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PROFITABILITY DETERMINANTS OF NORDIC ELECTRICITY COMPANIES

Bachelor's thesis

TVTB, Finance

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Tallinn 2023

I hereby declare that I have compiled the thesis independently
and all works, important standpoints and data by other authors
have been properly referenced and the same paper
has not been previously presented for grading.

The document length is 10837 words from the introduction to the end of the conclusion.

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TABLE OF CONTENTS

ABSTRACT

The focus of this paper is on the relationship among selected independent variables and profitability. To be more specific, this paper studies the relationship that eight company specific variables and two macroeconomic variables have with profitability of Nordic electricity companies. Profitability is measured as Return on assets and Return on equity. The method used in the paper to obtain results is a statistical regression model, fixed effects. Five regression analyses were conducted for each of the selected countries and Nordic as a whole. The main findings of this study show that company size in terms of sales, profit before tax and leverage positively affect ROA, whereas firm size in terms of total assets seemed to have a negative effect on ROA. When profitability was measured as ROE, size in terms of sales and profit before tax had a positive impact on profitability and leverage as well as firm size in total assets had a negative impact on profitability. Macroeconomic variables turned out to be in a relatively insignificant role in this paper.

INTRODUCTION

Energy sector is crucial to the world as it powers economies, industries, and societies. At least in the western society, energy plays a critical role in almost every facet of our daily lives. From the transportation we use to get around, to the manufacturing processes that create the products we consume, to the heating and cooling of our homes and even to the powering of the electronic devices that we rely on. To conclude, energy is an essential source that drives economic growth and development.

Determinants of profitability as a research subject has been studied extensively in various sectors such as banking (Yüksel *et al.* 2018, Kiviniemi, 2018) construction (Le, 2020), stone (Farias *et al*, 2022) and manufacturing (Susilo, 2020). Moreover, the profitability determinants of the energy sector have also been studied, but when considering the importance and size of the sector, the quantity of the previous studies is relatively low compared to for example baking sector. The analysis part of this study will not cover all of the different sub-industries in the energy sector but will focus mainly on the companies that operate in the field of electricity. Energy sector as a whole is still widely covered in this paper, as the other components of the sector are heavily linked to electricity generation.

As of the time of writing this, there is an ongoing energy crisis in Europe. Ever since the fall of 2021, the energy market has been experiencing increased tension around it due to factors such as rapid bounce back of the economy following the COVID-19 pandemic. The situation got significantly worse after Russia started its invasion of Ukraine in February 2022 (IEA, 2023). Due to Europe’s high dependency on Russian energy, the invasion has resulted in a major increase in natural gas prices, which in turn has contributed to an increase in the price of electricity in various European countries. The increase in energy prices has vastly contributed to general inflation. In many countries, this has had an extremely negative impact on the financial situation of individuals, firms, and economies of countries.

The ongoing energy crisis makes this specific topic now more relevant than ever for research. In addition, the author is not aware of any previous research, that has studied the profitability determinants of electricity companies in the Nordics. The chosen time period for which the financial data was retrieved is 2013 – 2021. The time period was chosen based on the availability of financial data, except for Danish companies, for which data financial data was only available starting from 2017. Even though this study does not cover the financial performance of companies during Russian invasion of Ukraine or the ongoing energy crisis in general, it still gives a useful base for comparison considering future research about financial performance of electricity companies.

The aim of this research is to find the nature of relationships and impact, that chosen internal and external variables have on the profitability of Nordic electricity companies. To find the most reliable results, a regression analysis is conducted using relevant data extracted from the same databases. The results are then exhibited in an understandable manner.

The research question of this research is stated as so:

1. Which and how selected company specific factors are related to the profitability of Nordic electricity companies?
2. Which and how selected external factors are related to the profitability of Nordic electricity companies?

The data used in this study consists of financial data of very large Nordic electricity companies and GDP growth as well as electricity price data of the countries. Data is refined in excel and Gretl software is used to run analyses and calculations for our research question.

The first chapter of this research paper deals with the theoretical background for this study by going over fundamentals of the energy sector. Moreover, the theoretical part also covers the previous literature conducted on profitability determinants. Second part of this paper handles the data and methodology used for obtaining the results for our research question. Lastly, the third part covers the analysis and discussion of the empirical results obtained from the regression analysis. After the third chapter, a conclusion is drawn of the research and possible recommendations are given.

1. THEORETICAL FRAMEWORK

In this chapter, we are going to first have a look at the energy sector from a wider perspective. This means that we are going to investigate concepts such as: energy sources and production, electricity and renewable energy, regulations in energy sector and impact of the on economy and society. After covering the energy sector and electricity we will then have a look at the energy mixes and production of the Nordic countries.

In the last sub-chapter, a review of previous literature regarding profitability determinants is conducted. This is done to give the reader a broader idea of the topic and why it is being studied. Moreover, the purpose of reviewing the previous literature is to give meaning to our research problem and proving the existence of gap in knowledge.

1.1. Energy sector and electricity

1.1.1. Sources and production of energy

Energy comes in many forms and is used every day to keep the wheels of the world spinning. Supply of energy is crucial as it is a key driver in global economic activities. With energy being such an important driver in the economy, it enables the availability of majority of the goods and services in today’s world (Liko, 2019). The U.S. Energy Information Administration (EIA) categorizes sources of energy into two general categories, primary and secondary. The primary energy sources consist of fossil fuels, renewable energy, and nuclear energy. Fossil fuels are natural gas, petroleum and coal. The secondary source of energy is electricity, which is generated using primary energy sources (EIA, 2022).

According to Eurostat’s article about energy consumption in 2020 in the EU, for the time period of 2010-2020, production of primary energy has experienced significant changes in it. Energy production for energy sources such as solid fossil fuels, oil, natural gas and nuclear energy, have been on a downward trend during 2010-2020. Heaviest decline in production was in natural gas with a drop of -62.4%. Second heaviest drop in production was seen in solid fossil fuels (43.0%). Oil and petroleum product experienced a decline in production of -35.1% (Eurostat, 2022). As the relevance of sustainability has increased in the modern world, there is also trends in energy production, that imply the same thing. The production of renewables and biofuels increased by 39.2% during 2010-2020.

When it comes to energy consumption, oil and petroleum products were consumed the most in with a share of 35.0% of total energy consumption in 2020. Electricity consumed accounted for 23.2% and natural gas 21.9% of total energy consumption (Eurostat, 2022).

1.1.2. Electricity and renewable energy

Now that we have covered the main aspects of the sources and production of energy in general, it is essential to also talk about electricity, as it is the main type of energy in this research considering the activities of the investigated companies. The electricity that is utilized by humans, is secondary energy and as mentioned previously, electricity is produced using primary energy sources, which include fossil fuels, renewable energy, and nuclear energy (EIA, 2022).

As the concerns of climate impacts have been rising for many years, a shift towards cleaner electricity production has been made across many parts of the world, including in the Nordics, which we will cover more in the 1.2.1 sub-chapter. Clean energy, or renewable energy refers to the energy that is derived from sources that are naturally replenishing and can be continuously replenished over time. These sources are considered renewable because they are virtually inexhaustible in duration. In contrast, energy sources such as fossil fuels are finite, meaning that they could get used up, whereas with renewable energy this is not possible. However, it is important to understand that renewable resources are flow-limited, which means that the amount of energy, that can be extracted from them per unit of time limited (EIA, 2022).

There are various renewable sources that can be used to produce clean and usable electricity. The most common natural sources for this purpose are biomass, geothermal resources, sunlight, water, and wind. From these sources, clean energy is produced in different forms such as bioenergy, geothermal energy, hydrogen, hydropower, marine energy, solar energy, and wind energy (Energy.gov). According to Our World in Data (2022), hydro, wind and solar power are the most produced renewable energy sources globally, with hydro power being first, wind being second and solar being third most produced.

Not only does the increased production and use of renewable energy help fight against climate change, but there is also various other socio-economic benefits from its production and usage. According to International Renewable Energy Agency (2017), if carbon dioxide emissions are reduced in line with the Paris Agreement, this results in an increase in global GDP by 0.8% in 2050, which is equivalent to a cumulative gain of 19 trillion USD. Moreover, a significant reduction in mining of coal and drilling of oil and gas, positively affects human health, when we are less exposed to air and water pollutants. In addition, renewable energy also creates new jobs and creates new education opportunities (IRENA, 2017).

1.1.3. Economic & Politic impact of the Energy sector

As mentioned previously, energy sector is one of the most important sectors in the economy. Results of various previous studies has shown a positive relationship between energy consumption and economic growth (Jaworski & Czerwonka, 2021). These previous studies include for example Sadraoui's (et.al, 2019) research, that studied the relationship between energy consumption and economic growth in the MENA region (Sadraoui et al., 2019). Moreover, research conducted by Hannesson (2009), also studied the relationship between energy consumption and economic growth in 171 countries and a significant positive relationship was found (Hannesson, 2009).

Generally, the increases in energy price are fundamentally different from price changes in other goods (Kilian, 2007). There are various reasons that explain this. Firstly, energy prices tend to have so called price shocks, where the price of energy rapidly increases. The price shocks are experienced at times, when the increases in price are not typical for other more traditional goods (Kilian, 2007). Secondly, energy as a good is more important for consumers, than most of the other goods. Examples of drivers for importance could be for example heating of households or transportation to work (Kilian, 2007). Third reason why energy price changes tend to be separated from traditional price changes, is that the price of energy is highly affected by political events, due to the heavy regulation for the sector by governments (Kilian, 2007).

Rapid increases in energy prices have major consequences on countries' economies. He & Lee (2022) studied the changes in energy supply on South Korea's economy. The results implied that because of an energy price shock, production, labour supply, capital stock and energy consumption experienced a decline. Moreover, an increase in consumption, goods' price level, inflation, wages and deposit interest rate, experienced an increase.

According to IEA's World Energy Employment Report, in 2019, the energy sector employed around 65 million people globally, which accounts for approximately 2% of global employment. In the same year, the employment in the sector was relatively evenly distributed. The companies, that operate in supplying fossil fuels, employed approximately 18.2 million people. Employment in power sector 20 million people and in the energy end use it was 24 million (IEA, 2022).

