default, regulatory and sovereign risks. Credit default is the risk that a company has taken but is unable to fulfil in terms of its obligations to refund the money lender (bank, institution, investors etc.). As TSOs continuously generate cash flows, they are not considered as high risk, regardless of their ownership structure. The regulatory risk, known as the Regulation Risk, is also important because regulators not only determine the permitted rate of return but also the framework in which a company can evolve. Lastly, sovereign risk has to be taken into account because political stability is a very important factor both for publicly- and privately-owned companies. Nevertheless, fully state-owned TSOs have the added advantage of being able to borrow money at a rate that is close to the rate allowed by the national government. Conversely, private TSOs have to allow for an extra payment in addition to loan repayments etc... This is known as the credit spread. This spread can be low, however, if the credit rating of the company is the same as that of the country where the company is registered; it can also be higher in the same proportion. Private TSOs have the drawback to rarely have the same credit rating of the country of domiciliation. The main rule is that their credit rating cannot be higher than the sovereign rate. But it is theoretically possible that it gets a higher credit rating depending on the structure and revenue sources. The logic behind this is that a company cannot be considered safer and in a more risk-free environment than the

²⁴ Gearing or leverage is part of a financial debt mechanism related to total equity.

²⁵ For the purposes of this study the focus here is set on pre-tax WACC

government, as it is the government that has the power to change the regulations and increase taxes if necessary.

The cost of capital is the other source of cost included in the WACC. For private shareholders, the higher the given cost of capital the better, because the higher the returns are likely to be. To avoid an excess while maintaining a sense of fairness, regulators can decide to use the Capital Asset Pricing Model (CAPM) to limit this cost²⁶. When the state is the only shareholder of a TSO, the question can be asked of whether or not there is a need to include the cost of capital in the WACC. From a social welfare point of view, removing this part of the calculation will likely bring electricity prices down and increase the consumer surplus, by having the same service but at a cheaper rate. In practice, there are two reasons why capital cost is included. The first is an indirect way for the government to raise money. Considered an inelastic²⁷ aspect of power consumption, an increase in tariffs is unlikely to create a drastic erode in demand. In the context of IEM, it would appear that the reason why state-owned companies take into consideration the necessary aspect of cost of capital is to limit differences with others companies. Companies in the power and energy sector are by nature rational actors of the market and prefer buying electricity at the lowest possible price. As European countries become increasingly interconnected, regulators need to be increasingly careful not to offer obviously unfair advantages to any particular TSO. State-owned TSOs also assess the cost of their capital by using the CAPM model.

The drawback of this model is missing permitted rate of return allowed by regulators. The WACC provided by NRAs are often confidential and the second issue is the different lengths of regulatory period in our sample. One TSO can start its regulatory period in 2011 and have the same return on the three years of analysis while another one can see its period finished in 2012 for example and receive two different returns over the three years period. Later, it will be also seen that size of the dataset is too small to perfectly match the requirement of a rigorous multiple linear analysis.

²⁶ Theoretically, shareholders have no maximum requirement in terms of the cost of capital. CAPM helps regulators to set the minimum return that a shareholder can accept in order to provide funds.

²⁷ A market is considered inelastic when a variation of prices implies a very low change in demand.

2.2.2 Hypotheses

Whether regulators use the same techniques needs to be verified through empirical analysis. More specifically, two characteristics should be observed. The first is that the cost of debt of a private²⁸ TSO should be greater than a state-owned one with the same characteristics (5). The second is that the cost of capital should follow the same trend as the cost of debt, where private shareholders requiring more return (6). Put together, those two assumptions should lead to a WACC that is lower when used for state-owned companies than when it is used for publicly-owned companies (7).

To sum up, the goal is to determine whether the ownership structure has an impact on the WACC and its parameters.

These formulae can be summed up as follows:

Hypothesis N°1:

The cost of debt of State-owned TSO is lower than the cost of debt of a Privately-owned TSO

$$(5) \quad H_0 [R_D (S_O) < R_D (P_O)]$$

Hypothesis N°2:

The cost of equity of State-owned TSO is lower than the cost of equity of a Privately-owned TSO

$$(6) \quad H_0 [R_E (S_O) < R_E (P_O)]$$

²⁸ Not entirely state-owned

Hypothesis N°3:

The weighted pre-tax WACC of a State-owned TSO is lower than the weighted pre-tax WACC of a Privately-owned TSO.

$$(7) \quad WACC(S_o) < WACC(P_o)$$

Where, H_0 = the null hypothesis

R_D and R_E are respectively the cost of debt and equity.

S_o and P_o = State-Owned and Privately Owned companies

WACC = Weighted Average Cost of Capital

Here both WACC are weighted with grid size²⁹.

If the research shows that these hypotheses can be respected then the ownership structure plays a determinant role in the WACC and its factors.

2.3 Methodology

The principal means of analysis here is to compare TSOs through their WACC factors³⁰ and by a multiple linear regression, determine if there is a link between ownership structure and the observed WACC.

Firstly, the average WACC of TSOs over the three years period of 2011-2013 is computed. However, TSOs do not have the same size. To make an equal comparison a weighting such as the number of kilometres of power network can be used. This enables the fairer means by which to calculate which type of company has the higher cost/km.

For the same period, the average cost of debt and equity is also computed. Both costs will be analysed separately. As the focus of this study is the observed costs, the return on equity is set as the cost of equity. Likewise, the observed cost of debt will be taken as a measure instead of

²⁹ See Methodology for explanation

³⁰ Cost of debt, cost of equity and observed WACC.

the regulatory cost of debt. Each factor, here the cost of debt, the cost of equity and the WACC/Mm will be tested under a multiple linear regression where the ownership is the explanatory variable. To reduce bias and errors the leverage will serve as control variable.