Reliability of the supply of energy and the reasonability of the price, that businesses and consumers pay for energy, plays a key role in the European economy (Streimikiene et al., 2013). Because of the energy sector's impact on society and economy, it tends to be highly regulated by the governments. In the past 20 years though, the form of regulation in the EU has changed (Streimikiene et al., 2013). In the past, the energy sector mainly consisted of fully state-owned monopolies. However, dissatisfaction towards the idea of having monopolies supplying the energy resulted in major changes in the sector. Moreover, the liberalization in other industries had proven to be working, so this also resulted in liberalization initiatives in the energy sector (Streimikiene et al., 2013). In the 21st century, barriers to generate and supply energy has been decreased with the objective of increasing the competition in the sector. By allowing various different companies to offer their energy, consumers have the opportunity to pick their energy supplier based on the consumers' preferences.

European union faces various challenges when it comes to field of energy in the EU. These challenges include for example increasing import dependency, limited diversification, high and volatile energy prices, growing threats of climate change and security risks (Ciucci, 2022). EU has set clear objectives for its energy policy, which are highly linked to the growing need for renewable energy. The main objectives are to diversify Europe's sources of energy, ensuring the functioning of a fully integrated internal energy market, improve energy efficiency, decarbonizing the economy and promoting research in low-carbon and clean energy technologies (Energy Union, 2015). Energy mix in the Nordic countries

1.2. Energy mix in the Nordics

Energy sectors in the Nordic countries are very modern and it can be seen in the share of renewable energy in their energy mix. According to Nordic Energy Research (2021), Nordic countries are leaders in the adaptation of renewable energy. This sub-chapter will go over the characteristics of the energy sectors and energy mix in each of the Nordic countries. Iceland is excluded from this study due to its small energy sector compared to the other Nordic countries.

1.2.1. Finland

Finland has an ambitious objective to decarbonize its economy and to be climate neutral by the year 2035. According to the International Energy Agency, for Finland to achieve this target, it requires big technological advancements and transformations in the energy market (IEA, 2021). Finland is one of the leaders in private and public spending, focusing on energy research development and demonstration (IEA 20121).

Finland’s energy production consists mainly of nuclear energy and hydro and wind power. On top of nuclear energy and hydro and wind power, Finland is a large producer of biomass energy, accumulating large reserves of peat as well as other wood resources (ITA, 2022). Finland does not have an extensive production of fossil fuels including oil, coal, and natural gas (ITA, 2022). This means, that it has to mostly import these energy sources from other countries.

1.2.2. Sweden

Sweden’s energy sector is fairly similar to the one in Finland. Because of the country’s large supply of moving water as well as biomass, it has an extensive domestic production of renewable energy sources including hydro, wind, solar and biofuels. In fact, in 2021, approximately 60% of Sweden’s produced electricity, came from renewable sources. This number was highest in the EU in that year. Similarly, to Finland, Sweden has to import most of its fossil fuels, including oil and gas. Main energy imports of Sweden consist of fossil fuels but also nuclear and biofuels (Swedish Energy Agency, 2022.

Sweden’s energy consumption per capita is relatively high due to its cold climate and necessary heating, but the carbon emissions can be considered low compared to other countries (Swedish Institute, 2022). Low emissions are explained by the afore mentioned extensive renewable energy production in Sweden. Approximately 75 percent of Sweden’s electricity production comes from hydro and nuclear power. Hydroelectric proportion of this supply in 43% and nuclear power's 31%. The other 25% of the electricity production is generated using wind power (16%) and heat & power plants (9%).

1.2.3. Denmark

Denmark has various objectives to cut down the usage of fossil fuels. One of these objectives is to stop using coal-fired power by the year 2030. Moreover, by 2030 the country targets to supply 100% of its electricity and 55% of total energy consumption using renewable resources. Additionally, Denmark is targeting to end the sale of petrol and diesel cars by 2030 (IEA, 2021).

In 2021, 74% of Denmark's electricity production came from renewable resources and 26% came from non-renewables. Wind power accounted for 48,6% of the renewables used in production of electricity. Biomass and other combustible renewables accounted for 21,2%. Solar power's share was 4,2%. The largest non-renewable resource used to generate electricity in Denmark was coal (15,9%) and the second largest was natural gas (6,3%). Other fossil fuels accounted for 3,7% (Statista, 2023).

1.2.4. Norway

Norway is one of the leading energy exporters in the world and like the other Nordic countries, it also has objectives to shift towards a more sustainable future. One of these objectives is to reduce greenhouse gas emissions by 40% of 1990 levels by 2030. According to IEA (2022), this objective will be difficult to execute since Norway's electricity supply as well as energy use in buildings is basically carbon free. Another objective for the country is to be a low-carbon society by the year 2050 (IEA, 2022).

Norway is one of the world's leading hydropower producers and this can also be seen in its energy mix. According to Statistics Norway (2023), in 2023 hydropower accounted for 89,7% of Norway's total electricity production. Wind power was the second largest contributor with a share of 8,8% and third largest thermal power with only 1,5% share

1.3. Review of previous literature

This sub-chapter's objective is to give the reader knowledge and understanding of topic, by reviewing previous research that have been conducted around the topic of profitability determinants. In the review, a short description of the study is given, and the results are revealed. A conclusion of the studies and variables used in them will be added to the end of this sub chapter. This is important, because it helps the reader to get a broader view of the topic itself. Moreover, the variables and method of analysis will be chosen with the help of previous literature.

Profitability determinants as a research topic has been widely studied in the past across numerous sectors such as banking, manufacturing, hotel industry, energy, and insurance. Moreover, out of all of the industries banking seems to be studied the most. Studies of profitability determinants in the energy sector seem to be less popular.

Fareed *et al.* (2016) conducted research studying profitability determinants of the power and energy sector in Pakistan. The authors collected financial data from 16 Pakistani energy firms from 2001 to 2012. Results showed that firm growth, firm size, and electricity crisis have a positive impact on the profitability whereas leverage, firm age and productivity had a negative impact (Fareed *et al.*, 2016).

Luts *et al.* (2021) studied profitability determinants of German unlisted renewable energy companies. The authors gathered financial information from 783 German companies for the time period of 2010-2018. Independent variables included of company specific variables such as company size, growth leverage and industry variables included for example economic growth, industry growth. Results of the study show that company- and industry specific determinants of profitability are statistically significant although company specific determinants tend to be more important (Luts *et al.*, 2021).

Westerman *et al.* (2020) conducted research about financial performance and diversification in the energy companies located in Western Europe. The authors used a sample of 129 publicly listed energy companies and gathered data from 2009 to 2015. After conducting univariate and multivariate regression analysis the authors found that size was a significant driver in firm profitability, which was measured as ROA. Moreover, the study results show that leverage in terms of debt to assets ratio and diversification had a negative impact on ROA in the energy sector.

Al-Homaidi *et al.* (2018) studied profitability determinants of banking institutions in India. Data was gathered from 60 commercial banks in India for the timeline of 2008-2017. The study considered both, bank specific variables as well as macro-economic variables' impact on profitability. Results show that bank size, number of branches, asset management ratio and leverage ratio all significantly impact profitability in terms of ROA. Macro-economic factors such as inflation rate, exchange rate and interest rate, were all found to have a significant impact on the profitability of Indian commercial banks (Al-Homaidi *et al*, 2018).

Yüksel *et al.* (2018) studied profitability determinants of the banking sectors in post-soviet countries. In their study, the authors gathered financial data of banks from 13 post-soviet countries from the years 1996 – 2016. Results of the study indicate that independent variables such as loan amount, non-interest income and economic growth can be considered as significant indicators of profitability in post-soviet countries' banks (Yüksel *et al.,* (2018)**.**

Le *et al.* (2020) studied the profitability determinants of publicly traded construction companies in Vietnam. Financial data from 73 companies were gathered from the period of 2008-2015. The results show that firm age as well as debt ratio had a negative impact on the profitability. Growth rate, asset turnover ratio and company size on the other hand had positive impacts of profitability (Le *et al.,* 2020).

A study was conducted by Farias *et al.* (2022) about the profitability determinants of the natural stone industry in Spain and Italy. Their sample consisted of 453 companies from Spain and Italy and financial data was gathered from 2015-2019 for the analysis. Independent variables were categorized into three categories: company specific, macro and diversity in business management. Results indicate that company size and growth as well as variation in the country's GDP, all have a positive impact on profitability. Moreover, leverage had a negative relationship with profitability. Countries' inflation and diversity in top management's relevancy in the analysis was insignificant (Farias *et al.*, 2022).

Morara and Sibindi (2021) studied the determinants affecting the financial performance of Kenyan insurance companies. Sample consisted of 16 life insurers and 37 general insurers. For the time period of 2009-2018, financial data was gathered to find results with the help of fixed and random effects model. Results show that company size has a positive impact on the companies' financial performance, that was measured using ROA and ROE. The study also reported that Age variable had a negative impact on firm profitability and that insurance companies with higher levels of leverage, performed better than peers with lower gearing.

Majority of the previous literature tend to use very similar variables when measuring the determinants impact on profitability. In most of the studies, such as (Fareed *et al.*, 2016; Westermann *et al.*, 2020), return on equity (ROE) or return on assets (ROA), or both were used as the dependent variables. Independent variables are often divided into company specific and macro-economic variables.

Regardless of the sector, the studies seem to use similar company specific variables such as company size, firm growth, leverage, and age (Fareed *et al.,* 2016; Luts *et al.* 2021; Le *et al.,* 2019). Macro-economic variables tended to change among previous studies except for economic growth, which can be found in most of the studies that used macro-economic variables. In addition to economic growth, previous studies also used inflation rate and interest rate (Yüksel *et al.,* 2018; Al homaidi *et al.,* 2018; Farias *et al.,* 2022).

Luts *et al.* (2021) study, that focused specifically on the energy sector, used more unique macro-economic variables such as energy price level, change in energy consumption. Moreover, Fareed *et al.* (2016) used energy crisis as a dummy variable in their study, but since the target countries of this research did not experience any energy crisis' during the time period in question, this variable in irrelevant for use.

Results of the previous studies are generally similar with certain variables. Variables such as company size, age, leverage, company growth, and GDP growth are inclined to affect the profitability in a positive manner (e.g Fareed *et al.* (2016); Farias *et al.* (2022); Luts *et al.* (2021). Variables such as leverage, and company age seem to have a negative impact on profitability (Fareed *et al.* (2016); Le *et al.* (2020); Morara and Sibindi (2021).