The multiple linear regression is used as follow:

$$(8) \quad y = \alpha_0 + \beta_1 X_1 + \beta_2 X_2$$

Where y is the endogenous variable, here the cost of equity, cost of debt and the WACC/Mm

α_0 , β_1 and β_2 are constants

X_1 and X_2 are the exogenous variable. In our model the first variable is the leverage and the second the ownership.

The explanatory variable X_2 is an indicator variable which means that its value is 1 if the ownership is private and 0 if the TSO is state-owned.

Part III: Presentation of results

3.1 Data and pre-analysis

To verify the previous hypotheses, a database is required. Indeed, applying these hypotheses to only one company is not relevant then a sample is used to test them empirically. As evoked earlier there are four main elements required here: The return on equity, the cost of debt, the WACC and the ownership structure. To gather this data, annual reports of TSOs have been used over the period 2011-2013.

The sample given here covers 16 TSOs (9 state-owned and 7 privately-owned). The companies located in a whole range of countries across Europe: APG in Austria, CEPS in the Czech Republic, Red Electrica in Spain, Fingrid in Finland, Terna in Italy, National Grid-Scottish Hydro Electric and Scottish Power for the United Kingdom, Tennet TSO in the Netherlands, PSE-Operator in Poland, REN in Portugal, RTE in France, Elia in Belgium, Eirgrid in Ireland, Svenska Kräfnet in Sweden and Statnett in Norway.

The choice of these companies is underpinned by both their grid size and their importance at the European level. The point they have in common is that they are all members of the European Network of Transmission System Operators for Electricity (ENTSO-E). Even if they are not all members of the European Union their regulators follow the same methods and framework in order to fix their permitted rates of return. The balance between state-owned and privately-owned companies helps to avoid giving a bias in the data analysis. Due to potential variation from year to year, the cost of equity and debt are computed as the average from over the period 2011-2013.

tso	private	leverage	wacc	size	equity	debt	waccsize	dummy
VERBUND-AUSTRIA	0,49	0,7222	0,0297	6700	0,0783	0,011	0,00443201	0
CEPS, A.S.	0	0,0898	0,0964	5501	0,1047	0,0122	0,01752234	0
RED ELECTRICA COR	0,8	0,4118	0,1581	40000	0,2464	0,0319	0,00395191	1
FINGRID OYJ	0,47	0,6681	0,0551	14000	0,113	0,0263	0,00393368	0
TERNA	0,7	0,685	0,0896	63500	0,1669	0,054	0,00141038	1
National Grid Electr	1	0,3671	0,093	26550	0,118	0,0499	0,00350287	1
TENNET Group	0	0,6693	0,0464	10051	0,1005	0,0197	0,00461858	0
PSE - OPERATOR SA	0	0,0761	0,0492	13519	0,0518	0,0181	0,00364188	0
REN SA	0,95	0,8208	0,0621	8733	0,1611	0,0405	0,00711257	1
SCOTTISH HYDRO EI	1	0,6763	0,1211	5300	0,2351	0,0665	0,02284576	1
SP TRANSMISSION I	1	0,6479	0,0848	4000	0,1659	0,0408	0,02121039	1
RTE	0,16	0,5902	0,0492	100675	0,08	0,0278	0,00048864	0
Elia	0,52	0,6259	0,0446	8412	0,0535	0,0393	0,0053034	1
Eirgrid	0	0,749	0,0595	6500	0,2042	0,011	0,00915423	0
Svenska Krafnet	0	0,4872	0,0433	15000	0,0807	0,004	0,00288766	0
Statnett	0	0,6416	0,0328	10000	0,0773	0,008	0,00328405	0

Figure 3: Dataset

The table above shows the dataset used for the regression. One can notice the three dependant variable: 'equity', 'debt' and 'waccsize'. The last variable is obtained by dividing the 'wacc' column by the 'size' column. The control variable 'leverage' is the average part of debt in the capital of a TSO over the period 2011-2013. The variable 'private' represents the part of capital held by private shareholders. To test our hypotheses this variable was modified into an indicator variable found under the column 'dummy'. If more than 50% of the capital went public then the value of the indicator is 1, else it is 0.

The size is expressed in km while other variables, except 'waccsize' and 'dummy', are numerical as they express percentages.

3.1.1 The Return on Equity

The Return on Equity (RoE) is a ratio that helps to measure the profitability of a shareholder's investment. The higher the profitability the higher the earnings are for the shareholders.

Some TSOs integrate the Return on Equity ratio in their annual report but most of them do not. To avoid a blank in the database, the RoE has been calculated with the help of the balance sheet and the income statement of the TSO.

Basically, the formula for the RoE is:

$$(8) \quad RoE = \frac{\text{Net Result of the Year}}{\text{Shareholder's equity}}$$

As the RoE varies from year to year, the RoE used in the database is taken from the average RoE for the last three years (2013, 2012 and 2011).

In the next chapter the different hypotheses will be tackled. Here, it is determined whether or not our data and model are a priori relevant.