2. DATA AND METHODOLOGY

This chapter is first going to present the variables that were selected for the analysis based on previously conducted studies and author's general assumptions. After the introduction to the variables, a description of the data used in this research will be given. Lastly, when the reader has got an understanding of the selected variables and collected data, it is logical to explain the chosen method used to find results for the research questions.

2.1. Selected variables

Based on the review of previous literature, two dependent variables and ten independent variables were chosen for the analysis. Eight of the independent variables are company specific and two of them are macro-economic variables. Moreover, COVID-19 pandemic will be used as a dummy variable to see, how the energy sector was affected by this particular pandemic.

Two dependent variables, that measure profitability was selected: Return on assets (ROA) and Return on equity (ROE). ROA is a way of measuring a company's profitability by dividing its net income by its total assets. This measure gives an overview to the investor of how efficiently the company uses its assets in generating profits. ROE on the other hand is calculated by dividing the company's net income by its shareholder's equity. This measure shows how the company manages to generate profits for its equity owners.

As mentioned previously, the ten selected independent variables consist of eight company specific and two macro-economic variables. The company specific independent variables that were chosen are: firm size (sales & assets), growth rate (change in sales & assets), leverage (Debt to equity), liquidity (current ratio) and company age. The macro-economic variables are economic growth (change in GDP) and change in the price of electricity. The COVID-19 pandemic will be used as a dummy variable.

Table 1 gives a simple breakdown of the determinants (variables), their abbreviations as well as formulas used to calculate the values. Moreover, the last column displays the expected impact of the variable on profitability based on the previous literature covered in theoretical background and author's general assumptions.

Variables	**Abbreviation**	**Formulas/Interpretation**	**Result hypothesis**
Dependent variables			
Return on assets	ROA	P/L before tax / Shareholders equity	N/A
Return on equity	ROE	P/L before tax / Total assets	N/A
		Company specific variables (internal)	
Firm size (Sales)	S	Operating turnover	+
Firm size (TA)	TA	Total assets	+
Firm growth (Sales)	FGS	[(Current year sales / last year sales) – 1] x 100	+
Firm growth (TA)	FGTA	[(Current year TA / last year TA) – 1] x 100	+
Profit before tax	PROF	P/L before tax	+
Leverage	LEV	(Shareholders equity / Total assets) x 100	-
Liquidity	LIQ	Current assets / Current liabilities	+
Firm age	AGE	2021 - years from incorporation	-
		Macro economic variables (external)	
Economic growth	GDP	|(Current year GDP/last year GDP) – 1] x 100	+
Price of electricity	EP	|(Current year price/last year price) – 1] x 100	+
		Dummy variable	
COVID-19	COV	1= Pandemic year, 0 = No pandemic	-

Source: Compiled by author using Microsoft Excel

Notes: (+) positive expected impact on profitability, (-) negative expected impact on profitability

Table 1. Determinants, abbreviations, formulas, hypothesis, and sources

2.2. Data

Three different sources were used to retrieve the data required for the regression analysis. The financial data of the companies was obtained from Bureau van Dijk's "Orbis Europe" database. GDP growth data of the four countries were obtained from a database of the World bank. Lastly, the energy price change data was gathered from Eurostat.

Financial data of the energy companies were collected for the period 2013 – 2021, except for Danish companies for which data was only available for 2017-2021. Author used various criteria when collecting the financial data of the companies. First criteria were that the company was active and not listed in any stock exchanges. Secondly, the company had to be established before 2011 for data availability reasons. The most suitable NACE industry classification for companies operating in the field of electricity in Orbis was "Electric power generation, transmission and distribution". Thirdly, due to the lack of financial data for many SME and large companies, the selected companies had to be classified very large. In the Orbis database, a company is classified as very large when one of the following criteria is met: Operating revenue ≥ €100M, Total assets ≥ €200million, number of employees ≥ 1000 or that the company is listed.

After the "first round" of data refinement, every country's selected companies were imported into separate Excel worksheets. Data was then refined again using the following criteria: if a company had 10 or more missing datapoints (n.a. or n.s.) the company was deleted from the sample. Moreover, in case of fewer than 10 missing datapoints, the n.a. or n.s. values were replaced with a blank cell. Moreover, the outliers in the datasets, were identified using box plots, the outliers were also replaced with a blank cell. Before the analysis, each sample's dataset were imported into one excel file, which can be found in the Appendix 4.

After refining the data, the final sample used in the analysis consisted of 202 companies. Largest number of companies in the sample were from Norway with quantity of 81. Second largest share was Finland with 48 companies in the sample. Sweden and Denmark had the smallest proportions with 44 and 29 companies, respectively. Each of the countries have their own sub-sample consisting only of selected electricity companies in that country. In addition to creating sub-samples for each of the countries, a sample including all of the selected companies from all countries is used to give a representation of the Nordic electricity market as a whole.

Below is Table 2, which gives an overview of the variable data for the Nordic region. Table presents mean, median, standard deviation, minimum and maximum values for each of the variables selected for this research. Data is from each of the studied countries' electricity companies used in this research. Time period for the data is 2017 – 2021, due to the lack of financial data available for Denmark before the year 2017. Individual tables presenting each of the countries' descriptive statistics can be found in Appendix 1.

Table 2. Descriptive statistics of the Nordic data for 2017-2021
(missing values were skipped)

Variable	Mean	Median	S.D.	Min	Max
Dependent variables					
ROA	4.76	4.17	5.34	-12.2	27.5
ROE	12.1	11	13.7	-34.4	62
Independent variables					
SizeTurnover	206	121	233	-3.55	2.35E+03
Leverage	40.5	36.3	21.8	-3.38	100
Liquidity	1.26	1.13	0.772	0.001	5.5
Growthturnover	6.28	2.29	31.8	-81.7	218
SizeTotalassets	458	285	484	2.81	2.69E+03
GrowthTA	6.4	3.19	22.3	-88	156
Profitbeforetax	25.2	11.1	50	-60.8	387
Companyage	32.3	24	24.5	10.2	118
GDPgrowth	1.56	1.95	1.95	-2.21	5.08
Electricitypricechange	3.33	2.6	13.5	-27.4	34.8
COV19dummy	0.2	0	0.4	0	1

Sources: Author's calculation results using Gretl, table made in Excel. Data retrieved from Orbis

According to the tables in Appendix 1, when measuring with ROA, Norwegian electricity companies in the sample tend to be the most profitable with an ROA of 6.04, followed by Sweden with 4.27. Finnish and Danish companies had average ROA of 3.82 and 2.61, respectively. When profitability is measured using ROE, Norwegian companies are the most profitable again with an ROE of 15.6 followed by Finland with 10.9. Swedish companies' ROE on average was 10.2 and Danish companies' was 6.62.

2.3. Method

The collected data from Orbis database was inserted into Microsoft Excel. As the data consist of both, time-series, and cross-sectional units, it was transformed into panel data form. All of the firms that were examined were on the vertical dimension and the chosen dependent as well as independent variables from every time period were on horizontal dimension. The total size of the matrix in terms of number of observations is thus, I (number of firms) x T (number of periods) x K (number of observations).

Regression analysis was used to find the answer for our research question. The choice of this specific method was motivated by various previous research (Westerman *et al.,* 2020; Le *et al.,* 2020; Yüksel *et al.,* 2018; Farias *et al.,* 2022). As the analysis will contained more than one independent variable, multiple linear regression was used instead of simple linear regression, which allows only one independent variable. Multiple linear regression analysis' objective is to predict or explain the behavior of the dependent variable, by examining the relationship between independent variables and the dependent variable (Freund *et al.* 2006, 73). In practice, by using multiple regression models, we are able to see how for example changes in firm size (independent variable) affect firm's profitability in terms of ROA (Dependent variable).

To be more specific about type of the chosen multiple regression, fixed effects model was chosen to be the most suitable for method of analysis. As mentioned previously, data used in this research is panel data, which contains unobserved heterogeneity. This is caused by the cross-sectional dimension in the data. According to Brooks (2019), unobserved heterogeneity refers to the persistent differences over time between the individual units being studied, which are also known as "individual effects", that cannot be estimated through simple pooled (OLS) regression. Fixed effects model is able to consider heterogeneity in the data, which is why it was picked as the method for analysis.

Below is the model of fixed effects (FE):

$$Y_{it} = \beta_0 + \beta_1 X_{1,it} + \cdots + \beta_k X_{k,it} + \alpha_i + u_{it}$$

Where:

Y_{it} – Dependent variable
β_0 – Constant
β_1 – Coefficient
X – Independent variable
α_i – Intercept
u_{it} – Error term

Similarly, to Kiviniemi's (2018) research about determinants of bank profitability, the key measures in the output of multiple regression analysis that we will focus on are P-value, R-squared, coefficients and values from F-test. By analyzing all of these measures, we are able to build a strong understanding of the results and thus give more reliable suggestions for future research.

P-value is a measure that can be used to summarize the incompatibility between a proposed model for a set of data and the actual data (Wasserstein & Lazar, 2016). Moreover, p-value as a measure quantifies the likelihood of obtaining a specific set of observations if the null hypothesis were true. Thus, it is often used in deciding whether to reject the null hypothesis or not and to see if a certain pattern in statistically significant. Most commonly, a $p\text{-value} < 0.05$ is used to determine whether to reject the null hypothesis or not (Bevans, 2022). Having $p < 0.05$ fundamentally means that you would only anticipate finding a test statistic extreme as the one computed by your test 5% of the time.

R-square or the coefficient of determination as a measure in linear regression model, represents the proportion of the variance in the dependent variable, that is explained by the independent variable(s). In other words, this measure helps us understand how our model fits the data. R-square values always range from 0 to 1. R-square value of close to 1 implies, that there is nearly a perfect relationship between the dependent and the independent variable(s). Conversely, a value of 0 implies that there is no linear relationship among the variables. (Saunders *et al.,* 2012; John *et al.,* 2005, 196-197).

With the help of F-test, we are able to determine the significance level of our regression model. According to Orlov (1996, 10-11), the results of an F-test gives us an answer to the question: “With what level of confidence can we state that at least one of the coefficients in the regression model is significantly different from zero?”. If the confidence level is 0.95 (or 95%), this means that with 95% confidence, we can say that at least one of the coefficients is significant in our model.