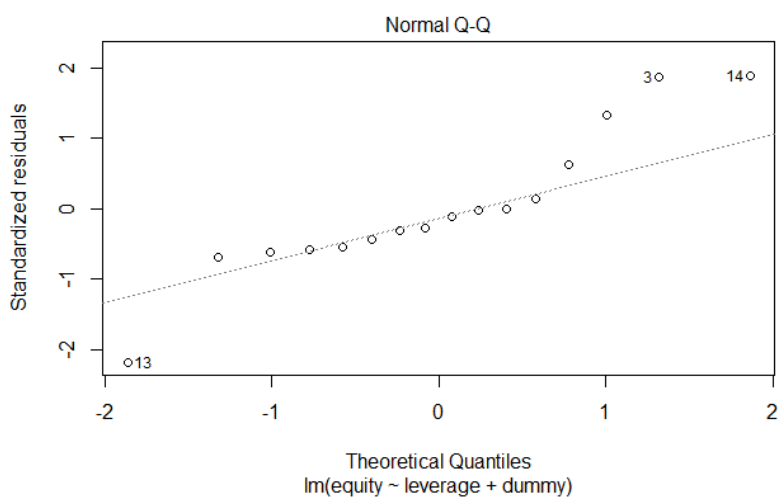


Figure 4: Normal Q-Q for the equity variable

The figure above aims to determine if the different values of the variables ‘leverage’ and ‘dummy’ are conjointly normally distributed. As we can see most of points are along the regression line which means that the two sets of points are normally distributed. The regression line being flatter than the $y = x$ line, the distribution on the horizontal axis is more dispersed than the one on the y axis. The three residuals on the upper right of the figure prove that both distributions are not perfectly normally distributed.

This slight imperfection can be also found in the figure under, Residuals vs Fitted. The goal of this graphic is to show whether the model used is valid or should be changed. In this case, our model to explain the cost of equity through the leverage and the ownership structure seems quite relevant. Indeed, a totally straight line means the model should not be changed. The model used to explain equity is therefore not perfect but should explain the most of it.

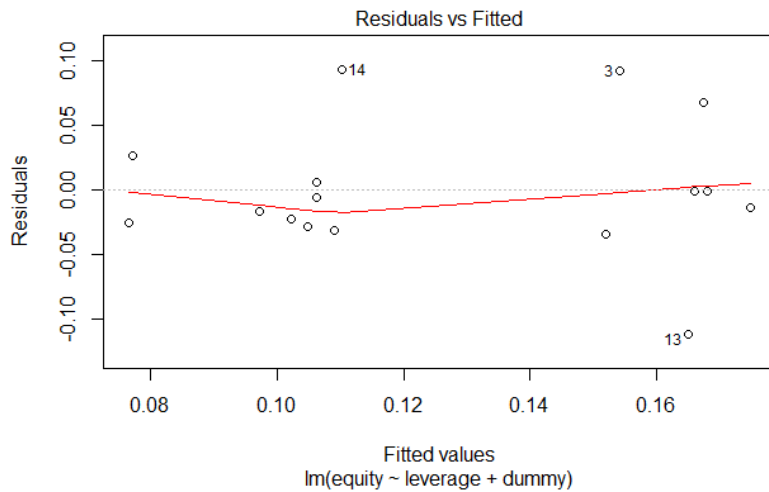


Figure 5: Residual vs Fitted graphic for the equity variable

3.1.2 The cost of debt

Besides equity financing the other well-known debt is the cost of incurring and maintaining debt. The cost of debt can vary widely depending on the profile of the borrower and the borrower's ability to repay the debt i.e. refund the lender and cover any loans costs. Annual reports again formed the basis of research on the cost of debt for each TSO.

The formula used is:

$$(9) \quad R_D \text{ real} = \frac{\text{Interest expenses}}{\text{Borrowings}}$$

In the same way that the RoE has been calculated, the cost of debt used in the database has been taken from the average cost over the three previous financial years (2011-2013).

As for the equity, an a priori analysis of the model to explain the debt is computed. The normal Q-Q graphic is quite interesting for two reasons. First, the points seem very close to the regression line which means that both variables of this model are normally distributed. Finally, the straight line almost has a slope of 45° which minimizes the dispersion of the data.

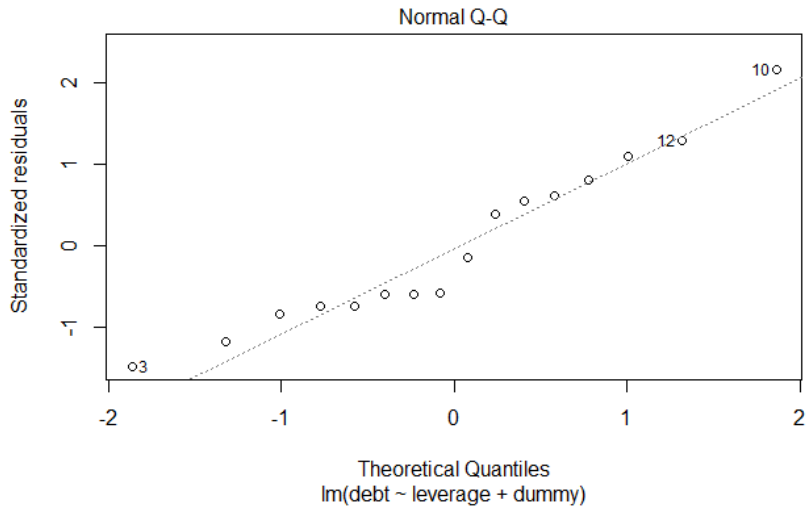


Figure 6: Normal Q-Q for the debt variable

Despite the lack of points in the centre of the graphic under, the red line is quite straight which helps the model to be significant. One should stay careful with this assumption as maybe more observation on the figure under would have led to a non-linear model. Only the test of the second hypotheses may confirm it.