The regression coefficients in our regression model are important because they indicate the extent to which a change in X (Independent) variable is related to a corresponding average change in Y (Dependent) variable (The BMJ, 2020). To put it more simply, they represent the amount by which Y variable changes for every unit increase in X variable. Thus, the coefficient (β) represents the slope of the regression line and whether it is upward or downward.

In order to get reliable results from the regression analysis, it is crucial to check whether each of our independent variables have a linear relationship with our dependent variables. Moreover, it was investigated whether the independent variables are correlated with each other to avoid multicollinearity. Multicollinearity is situation where independent variables are highly correlated with each other, which can lead to in accurate results (Ngo, 2012). In the case of multicollinearity between two or more independent variables, one or more independent variable has to be removed from the analysis. In this research, the threshold to remove an independent variable from the analysis was to have a correlation ≥0.6 with another independent variable. These relationships were investigated using correlation matrices. Outliers in the dataset were detected using box plots and extreme outliers were removed.

The analysis itself consists of separate regression analyses for each of the countries and a joint regression for Nordic electricity companies for time period. Moreover, since required financial data for Danish companies was only available for 2017-2021, the joint regression including all of the studied countries is conducted for 2017-2021. Since each of the countries have different energy markets, each of the countries’ datasets are individually tested for multicollinearity, which is why some of the tests are run with different variables..

3. EMPIRICAL RESULTS AND DICSUSSION

In this chapter, the results of the conducted regression analyses are presented and analysed. In the first sub-chapter, we will go over the results for each of the individual tests conducted for each of the Nordic countries, and for the Nordic as a whole. In the first sub-chapter, the results are presented separately for the samples. In the second sub-chapter, the results are discussed and analysed more thoroughly with the help of a table containing an overview on all the analysed models.

3.1 Results

3.1.1. Finland

Sub-sample consisting of Finnish electricity companies was analysed first. With the help of correlation matrix (found in Figure 1 in the Appendix 3), we were able to select the variables used in the fixed effects model. Due to non-existing correlation between ROA and growth in turnover, company age, electricity price change, these independent variables were excluded from the analysis. Moreover, growth in turnover and electricity price change were also excluded from the analysis where ROE was the dependent variable. Dummy variable (COV-19) was excluded due to exact collinearity.

The results for the Finnish sub-sample are exhibited in Appendix 2, Table 6. From the results, it can be seen that five independent variables are shown to have a significant impact on profitability, when measured as ROA. These variables are firm size in sales at 1% significance, leverage (5%), firm size in total assets (1%), growth in total assets (5%) and profit before tax (1%). GDP growth and liquidity showed insignificant impact.

Coefficient for firm size in sales was very low,0.005, which indicates that for every one unit increase in firm size in sales, profitability (ROA) increases by 0.005. Leverage's coefficient was 0.023 and size in total assets was shown to have negative impact on ROA with a coefficient of -0.008. When it comes to firm growth in total assets, a positive impact on ROA was discovered with a coefficient of 0.013. As for the coefficients, profit before tax turned out to have the highest positive impact on ROA with a coefficient of 0.209.

When profitability was measured with ROE, coefficients of the independent variables were much higher, than for ROA. Profit before tax indicated a coefficient of 0.618, meaning that for every one unit increase in profit before tax, profitability increases by 0.618 when measured as ROE. Liquidity turned out to have an extremely high coefficient of 0.98, although this was measured at 10% significance. Conversely to ROA, leverage had a negative impact on ROE with a coefficient of -0.160. Size in terms of sales had a smaller, but positive impact on ROE, as the coefficient was 0.029. Moreover, firm size in terms of assets affected ROE in a negative manner with a coefficient of -0.024.

R-squared values for the models were 0.659 (ROA model) and 0.550 (ROE model). P-value (F) for the ROA model was < 1% and also for ROE model it was < 1%, which indicates that there is strong evidence to reject the null hypothesis that the coefficients in the model are zero.

3.1.2. Sweden

As for the Swedish companies, it was found that liquidity, growth in assets, firm age, and electricity price, were not correlated with profitability when it was measured as ROA (see figure 2 in Appendix 3). Liquidity, company age, GDP growth and electricity price were all excluded from the analysis when ROE was the measure of firm profitability. Compared to Finland, Sweden had fewer independent variables chosen for its analysis. Dummy variable (COV-19) was excluded due to exact collinearity.

Results of the fixed effects regression can be viewed in Appendix 2, Table 7. From the table it can be seen that when profitability was measured with ROA, three independent variables showed significant impact on the dependent variable with less than 1% P-value. These independent variables were leverage with a positive relationship, size in total assets with a negative relationship and profit before tax with a positive relationship. Size in sales, growth in sales and GDP growth were statistically insignificant.

When ROE was used as the dependent variables for Swedish firms, the same independent variables were impacting the dependent variable at 1% significance level. Moreover, size in terms of turnover has a positive correlation with ROE at 10% significance. Leverage this time has a negative effect and size in total assets was also negatively affecting ROE. Profit before tax affected ROE in a positive manner. Firm growth in sales and assets were statistically insignificant.

When it comes to coefficients in the ROA model, profit before tax and leverage showed the highest correlation with positive coefficients of 0.088 and 0.064, respectively. Similarly, to Finland, size in terms of total assets indicated a small negative relationship with ROA with a coefficient of -0.003. When profitability was measured with ROE, profit before tax had the biggest impact on profitability, with a positive coefficient of 0.210, which indicates a similar direction for correlation with Finland. Size in total assets and leverage on the other hand had both small negative impact on ROE, as the coefficients for these independent variables were -0.01 and -0.055, respectively.

The models' R-squared values were 0.423 for ROA and 0.345 for ROE. Both models had a p-value (F) of less than 1%, indicating that they were statistically significant. In simpler terms, the models had a high level of accuracy in predicting the outcome, and the results were not due to chance.

3.1.3. Norway

The analysis for Norway was quite different compared to other countries' analyses. AS can be seen in Figure 3 in Appendix 3, only two independent variables were shown to not have any significant correlation with ROA. These variables were growth in total assets and company age and were excluded from the ROA model. Moreover, company age was the only variable that was not correlated with ROE, so it was excluded from the ROE model. In addition, multicollinearity amongst variables was highly present. GDP growth and electricity price change had ≤ 0.8 correlation and size in sales and growth in sales were had ≤ 0.7 correlation. Thus, a decision was made by the author to exclude Growth in GDP and size in sales from both of the models. Dummy variable (COV-19) was excluded due to exact collinearity.

Results of the fixed effects regression conducted about Norwegian companies can be found in the Appendix 2, Table 8. As the table suggests, only two independent variables seem to have impact on profitability, when measured as with ROA. These two variables are firm size in terms of total assets and profit before tax. Size in total assets affected ROA positively at 1% significance. Profit before tax also had a positive impact on ROA at 1% significance. Leverage, liquidity, and growth in sales were in significant.

When ROE was used as the measure for profitability, the chosen independent variables were shown to have more significant impact on ROE than for ROA. Five independent variables were found to have an impact on ROE. These variables were leverage at 1% significance, growth in sales at 10% significance, size in total assets at 1% significance, growth in total assets at 10% significance and profit before tax at 1% significance. Although many variables were selected for the analysis, five of them showed statistically insignificant relationship with ROA. These variables were size in sales, liquidity, growth in sales, growth in total assets and company age.

Coefficients for the ROA model were much smaller when compared to the ROE model. Size in total assets showed a very small and negative correlation of -0.0088, whereas profit before tax had a positive impact on ROA with a coefficient of 0.105. As for the ROE model, coefficients tended to be more significant. Leverage displayed a negative impact on ROE, with a coefficient of -0.271. Profit before tax had a positive effect on ROE, as the coefficient for this variable was 0.246. Size in total assets and growth in total assets both had a negative impact on ROE, with coefficient being -0.018 and -0.042, respectively. Firm growth in sales had a positive coefficient of 0.035.

The R-squared values of the models or ROA and ROE were 0.447 and 0.408, respectively. Moreover, both models were statistically significant as the P-value (F) was < 0.01. The dataset consisting of only Norwegian companies was the largest individual data set out of all of the selected countries.

3.1.4. Denmark

The sub-sample consisting of only Danish electricity companies, presented some interesting findings. To begin with, only one variable weas excluded from the analyses and this was GDP growth. Reason for this is that it was found that GDP growth did not have any significant relationship with neither ROA or ROE (See figure 4 in Appendix 3). Dummy variable (COV-19) and electricity price were excluded due to exact collinearity.

The table showing the results for the Danish sub-sample can be found in Appendix 2, Table 9, According to the table, when profitability is measured with ROA, three independent variables have impact on profitability at > 10% significance. These variables are leverage at 10% significance, size in total assets at 1% and profit before tax with 1%.

When ROE was used as the measure profitability, it was found that four independent variables had statistically significant impact of on the dependent variable. Size in terms of sales were had a negative impact with 5% significance and size in total assets also affected ROE negatively at 1%. Moreover, growth in sales as well as profit before tax were found to have positive impact on ROE.

As for the coefficients in the ROA model, profit before tax had the highest coefficient value with 0.125, leverage second highest with 0.048 and size in total assets with a coefficient of -0.004. Similarly, to the other countries, ROE model seems to have higher coefficient also in this case. Highest coefficient values in the ROE model, was profit before tax (0.263) and growth in assets (0.152). Size in terms of sales and total assets, had coefficients of -0.031 and -0.008, respectively.

The R-squared values of the models for ROA and ROE were 0.550 and 0.610, respectively, indicating that models explain approximately 55% and 61% of the variability in ROE, respectively. Additionally, both models were statistically significant as the P-value (F) was less than 0.05.

3.1.5. Nordic

The Nordic sample consisted of all of the countries' selected electricity companies. As the author mentioned previously, data for Danish companies was only available from 2017, the time period for this sample's analysis is 2017 – 2021. In the ROA model, only leverage, growth in sales, profit before tax, and electricity price change were investigated, due to other variables' insignificant relationship with the dependent variable (See Figure 5 in Appendix 3). The ROE model's variable selection had the same independent variables that in the ROA model, but also growth in total assets and company age. Dummy variable (COV-19) was excluded due to exact collinearity.

Results can be observed from Table 10, found in the Appendix 2. Profitability, when measured as ROA, was impacted by four independent variables at 1% significance. These variables were leverage, growth in total assets, profit before tax, company age and electricity price change. All of these variables had a positive impact on ROA, except for company age and growth in assets. had a negative relationship with ROA.