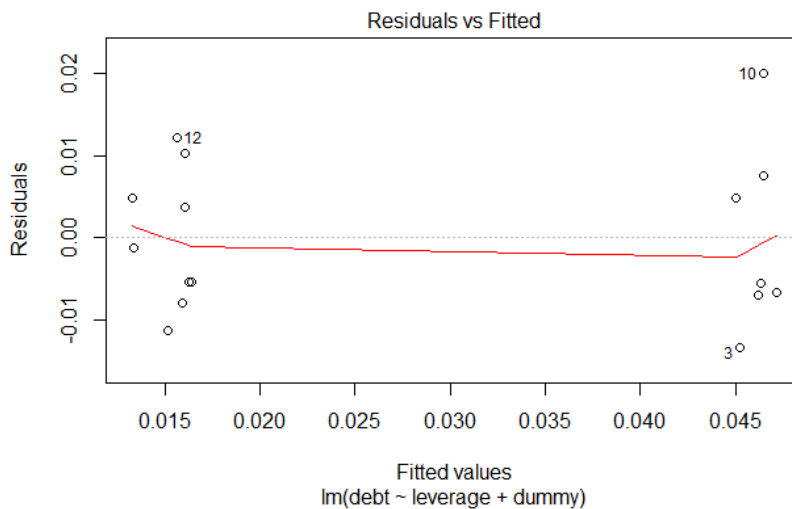


Figure 7: Residual vs Fitted graphic for the debt variable

3.1.3 The WACC

The definition and formula used for the WACC has already been explained earlier but it is important to underline that it is the Weighted Average Cost of Capital, where the cost of equity is calculated under the RoE and where the cost of debt lasted using the previous formula. The weightings used are not known, however.

One ratio that is often employed in the sector is ‘gearing’ or ‘leverage’. This represents the part of debt compared to equity. With the two previous formulae it is easy to compute the gearing.

$$(10) \quad \textit{Gearing} = \frac{\textit{Borrowings}}{\textit{Equity}}$$

Generally, a given gearing can make a company very risky or not, depending on the particular sector. Moreover, knowing the gearing of TSO helps to compare themselves with each other within a given sector. By contrast, the WACC formula depends on the capital structure rather than the gearing³¹. Fortunately it is quite simple to switch from gearing to capital structure. If the borrowings are the debt part of the capital structure then it is possible to find this out with the following formula:

$$(11) \quad \textit{Part of debt in the Capital Structure} = \frac{\textit{Borrowings}}{\textit{Equity} + \textit{Borrowings}}$$

Once this rate is known, the WACC is easier to calculate. Concerning the third hypothesis, the WACC is weighted by the grid size.

³¹ Actually, the WACC used here does not require any gearing although many studies replace capital structure by gearing in order to compute what is known as the “vanilla WACC”.

A priori the results of the testing of the third hypothesis won't be relevant. The normal Q-Q shows some far away points in the upper right while the others are rather well located around the regression line. In this model both variables "leverage" and "dummy" seem quite well normally distributed.

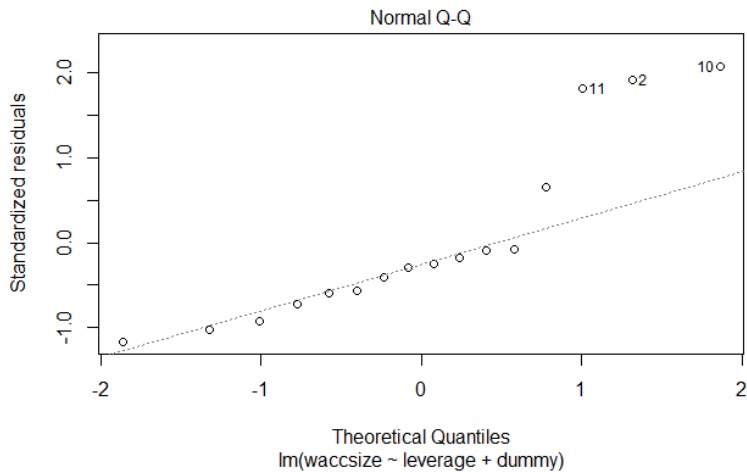


Figure 8: Normal Q-Q for the waccsize variable

Conversely, the Residuals vs Fitted graphic shows a red line not straight at all. That means that our model should be changed because it does not match the requirements of a linear regression.

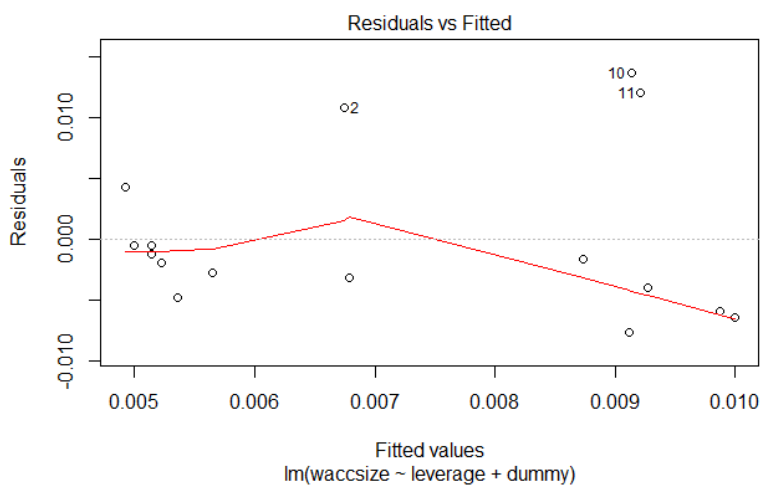


Figure 9: Residual vs Fitted graphic for the waccsize variable

Part IV: Analysis of hypotheses

4.1 Introduction

In this section the different hypotheses are analysed one by one with the help of our multiple linear regression model as shown in the methodology section.

4.2 The equity hypothesis

Over the period 2011-2013 the general trend among both state- and privately-owned TSOs has been to see an increase in the RoE. The main reason behind this is the relative recovery of the economy after the financial crisis in 2008. In 2008, the world was in panic, as the stocks markets collapsed, many businesses went bankrupt and many people lost their jobs. This had an impact on the rates of electricity consumption across Europe, which in turn had an impact both on the economic environment and, in consequence, on the TSOs' financial results.