In the ROE model, only three variables were found to have a statistically significant impact on profitability, when measured as ROE. These variables were leverage, profit before tax and company age, with significances of 1%, 1% and 5%, respectively. Profit before tax affected profitability in a positive manner whereas company age and leverage had a negative effect on profitability. Growth in sales and growth in total assets turned out to have no significant impact on ROE.

Coefficients in the Nordic sample were lower compared to the country specific sub-samples. In the ROA model, highest coefficient of determination was 0.149, which belongs to electricity price change. Leverage and profitability both had positive coefficients of 0.055 and 0.052, respectively. Firm growth in sales had a coefficient of 0.015. Growth in sales and company age showed negative relationships with ROA with coefficients of -0.031 and -0.016, respectively. As for the ROE model, coefficients were a bit higher, than for ROA. Leverage and company affected ROE in a negative manner. Coefficients for these variables were -0.123 and -0.056. Profit before tax had a positive relationship with ROE, and it's coefficient was 0.132.

The R-squared values for the Nordic sample's models, were relatively low compared to the company specific sub-samples. The ROA showed an R-squared of 0.221 and for the ROE model, this value was 0.179. The R-squared values of the models for ROA and ROE were 0.550 and 0.610, respectively, indicating that models explain approximately 55% and 61% of the variability in ROE, respectively. Additionally, both models were statistically significant as the P-value (F) was less than 0.05. P-values for the models were both < 1%.

3.2. Discussion

Tables 11 and 12 below, attempt to simplify the results of this research. Each table observes the independent variables' relationship with the dependent variable. Relationships are measured as coefficients and colors "green" and "red" indicate the nature of relationship, positive or negative, respectively. The statistical significances of the relationships are displayed as stars after the coefficient. Moreover, the cells that contain "-", indicate that this variable was not included in the analysis due to minimal correlation with the dependent variable or multicollinearity with other independent variable(s).

Table 11. Coeffcients in the ROA model

	ROA				
	FI	SWE	NOR	DE	NRDC
S	0.005 ***	0.002	-	0.004	-
LEV	0.023 **	0.064***	0.013	0.048 *	0.055 ***
LIQ	-0.163	-	0.057	-0.09	-
FGS	-	0.019	-0.007	0.007	0.015**
TA	-0.008***	- 0.003***	-0.009 ***	-0.004***	-
FGTA	0.036 **	-	-	0.02	-0.031 ***
PROF	0.209 ***	0.088 ***	0.105 ***	0.125 ***	0.052 ***
AGE	-	-	-	-0.051	-0.016 ***
GDPG	-0.123	0.468	-	-	-
EP	-	-	-	-	0.149**

Notes: ***,**,* indicate the statistical significance measures (P-value) at 0.01, 0.05 and 0.1, respectively. "-" indicates absence of variable in the analysis

Sources: Author's illustration
made in excel

Table 12. Coeffcients in the ROE model

	ROE				
	FI	SWE	NOR	DE	NRDC
S	0.029 ***	0.009*	-	-0.031 **	-
LEV	-0.16 ***	-0.055 ***	-0.271***	-0.011	-0.123***
LIQ	0.98 *	-	-0.589	-1.977	-
FGS	n/a	0.016	0.035 *	-0.038	0.037
TA	-0.024 ***	-0.010***	-0.018 ***	-0.008 ***	-
FGTA	0.047	0.059	-0.042 *	0.152 ***	-0.013
PROF	0.618 ***	0.210 ***	0.246 ***	0.263 ***	0.132***
AGE	-	-	-	-0.041	-0.056**
GDPG	-	-	-		-
EP	-	-	-	-	-

Notes: ***,**,* indicate the statistical significance measures (P-value) at 0.01, 0.05 and 0.1, respectively.

"-" indicates absence of variable in the analysis

Sources: Author's illustration made in Excel

When profitability is measured with ROA, firm's size in terms of sales does not seem to have significant impact on profitability, which is contradictory to Fareed *et al.* (2016) study, where firm size in sales was the largest determinant for profitability. Finnish, Swedish and Danish companies all exhibit positive correlation of less than 0.01, with Finland having the only statistically significant value at 1%. As for the ROE model, Finnish sample and Swedish sample showed positive relationship among size in sales and profitability at 1% and 10% significances, but with low coefficients (0.029 & 0.009). Danish companies responded negatively to size in sales at 5% significance and -0.031 coefficient indicating that for every one unit increase in leverage, profitability (ROA) decreases by -0.031.

Leverage on the other hand turned out to have positive impact on profitability for all of the investigated samples, when profitability was measured with ROA. Out of the five samples, Norway was the only on to not show statistically significant results. Sweden and Nordic had coefficients of 0.062 and 0.055, both at 1% significance. Corresponding values for Finland and Denmark were 0.023 and 0.048 at 5% and 1% significance levels. As for the ROE model, results were completely different and more significant. Leverage had negative impact on profitability in all of the samples. The samples were all statistically significant at 1%, except for the Danish sample, which was not statistically significant on any level. Moreover, the coefficients were much higher with Norway and Finland having the highest (-0.271 & -0.160). Coefficients for the Nordic and Swedish samples were 0.123 and -0.055, respectively. Leverage's negative impact on ROE is similar to study results in Farias *et al* (2016) study.

Liquidity's impact on ROA wasn't significant in any level for all of the samples. Finland and Denmark showed negative relationship with ROA, whereas Norway showed a positive. Liquidity's impact on ROE were also statistically insignificant for Norway and Denmark, but for Finland, liquidity showed a positive impact at 10% with a very high coefficient of 0.98.

Firm growth in sales turned out to have no statistically significant results except nor the Nordic sample at 5% and with a low positive coefficient of 0.015. Sweden and Denmark also showed positive relationships whereas Norway showed negative. When ROE was the measure of profitability, the results stayed relatively insignificant. Norwegian sample was the only one to be statistically significant at 10%, with a positive impact on ROE (0.035). Other samples also showed positive impacts.

Against author's intitial expectations, Firm size in terms of total assets showed negative impact on profitability in both models. For the ROA model, all of the country-specific sample had a negative impact on ROA at 1% significance. The coefficients were very low ranging from -0.003 to -0.008. As for the ROE model, the results were very similar to the ones in the ROA model. Country specific results were all statistically significant and the coefficients were just a little bit higher compared to the ROA model. Thus, the results turned out to be different from the initial expectations, which were projected positive impact.

Firm's growth in total assets, was once statistically significant at 5% in the ROA model. This was for Finland, as a positive relationship between growth in total assets and ROA was found. Coefficient of determination was 0.036. For the other samples, Denmark showed positive impact and Nordic negative, both with statistical insignificance. When ROE was the measure for profitability, Denmark was the only one to display statistically significant results at 1%. The relationships between growth in total assets and ROE, was positive, with a relatively high coefficient of 0.152. Norwegian sample showed a negative relationship at 10% significance and -0.042 coefficient. The initial expectations regarding the impacts were true with the Finnish sample in the ROA model and the Danish sample in the ROE model.

Profit before tax ended being the independent variable with the most significant impact on profitability in both models, as the p-values for all of the samples' coefficients were <1%. In the ROA model, Finnish companies' profitability tended to be the most affected by profit before tax with a positive coefficient of 0.209. Second highest coefficient belonged to Danish sample and third highest to Norwegian sample with the coefficients being 0.125 and 0.105, respectively. Sweden and Nordic were least impacted by profit before tax, as the coefficients for these samples were 0.088 and 0.052 respectively. When ROE was used as the measurement for profitability, profit before tax displayed the highest impact on profitability out of all of the variables in both models. For Finnish companies, profit before tax showed a high coefficient of 0.618, meaning that for every unit change in profit before tax, ROE increases by 0.618. Denmark, Norway and Sweden all had quite similar coefficients for profit before tax; 0.263, 0.246 and 0.210, respectively. In the Nordic sample, profit before tax had a positive relationship with ROE, with a coefficient of 0.132. The results regarding this specific variable's impact on profitability are in line with the author's projections of the results. Moreover, they are similar to the results presented in Luts *et al.* (2021) study on profitability determinants of German renewable energy companies.

As for the age variable, it was only found to be having a negative impact on Nordic samples ROA and ROE at 1% and 5% significances, respectively. The coefficient for the ROA model was -0.016 and for the ROE model it was -0.056. Moreover, Denmark also had negative but statistically insignificant coefficients in both of the models. With this being said, the initial projections made on the effect that firm's age has on its profitability are aligned with the actual results of the models. Moreover, Fareed *et al.* (2016) study results about profitability determinants of Pakistan's energy companies also display negative association between firm age and profitability.

GDP and electricity price change were chosen as the macroeconomic independent variables in this research. However, they turned out to have very little significance, when it comes to profitability determinants of Nordic electricity companies. In the ROA model, GDP growth was only selected for Finland's and Sweden's analyses. Both results turned out to be statistically insignificant, with coefficient being -0.123 for Finland and 0.468 for Sweden. In the ROE model GDP growth was excluded from every sample's analysis. Electricity price change on the other hand, was included only once on the whole analysis. This was for Denmark in the ROA model. Electricity price change turned out to be positively impacting ROA at 5% significance, which is in accordance with the author's expectations.

CONCLUSION

Profitability determinants has been studied a lot among various sectors ranging from banking to manufacturing and construction to pharmaceutical. Energy sector's share of the previously conducted studies around this topic is very low, whether it is about renewable energy, electricity, oil, or coal. The research problem of this study is based around the idea that there is a significant gap in knowledge, when it comes to the profitability determinants in the Nordic electricity sector, giving the author a chance to contribute to the society by attempting to fill this gap using his best effort.

There were two research questions, to which the conducted analysis gave results to: **"**Which and how selected company specific factors are related to the profitability of Nordic electricity companies?" and "Which and how selected external factors are related to the profitability of Nordic electricity companies?". The aim for this research was to find the nature of relationship among the chosen independent variables and profitability of Nordics electricity companies measured as ROA and ROE. Independent variables that were chosen for the analysis were size measured in sales and assets, firm growth measured in growth in sales and assets, leverage, liquidity, profit before tax, firm age, electricity price change and GDP growth. Covid-19 pandemic was supposed to be used as a dummy variable, but it did not give any results due to exact collinearity.