During the two years that followed the beginning of the crisis the return on equity remained largely negative for a large part of the sector.

Since 2011 the situation has improved as the economic environment recovers and energy consumption regains the levels it saw back in 2008. This is expected to keep growing. This tendency and current outlook have an implicit impact on the returns on the equity of European TSOs which have begun to balance their books and see their profits rising.

The main advantage for shareholders who are investing in a TSO is the low risk. Those companies are generating a quite predictable amount of cash every day and the asset risk is minimal. The principal risks for privately-owned companies come from the regulation and the public policy. When a new grid needs to be built, a TSO requires the agreement of its NRA and after many problems may block the project, such as the authorisation to build (planning permission) or the NIMBY³² issue. As a state-owned company, the risk is less because it is less affected by political issues and it does not seek profit in the short-run. The general aim of

³² NIMBY: Not In My Backyard. This issue occurs when a project in the public interest is about to be launched and while people accept the idea that it is useful or necessary, they refuse to accept its externalities. In the case of expansion of the electric grid, even if its aims are everyone's welfare, people do not want to suffer its presence in their neighborhood area.

both state- and privately-owned companies is to keep costs as low as possible in order to provide customers with the cheapest electricity possible.

The difficulty for private TSOs will be to keep a stable level of RoE over time. With the EU's objectives for 2020 in the energy sector, European TSOs have to invest a great deal of money in new offshore lines or in new interconnections. One way to finance these projects is to raise equity but "a significant rise in tariffs would still be required to achieve the whole scale of the investment programs"³³. Henriot (2013) claims that "by injecting a small share of external equity, it is possible to achieve the whole scale of the investment program while dampening the impact on tariffs. However, higher amounts of equity lead to further expenses in order to provide a satisfactory return to investors". No rational investor would accept to provide money to a riskier company at the same rate as the government can offer. An implicit risk, where private ownership is riskier than public ownership, can explain the difference in returns.

The use of the multiple linear regression model may help to determine whether we can empirically admit that privately-owned companies have a higher cost of equity.

```
Call:
lm(formula = equity ~ leverage + dummy)

Residuals:
    Min       1Q   Median       3Q      Max
-0.111391 -0.025539 -0.009702  0.011879  0.093858

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.07282    0.03911   1.862  0.0854 .
leverage     0.05010    0.06619   0.757  0.4626
dummy1       0.06072    0.02835   2.142  0.0517 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.05517 on 13 degrees of freedom
Multiple R-squared:  0.3166,    Adjusted R-squared:  0.2114
F-statistic: 3.011 on 2 and 13 DF,  p-value: 0.08425
```

Figure 10: Results of the regression model testing for equity

The table above summarizes the results of the model applied to the cost of equity. We can now write the fitted regression line for this hypothesis.

$$12) \quad y = 0.072 + 0.05 X_1 + 0.06 X_2$$

³³ Henriot (2013)

Where, 0.072 is the estimate of the intercept

0.05 is the slope for the control variable 'leverage'

0.06 is the slope of the explanatory variable 'dummy'

The focus is set on the dummy variable about ownership. The variable 'leverage' is not significant. The ownership is significant at a 10% level, and the 'dummy' variable is significant at 5.17%. The model is relatively weak with an adjusted R squared of 21.14%. Adding more control variables may reinforce the model.

The slope of the explanatory variable can be interpreted as: private shareholders cost 6% more in equity than state shareholders.

```
confint(mod2, level = 0.90)
              5 %      95 %
(Intercept)  0.003553077 0.1420841
leverage     -0.067124929 0.1673200
dummy1       0.010516284 0.1109171
```

Figure 11: Confidence interval for the equity hypothesis

To match the ownership significance, a 10% confidence interval is chosen. The table above shows that the 'dummy' variable ranges between 1% and 11%.

The significance level of the variable 'dummy' (5.17%) being lower than the confidence interval level (10%), the null hypothesis that privately-owned companies have higher cost of equity than state-owned companies can't be rejected.

The first hypothesis now proven right, the first assumptions were then correct.

4.3 The debt hypothesis

The most familiar way to finance a project is to borrow money. Money can come from banks or from financial markets by issuing corporate bonds. Bank loans have the advantage of having lower transaction costs but conversely the interest rate is generally higher because the bank takes on the risk of lending by itself. Furthermore, to mitigate risks, banks place debt covenants on corporate loan. This means that the company is not free to carry out all the

operations it wants. For example, a debt covenant would prevent the borrower issuing any other debt while the loan is not completely paid off. Debt covenants are the main reason why companies use banks as a lender only in the last resort.

As in our sample, when TSOs have a good rating, due to the fact that they are all in the investment grade category³⁴, they can issue bonds on financial markets. Here the company pays the market level interest rate and can raise more money than with banks. The drawback is the transaction costs because TSOs need to find a bank or financial institution that will accept a bonds issue on the secondary market, which implies higher transaction costs. It is therefore more attractive for a company to issue bonds when the required amount of money exceeds a certain level.

Generally state-owned companies have lower cost of debt than privately-owned companies due to their very low risk of bankruptcy. Countries such as Sweden and Norway incur less than 1% of the cost of debt because of their good credit rating and the direct involvement of the state. For example, in Sweden, Svenska Kraftnät, the Transmission System Operator, is both an external and state-run organisation of the government. The company has no shares and could be considered almost as a ministry because all the directors are chosen by the government. This is the most specialized case of a state-owned company.

Companies like RTE, the French TSO, is an example of another scenario: as a subsidiary of EDF, RTE is 84% owned by the French government. The computed cost of debt for RTE is 2.78%. In addition to its close relationship with the government, two factors can explain why there is a difference of more than 2% between its debt and that of other companies. The rating is the first reason for this difference: Sweden enjoys an AAA rating, the highest rating possible, while France has an AA, which the second best rating according to S&P. The second factor is the debt weighting in the capital structure of a company. The French operator has 59% debt compared to Svenska Kraftnät with 48.7%. This higher leverage implies a higher level of risk for the lender, who in turn would require a higher level of return.