After refining the data and removing outliers, there were a total of 202 very large electricity companies from Nordic countries excluding Iceland. The decision to exclude Iceland from the study was made by the author due to the country's relatively low energy sector compared to other Nordic countries. Financial data of these companies were obtained from Bureau van Dijk's "Orbis Europe" database. As for the GDP and electricity price, data was gathered from World bank and EIA, respectively. The time period for the study was 2013-2021. This specific period was picked based on the availability of the data of the companies.

As for the method of analysis used to find the relationships among the selected independent variables and dependent variables, fixed effects model was picked as the most suitable method. For each of the countries, sub-samples were made to represent the electricity sectors in that country. Moreover, a sample consisting of all the companies in the Nordic was made to represent the Nordic electricity sector as a whole. Before running the regressions, each of the samples were tested for multicollinearity and that the selected independent variables were correlated with the dependent variables. In the case of multicollinearity or a very low correlation among independent and dependent variable, the variables were excluded from the analysis.

The analyses turned out to give some interesting results. Independent variables such as size in terms of sales, leverage, and profit before tax, all tend to mostly affect profitability in a positive manner when measured as ROA. Firm size in terms of total assets on the other hand tended to have a negative impact on ROA for the countries. Macroeconomic variables turned out to be mostly insignificant, except for the Nordic sample, where changes in electricity price had a significant positive affect on ROA. Change in GDP had statistically insignificant impact on both profitability measures.

When profitability was measured as ROE, the results seemed to be more significant, but positive and negative effects on profitability varied among samples. Profit before tax and size in terms of sales had the most significant positive effects on ROE. Size in terms of total assets showed negative effect on ROE for each of the country specific samples. Leverage on the other hand, showed completely different effects on ROE, than on ROA. Leverage showed negative effects on ROE in all of the samples, with Denmark having the only statistically insignificant value. GDP growth and electricity price change both were excluded from the ROE model, due to severe multicollinearity. Firm growth in sales and liquidity mostly had statistically insignificant results as determinants of profitability in both models, ROA and ROE

As there were five different samples, that regression models were conducted on, the results did vary among various variables. The initial expectations, that the author had set before the analyses, did turn out be true in some cases, but with some cases they did not. For future researches, the author would suggest to study the same topic, but after the on-going war in Ukraine has ended. This would give a chance to see what kind of impact the war has had on profitability and its determinants in Nordic electricity companies.

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APPENDICES

Appendix 1. Descriptive statistics for Nordic countries' individual data

Table 3. Descriptive statistics for very large Finnish electricity firms 2013-2021
(missing values were skipped)

Variable	Mean	Median	S.D.	Min	Max
Dependent variables					
ROA	3.82	3.66	4.14	-8.25	20.8
ROE	10.9	11.2	12.8	-30.1	54.9
Independent variables					
SizeTurnover	143	123	101	0	478
Leverage	35.7	35.4	15.1	-3.38	78.4
Liquidity	1.48	1.35	0.836	0.026	4.48
Growthturnover	2.46	0.469	13.7	-28.4	60.8
SizeTotalassets	337	299	255	2.81	1390
GrowthTA	4.17	3.28	9.25	-47.3	31.2
Profitbeforetax	12.1	10.2	16.9	-34.5	113
Companyage	38.7	27.1	28.5	11	111
GDPgrowth	0.935	1.14	1.77	-2.21	3.19
Electricitypricechange	1.46	0.949	2.63	-0.951	7.57
COV19dummy	0.111	0	0.315	0	1

Sources: Author's calculation results using Gretl, table made in Excel. Data retrieved from Orbis

Table 4. Descriptive statistics for very large Swedish electricity firms 2013-2021
(missing values were skipped)

Variable	Mean	Median	S.D.	Min	Max
		Dependent variables			
ROA	4.27	4.6	5.3	-13.3	27.5
ROE	10.2	10.8	10.6	-34.4	42.9
		Independent variables			
SizeTurnover	288	192	267	10.3	1.03E+03
Leverage	40.1	38.8	22	1	86.2
Liquidity	1.18	1.08	0.72	0.053	3.58
Growthrateturnover	-0.475	-0.826	13.6	-36.5	45.3
SizeTotalassets	437	226	526	16.6	2.26E+03
GrowthTA	1.07	1.04	13.2	-57.7	58.5
Profitbeforetax	13.7	7.07	23.9	-44.5	142
Companyage	47	34.8	30.9	11.6	118
GDPgrowth	2.2	2.07	1.95	-2.17	5.08
Electricitypricechange	0.363	-0.107	7.69	-10.2	15.8
COV19dummy	0.111	0	0.315	0	1

Sources: Author's calculation results using Gretl, table made in Excel. Data retrieved from Orbis

Table 5. Descriptive statistics for very large Norwegian electricity firms 2013-2021
(missing values were skipped)

Variable	Mean	Median	S.D.	Min	Max
		Dependent variables			
ROA	6.04	5.16	5.81	-8.69	24
ROE	15.6	12.6	15	-17.4	62
		Independent variables			
SizeTurnover	177	101	201	-3.55	1.08E+03
Leverage	43	37.1	23.2	-14.8	100
Liquidity	1.14	1.02	0.765	0.001	4.89
Growthrateturnover	6.21	1.64	38.7	-81.7	218
SizeTotalassets	509	290	544	0.0563	2.69E+03
GrowthTA	7.43	2.56	26.8	-88	156
Profitbeforetax	37.7	16.5	61.8	-158	340
Companyage	24.4	23.3	15.3	11.9	117
GDPgrowth	1.49	1.12	1.19	-0.717	3.88
Electricitypricechange	0.885	2.13	17.1	-27.4	34.8
COV19dummy	0.111	0	0.314	0	1

Appendix 2. Fixed effects model results

Table 6. Fixed effects model results for ROA and ROE (Finnish companies)

Dependent variable	ROA				ROE			
	Coeff.	std. Error	P-value		Coeff.	std. Error	P-value	
constant	2.951	1.028	0.006	***	10.210	3.461	0.003	***
S	0.005	0.003	0.117	*	0.029	0.010	0.004	***
LEV	0.023	0.011	0.046	**	-0.160	0.042	0.0002	***
LIQ	-0.163	0.146	0.271		0.980	0.585	0.094	*
FGS	-							
TA	-0.008	0.001	4.29E-21	***	-0.024	0.003	4.9E-14	***
FGTA	0.036	0.014	0.013	**	0.047	0.050	0.353	
PROF	0.209	0.018	6.39E-67	***	0.618	0.036	6.8E-65	***
AGE	-				-			
GDPG	-0.123	0.588	0.836		2.044	1.543	0.185	
EP	-							
COV	-							
P-value (F)	7.8E-15				2.0E-18			
R-Squared	0.659				0.550			
# of obs.	278				276			

Notes: ***,**,* indicate the statistical significance measures (P-value) at 0.01, 0.05 and 0.1, respectively.

Sources: Authors calculations in Gretl, table created with Excel.

Table 7. Fixed effects model results for ROA and ROE (Swedish companies)

Dependent variable	ROA	ROE

	Coeff.	std. Error	P-value		Coeff.	std. Error	P-value	
constant	0.961	1.597	0.548		12.394	1.414	0.000	
S	0.002	0.002	0.312		0.009	0.005	0.057	*
LEV	0.064	0.013	8.04E-07	***	-0.055	0.021	0.0090	***
LIQ	-				-			
FGS	0.019	0.021	0.363		0.016	0.036	0.652	
TA	-0.003	0.000	3.52E-12	***	-0.010	0.001	3.34E-11	***
FGTA	-				0.059	0.043	0.173	
PROF	0.088	0.014	5.23E-10	***	0.210	0.028	3.91E-14	***
AGE	-				-			
GDPG	0.468	0.670	0.485		-			
EP	-				-			
COV	-				-			
P-value (F)	1.6E-18				6.2E-09			
R-Squared	0.423				0.345			
# of obs.	248				232			

Notes: ***,**,* indicate the statistical significance measures (P-value) at 0.01, 0.05 and 0.1, respectively.

Sources: Authors calculations in Gretl, table created with Excel.

Table 8. Fixed effects model results for ROA and ROE (Norwegian companies)

Dependent variable	ROA				ROE			
	Coeff.	std. Error	P-value		Coeff.	std. Error	P-value	
constant	6.789	0.501	8.78E-42	***	29.928	2.241	1.1E-40	***
S	-				-			
LEV	0.013	0.010	0.174		-0.271	0.034	0.000	***
LIQ	0.057	0.305	0.851		-0.589	0.841	0.483	
FGS	- 0.0073	0.008	0.342		0.035	0.018	0.051	*
TA	- 0.009	0.001	3.43E-30	***	-0.018	0.002	0.000	***
FGTA	-				-0.042	0.026	0.100	*
PROF	0.105	0.009	6.65E-34	***	0.246	0.022	0.000	***
AGE	-				-			
GDPG	-				-			
EP	-				-			
COV	-				-			
P-value (F)	1.8E-19				5.7E-23			

	ROA				ROE			
R-Squared	0.447				0.408			
# of obs.	493				464			

Notes: ***,**,* indicate the statistical significance measures (P-value) at 0.01, 0.05 and 0.1, respectively.

Table 9. Fixed effects model results for ROA and ROE (Danish companies)

Dependent variable	ROA				ROE			
	Coeff.	std. Error	P-value		Coeff.	std. Error	P-value	
constant	1.497	1.759	0.395		15.254	4.445	0.001	***
S	0.004	0.006	0.505		-0.031	0.012	0.012	**
LEV	0.048	0.026	0.059	*	-0.011	0.079	0.888	
LIQ	-0.090	0.615	0.884		-1.977	1.753	0.259	
FGS	0.007	0.023	0.772		-0.038	0.066	0.567	
TA	-0.004	0.001	0.000	***	-0.008	0.003	0.008	***
FGTA	0.020	0.022	0.361		0.152	0.052	0.004	***
PROF	0.125	0.022	0.000	***	0.263	0.041	0.000	***
AGE	-0.051	0.044	0.248		-0.041	0.126	0.746	
GDPG	-				-			
EP	-				-			
COV	-				-			
P-value (F)	0.0152				1.486E-07			
R-Squared	0.550				0.610			
# of obs.	65				70			

Notes: ***,**,* indicate the statistical significance measures (P-value) at 0.01, 0.05 and 0.1, respectively.
Sources: Authors calculations in Gretl, table created with Excel.