The second reason why publicly-owned companies can be granted 'cheaper' money than privately owned ones is the implicit guarantee that the state can offer. Firstly, TSOs have an important social role because they carry electricity everywhere across Europe: governments

³⁴ The investment grade category is the higher class of rating. Companies within this class of rating class are believed to present a low risk of investment. For Standard & Poor's the rating ranges from AAA to BBB-. By contrast, the High Yield category constitutes the lowest class of rating. Investing in companies within this class is considered as highly speculative or risky. On the Standard & Poor's rating scale this ranges from BB+ to D.

and citizens are both consumers of power and therefore neither would accept seeing the utility sector collapse. Even if governments are reluctant to inject money in these companies they know they cannot let them depreciate in terms of value and they will always save them if they encounter problems. The drawback of this implicit guarantee is the moral hazard for managers who would otherwise be tempted to be less careful.

The multiple regression model can help to support the assumptions that state-owned companies have lower cost of debt than privately-owned TSOs.

```
Call:
lm(formula = debt ~ leverage + dummy)

Residuals:
    Min       1Q   Median       3Q      Max
-0.013330 -0.006706 -0.003207  0.005533  0.020040

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.012919   0.007136   1.810   0.0934 .
leverage     0.004650   0.012077   0.385   0.7064
dummy1       0.030396   0.005172   5.877 5.44e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.01007 on 13 degrees of freedom
Multiple R-squared:  0.7399,    Adjusted R-squared:  0.6998
F-statistic: 18.49 on 2 and 13 DF,  p-value: 0.0001581
```

Figure 12: Results for the regression model testing for debt

The table above summarizes the results when testing the model for debt. The fitted regression line can be expressed as follow:

$$13) \quad y = 0.013 + 0.004 X_1 + 0.03 X_2$$

Where, 0.013 is the estimate of the intercept

0.004 is the slope for the control variable 'leverage'

0.03 is the slope of the explanatory variable 'dummy'

Seeing the table one can immediately see that the model fits very well for this hypothesis with an adjusted R squared of 69.98%. The control variable 'leverage' is not significant while the ownership is very significant with less than 1%!

The slope of the explanatory variable (0.03) means that privately-owned companies have a 3% higher cost of debt.

```
confint(mod1, conf.level=0.95)
              2.5 %      97.5 %
(Intercept) -0.002497977 0.02833680
leverage     -0.021441728 0.03074195
dummy1       0.019222169 0.04156978
```

Figure 13: Confidence interval for the debt hypothesis

The 5% confidence interval for the 'dummy' variable ranges from 1.9% to 4.1%. The significance level of the 'dummy' variable ($5.44e^{-05}$) being lower than the 5% chosen confidence interval the second hypothesis cannot be rejected.

The assumptions are then confirmed; privately-owned companies have a higher cost of debt than state-owned companies. If we compare the slopes for the 'dummy' variable in the two first hypotheses it is seen that the spread of cost of equity is higher than the spread for the cost of debt. It can be explained by the will of both ownership categories to enjoy the lowest interest rate possible while contracting debt. Conversely, governments request few return on equity while private shareholders try to get as much as possible.

4.4 The WACC hypothesis

Together with capital structure, the cost of debt and equity produces the Weighted Average Cost of Capital. The percentage found is the minimum required return that a TSO must request in order to apply for inclusion in a project.

It is important to note that most of the TSOs studied have a capital structure where debt represents about 60% to 75% of that capital. All these companies have been given an investment grade category rating.

As regards public entities, the WACC that has been permitted is often higher than the computed one. The cause of this can be found in the cost of debt. For most state-owned TSOs

the cost of debt is well below the assigned one. The hypothesis behind this observation could be that regulators anticipate new investments and then give TSOs an expected margin for new borrowings.

By contrast, regulated WACC for privately owned TSOs are in most cases lower than the observed one. The cost of debt of those companies being coherent, the source is to be found in the cost of equity. Theoretically, private shareholders require no maximum limit on the return on equity and therefore regulators have to set a fair ceiling. They have to give enough remuneration to keep the shareholders but they are also concerned by the consumers' bill. The only reason that could explain this excess of observed return on equity is the especially good financial results of private TSOs over last three years.

For this last hypothesis, one has to remember the a priori analysis available in the data section of this research. There it is assumed that the model is not linear when the variable 'waccsize' is tested. The multiple linear regression model can help to support or not this pre-analysis.

With the help of the figure 14 the fitted regression line can be written as follow:

$$14) \quad y = 0.007 - 0.003 X_1 + 0.004 X_2$$

Where, 0.007 is the estimate of the intercept

-0.003 is the slope for the control variable 'leverage'

0.004 is the slope of the explanatory variable 'dummy'

Immediately a change is perceivable with the negative slope for the control variable 'leverage'. It has no consequences on the model as the variable has no significance. What is changing, compared to the analysis of the two previous cases, is the lack of significance of the 'dummy' variable. Added to this the adjusted R squared is negative which means that the model is very weak.

```

Call:
lm(formula = waccsize ~ leverage + dummy)

Residuals:
    Min       1Q   Median       3Q      Max
-0.0077019 -0.0041976 -0.0017792  0.0006655  0.0137094

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.006996   0.005081   1.377   0.192
leverage    -0.002769   0.008599  -0.322   0.753
dummy1       0.004014   0.003682   1.090   0.296

Residual standard error: 0.007167 on 13 degrees of freedom
Multiple R-squared:  0.08453,    Adjusted R-squared:  -0.05631
F-statistic: 0.6002 on 2 and 13 DF,  p-value: 0.5632

```

Figure 14: Results for the regression model testing for WACC

Concerning the confidence interval the situation is also poor. Indeed, the 5% level of confidence ranges from -0.4% to 1.2%. Zero being part of the range, there is not enough statistical significance thus the third hypothesis can be rejected.

```

confint(mod3, conf.level= 0.95)
              2.5 %      97.5 %
(Intercept) -0.003981232  0.01797240
leverage    -0.021345967  0.01580758
dummy1      -0.003941892  0.01196908

```

Figure 15: Confidence interval for the WACC hypothesis

Several causes can explain why this model is poor for the third hypothesis. First, the non-linearity of this model. It was shown in the data section that the Residuals vs Fitted graphic expressed a non-linear model. Adding more control variables could have help to get a linear model.

The second cause is the WACC/km. The size of grids might have drastically change the potential relation between the ownership and the WACC. The aim of weighting the WACC with the grid size was to reflect the costs of TSOs by a standardize measure. That supposed that there was a correlation between the size of a TSO and its WACC which was not checked before.

However it is possible to deduce, without proof, that the WACC, not weighted, of a state-owned TSO is lower than of a privately-owned. Indeed, the two previous hypothesis analyses confirmed that both the observed cost of equity and debt were higher when the TSO's ownership was private. Once this is known, as the leverage in the sector is roughly the same, the WACC will be higher for private companies.

4.5 The Ideal Structure of a TSO

All these comparisons lead to one question: what is the perfect structure of both ownership and capital?

Perfection is rarely achieved. However, some elements can help to approach the idea of perfection more closely. With regards to the capital structure of a company, many regulators tend to want to limit debts to around 70% of the company's capital structure. This is the optimum rate permitted within a capital structure as this is supposed to be the cheapest one. TSOs need to adhere to this limit because exceeding it could irremediably lead to companies being downgraded in terms of their rating.

A major difficulty concerning TSOs is the change of ownership. While privatisation is still relatively easy to achieve, the reverse is almost impossible today. Both kinds of companies have their advantages and drawbacks: an ideal TSO would be one that maximises the welfare of a maximum number of people while making a profit.

4.5.1 State-owned Companies

Public-owned companies are theoretically the most suitable structures that can optimise the welfare of society. There are two reasons for this: The first is that governments have a necessarily socially-oriented vision of society; Leaders of any European country see TSOs as primarily a public service, where provision of electricity is a public utility. This means that companies working in this sector are liable to deliver the cheapest and most reliable service - the bill for the final consumer being the main concern. Despite this, TSOs still need to be profitable. To achieve this, the price paid by consumers has to be slightly higher than the real cost price, and the cost of equity to be as low as possible so as to ensure a minimum profit each year. Naturally, this situation is not realistic because governments use the energy sector as much as possible to feed its budget.

The second element is the ability of a government to raise funds. As shown earlier, state-owned TSOs are able to get into debt at a very low cost. The closer the relationship of the TSO to their government the cheaper the money will be. The best example of this is Sweden where its operator is almost a part of the ministry in charge of energy. The drawback of very

low prices is that it is hard to sustain in the long run. Grids are elements that wear out over time, whereas investments are needed for maintenance of infrastructure etc. Moreover, with the construction work required in order to create these new interconnections among countries and around Europe, not least offshore, together with power plants with onshore grids, many expensive investments are required, at variable degrees and intervals. With low regulated prices TSOs will not be able to afford these projects because their cash flows will not recover the cost of financing them. Keeping prices low is therefore not necessarily a good long term solution for state-owned companies.

Nevertheless, there is an exception which allows TSOs to reduce their operating costs drastically and control their new investments. This reduction could be viable if it offsets the costs involved in the integration of the new CAPEX.

4.5.2 Privately-owned Companies

Where private entities are concerned, it is difficult to believe that business owners seek social welfare above profit and everything else. With more and more TSOs being privatized in Europe, with market efficiency being a determining factor, governments can be seen to want to be less involved in economic activity because of the mix with the principles of capitalism.

If social welfare and the well-being of citizens is still high on the list of a governments priorities, this is not necessarily so of a privately-owned company. The main drawback of private ownership, if the social welfare is still a goal, is the potentially high cost of financing the company. These TSOs principally look to maximising profit; Returns on equity is more important to them than the bill the consumer has to pay. Regulators are there to guide those entities, which depend upon them, to make sure that prices charged by TSOs are socially acceptable. As a result NRAs therefore limit their revenues and provide incentives for investment. Otherwise they would maintain their grid and focus only on reducing Opex to make more profit even if this is not an effective long-term management strategy in terms of infrastructure.

Financing costs are the main struggle of private entities as they become well- regulated TSOs. Moreover, no government would agree, in today's economic climate, to consider re-nationalizing these companies unless the company faced serious financing problems or required a government bailout, as in the banking sector in recent years. Private TSOs, with

the same credit rating, would never be able to have the same quantities of cheaper money as a public company.

4.4 Conclusion

The conclusion of this analysis is that there is no ideal ownership structure for a TSO for the reasons expressed above. However it is possible to determine an ideal capital structure depending on the sector. For TSOs it is around 66% indebtedness, regarding the mean leverage in the sector and the rigour with which some NRAs demand TSOs to keep their leverage at that level.

Before the discussion about the ideal structure of both capital and ownership that a TSO could have the three hypotheses of this research are tested and analysed. The two first hypotheses were conclusive as our model explained significantly the relation of both the cost of debt and equity depending on the ownership. For the last hypothesis the model used was not linear and the presumed dependent variable was biased because it was weighted by the grid size.