Table 10. Fixed effects model results for ROA and ROE (Nordic companies)

Dependent variable	ROA				ROE			
	Coeff.	std. Error	P-value		Coeff.	std. Error	P-value	
constant	0.961	0.636	0.131		17.173	1.984	0.000	***
S	-							
LEV	0.055	0.009	2.25E-09	***	-0.123	0.025	0.000	***
LIQ	-							
FGS	0.015	0.008	0.069	**	0.037	0.024	0.134	
TA	-							
FGTA	-0.031	0.010	0.003	***	-0.013	0.028	0.650	
PROF	0.052	0.005	0.000	***	0.132	0.014	0.000	***
AGE	-0.016	0.006	0.004	***	-0.056	0.023	0.014	**

GDPG					
EP	0.149	0.010	0.043	**	
COV	-				
P-value (F)	2.6E-20				1.68E-13
R-Squared	0.221				0.179
# of obs.	728				687

Notes: ***,**,* indicate the statistical significance measures (P-value) at 0.01, 0.05 and 0.1, respectively.

Sources: Authors calculations in Gretl, table created with Excel.

Appendix 3. Correlation matrices

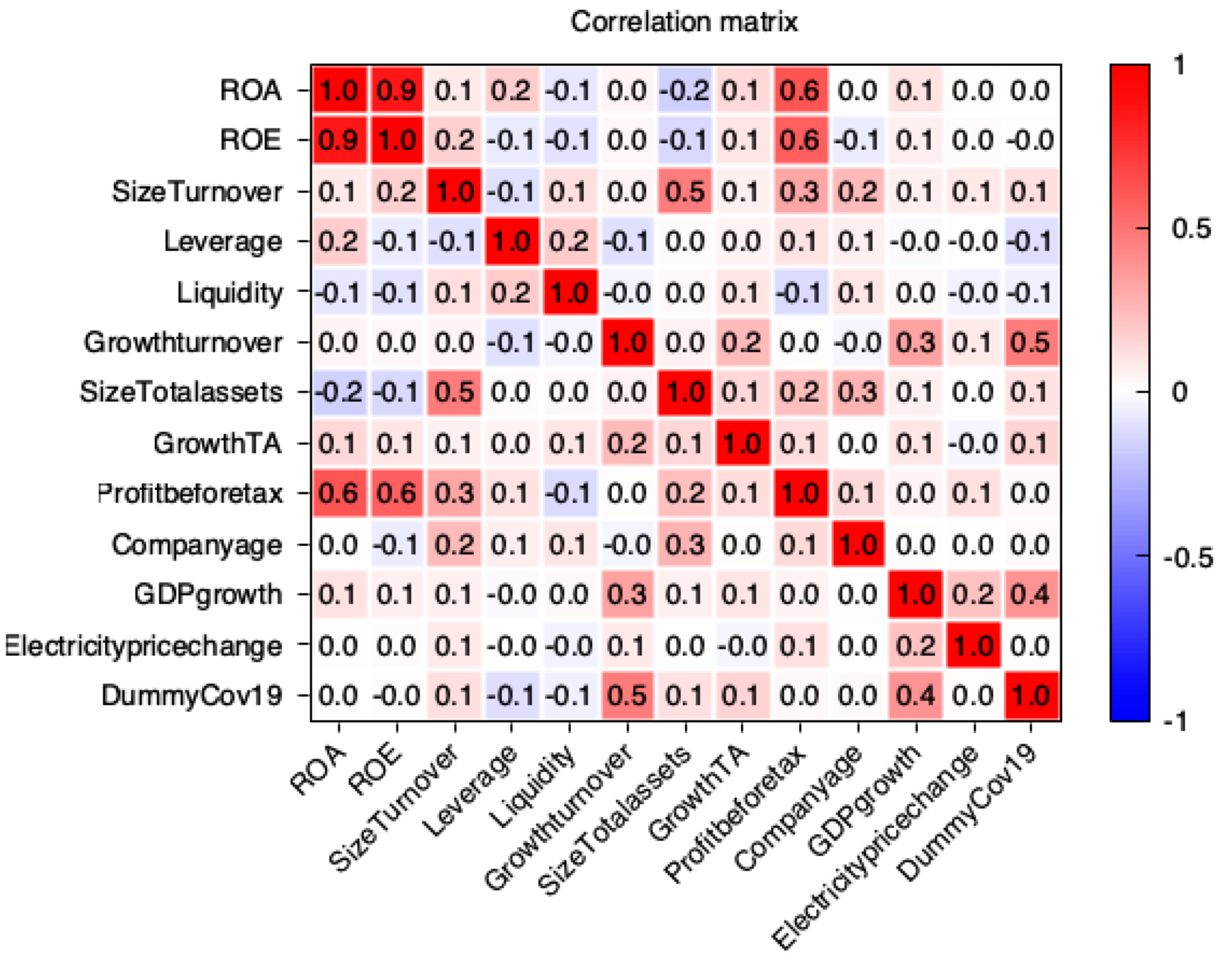