Part V: Conclusion

5.1 General Conclusion

The goal of this study was to determine whether the ownership had an impact on the costs of TSOs. The hypotheses stated that privately-owned companies had to support higher financing cost, debt and equity, than state-owned company. A multiple linear regression model was used where the leverage was a control variable and the ownership the independent variable on which the focus was set. The results were statistically significant and the hypotheses were not rejected.

This research is interesting for TSOs as they can use it to situate themselves in the sector and compare their own situation with other European TSOs.

It is also interesting for NRAs because they now know that similar TSOs with different ownership structure should be granted different permitted return.

Further research is called as this model could be improved and the size of the dataset increased. It would also be interesting to perform the same analysis on European TSOs for gas and compare the results.

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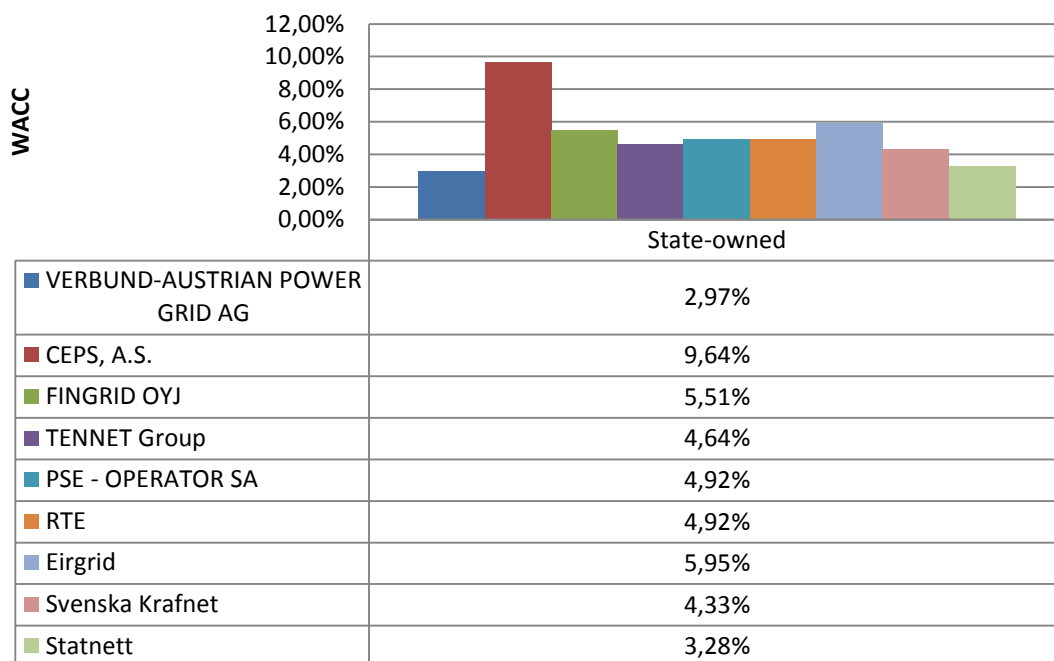
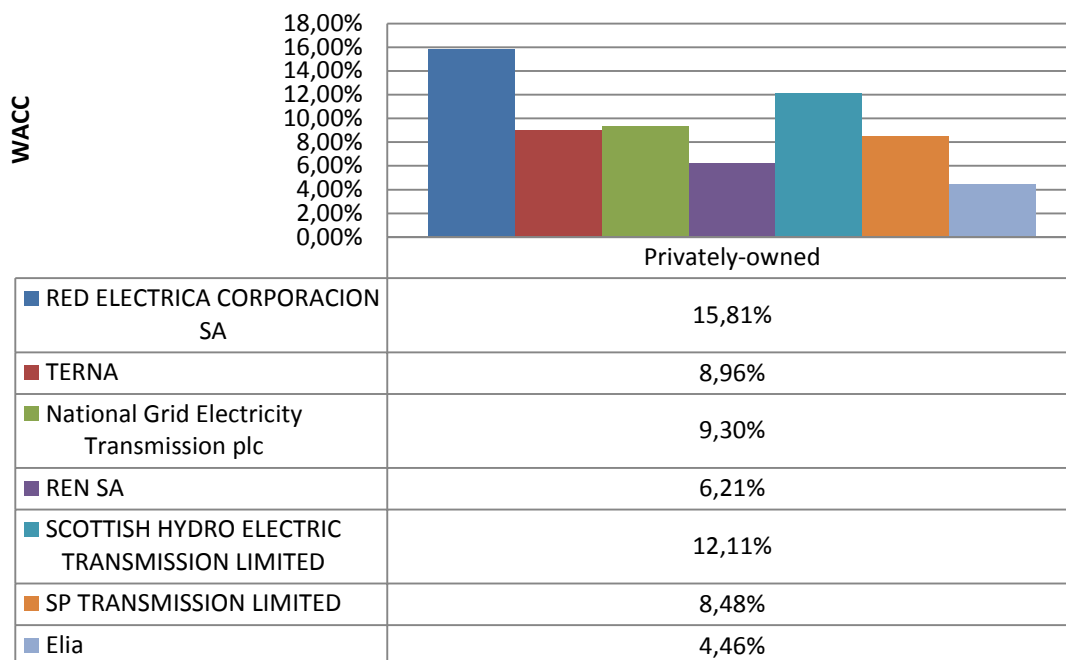
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Part VII: Appendix

A The average computed WACC over period 2011-2013 depending on the ownership



B Average debt, equity and capital structure of TSOs over the period 2011-2013

Debt	State-owned TSOs	Privately owned TSOs
	1,53%	4,61%
Equity	State-owned TSOs	Privately owned TSOs
	9,89%	16,38%
Capital structure	State-owned TSOs	Privately owned TSOs
	52,15%	60,50%