Figure 1. Correlation matrix for the Finnish sample

Source: Created by author using Gretl software

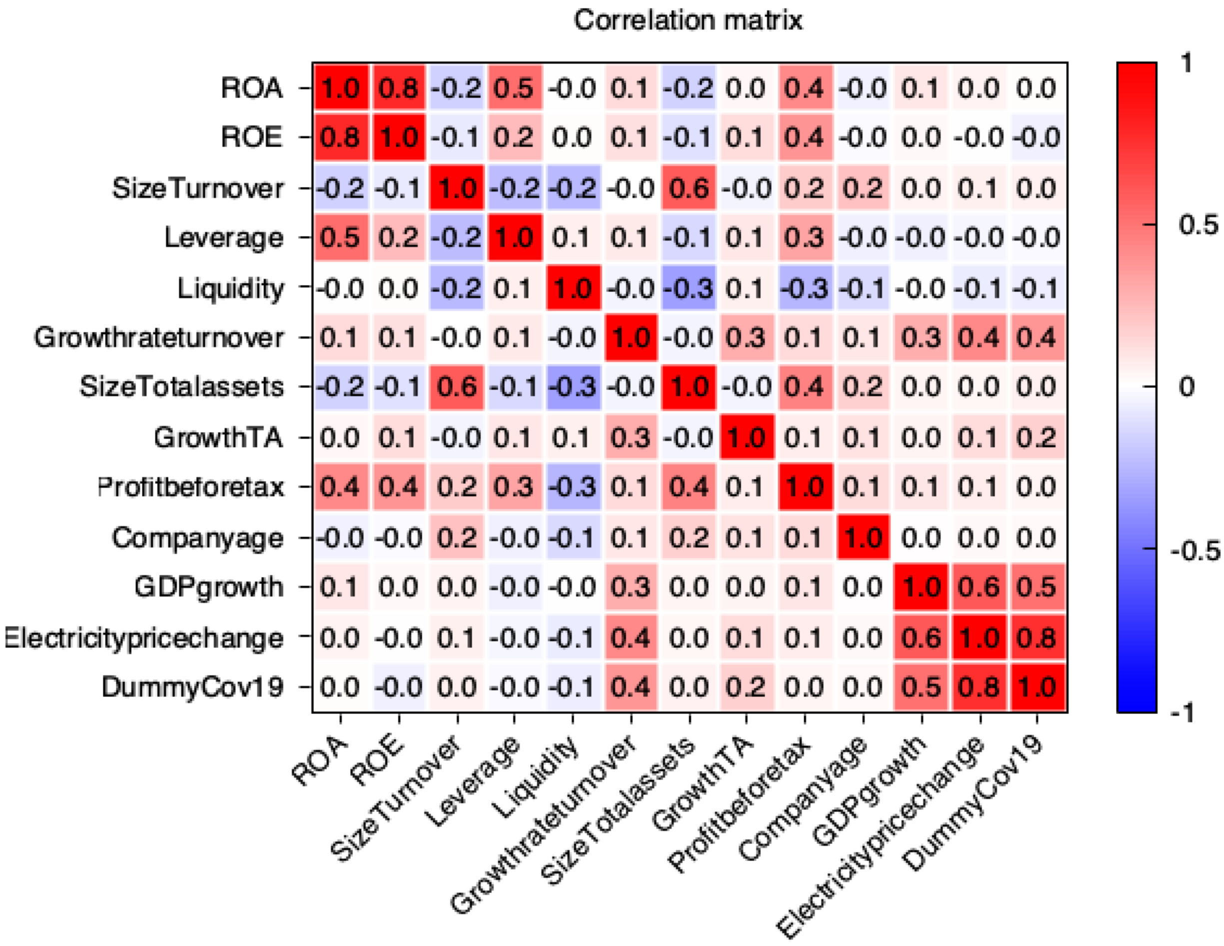

Figure 2. Correlation matrix for the Swedish sample

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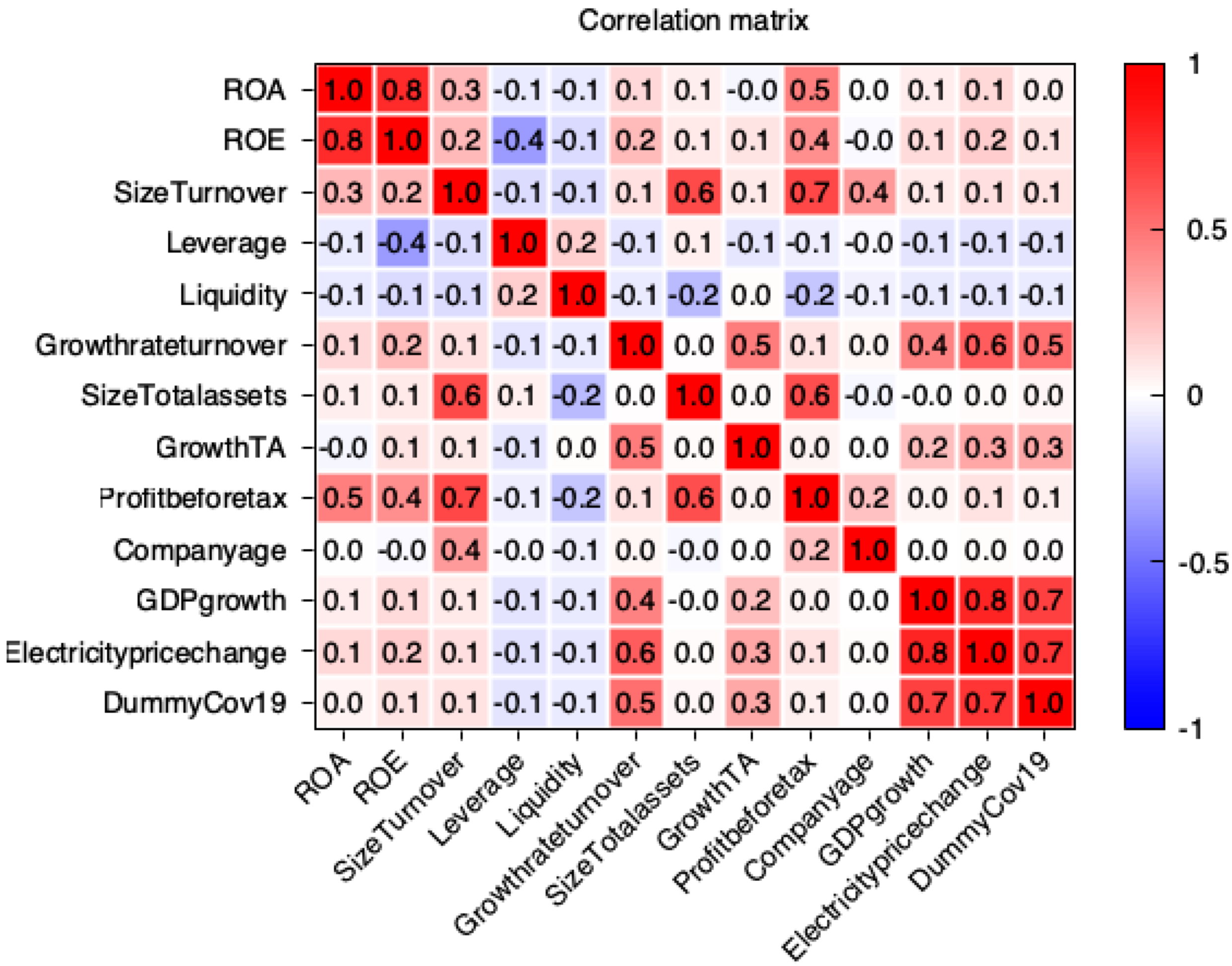

Figure 3. Correlation matrix for Norwegian sample

Source: Created by author using Gretl

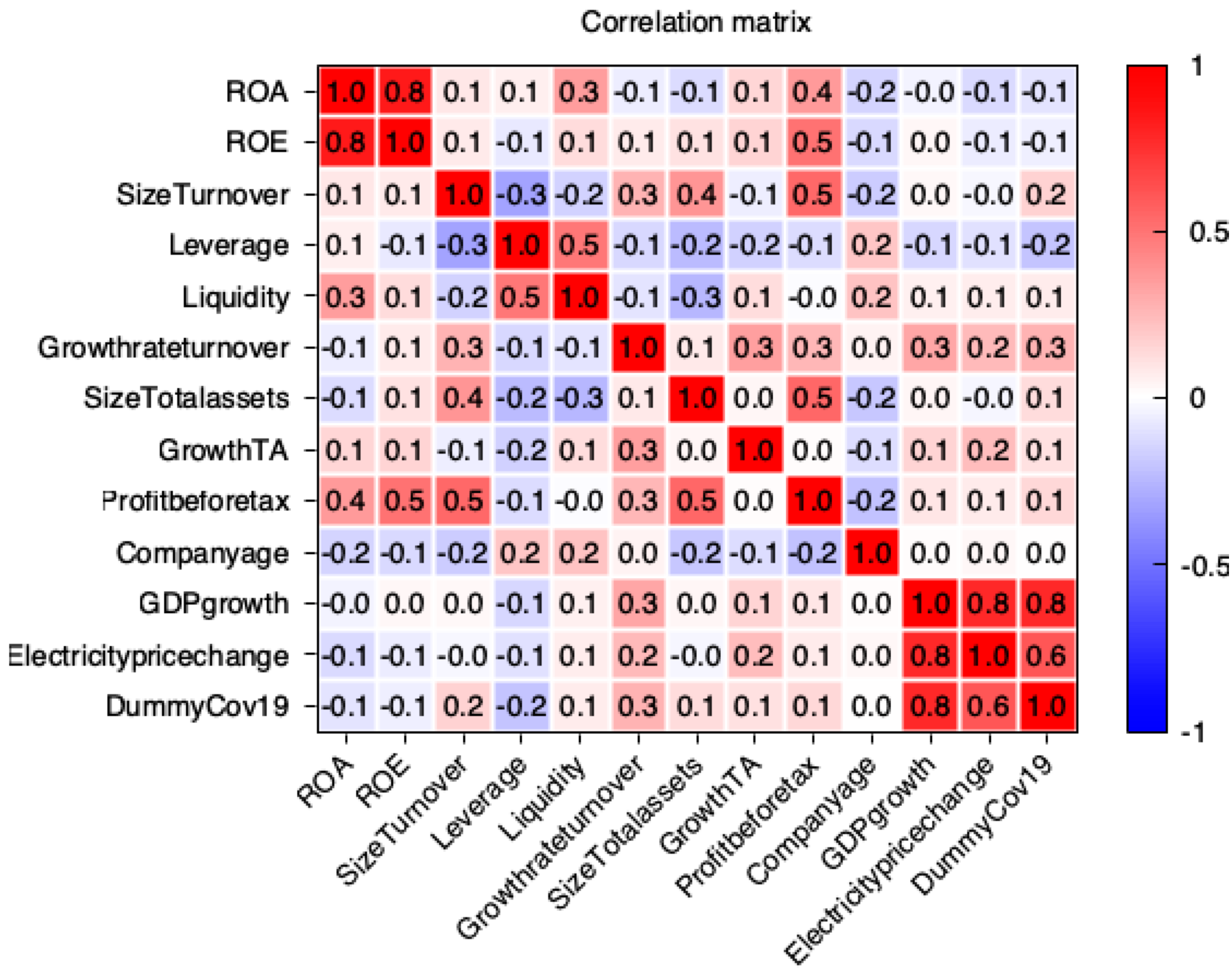

Figure 4. Correlation matrix for the Danish sample

Source: Created by author using Gretl software

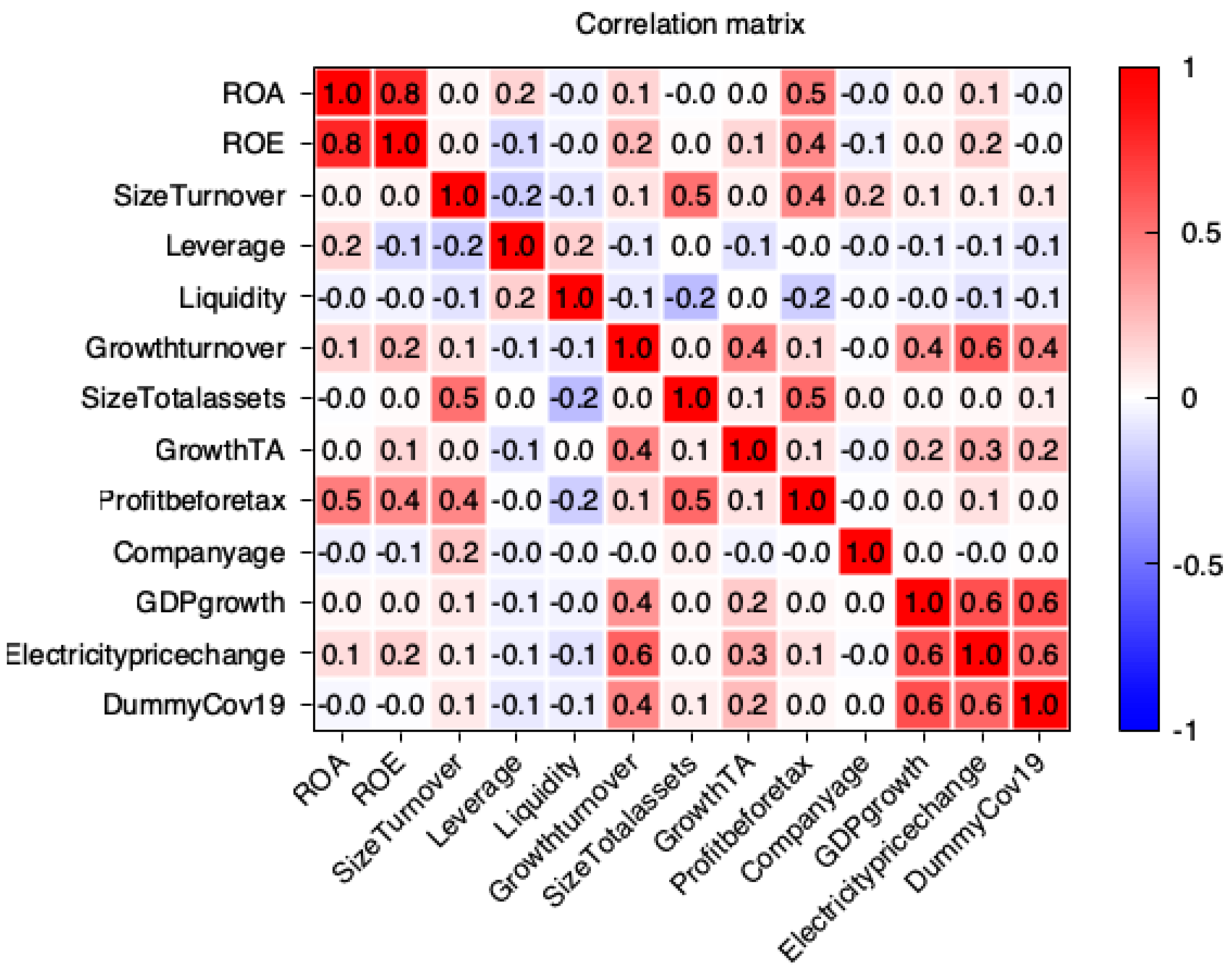

Figure 5. Correlation matrxi for the Nordic sample

Source: Created by author using Gretl software

Appendix 4. Link to datasets

Company financial data: https://livettu-my.sharepoint.com/:x:/g/personal/mamoil_ttu_ee/EV-6OsZ77GJLkYpvBndgTJ8B1h1tnATkaHghshgdMbO8vw?e=ONEABQ

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