LUT School of Business and Management

Master’s Thesis, Strategic Finance and Business Analytics

PROFITABILITY DETERMINANTS OF RENEWABLE ENERGY FIRMS

CASE: non-listed, private equity firms in Germany

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ABSTRACT

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The fight against climate warming has urged the nations and the global community to cut emissions and define ambitious environmental goals. In this context, the importance of renewable energy has been magnified. Hence, it is valuable to learn about the conditions in which the firms in the renewable energy (RE) industry can thrive. The purpose of this thesis is to first, investigate the factors of firm-level profitability based on the previous research, and second, to find out which profitability determinants affect the profitability of the German private equity firms in the industry of RE producers.

The results from a panel data analysis showed that both firm- and industry-specific determinants were significant, but the firm-specific determinants explained more variance in profitability. The profitability determinants that were significant in most tests with a positive effect on profitability were related to the company size and the share of renewables. The change in electricity consumption affected profitability negatively.

The governmental support system, Feed-in Tariff, had a significant negative effect contrary to expectations. One of the important findings was that the 'Size measured by Assets' affected profitability negatively in large companies. This could imply that the large companies practice expansion strategies at the cost of profitability. Within the small and medium-sized (SME) firms, the change in Market Concentration had a positive effect on profitability, which suggests that the SME's benefit from both industry growth and increasing market concentration. It appeared that Liquidity and Leverage have no consistent, significant effect on profitability. The results of the thesis contribute to the existing knowledge on firm- and industry-level profitability determinants in the less studied RE industry sector and should be of interest to companies, investors, and policymakers alike.

TIIVISTELMÄ

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Ilmastonmuutoksen vastainen kamppailu on johtanut valtiot ja globaalin yhteisön asettamaan yhä tiukentuvia ympäristötavoitteita, mikä on entisestään nostanut uusiutuvan energian merkitystä. Siksi on arvokasta tutkia minkälaisissa olosuhteissa alan yritykset voivat menestyä. Tämän tutkielman tavoitteina on tutkia kannattavuustekijöitä aikaisemman kirjallisuuden pohjalta, sekä selvittää Saksan markkinoilla ja uusiutuvan energiantuotannon alalla toimivien yksityisen pääoman yritysten kannattavuutta määrittelevät tekijät ja näiden vaikutus.

Paneelidata-analyysin tulosten perusteella voidaan sanoa, että niin firmakohtaiset kuin teollisuuskohtaisetkin tekijät ovat merkitseviä, mutta firmakohtaisten tekijöiden osuus kannattavuuden selitettävyydessä on suurempi. Firman kokoon ja uusiutuvan sähkön osuuden muutokseen liittyvät tekijät todettiin toistuvissa testeissä merkitseviksi ja ne vaikuttivat kannattavuuteen sitä parantaen. Sähkönkulutuksen kasvulla todettiin olevan negatiivinen vaikutus kannattavuuteen.

Vastoin odotuksia todettiin uusiutuvan sähkön tuotantotuella eli syöttötariffilla olevan negatiivinen vaikutus kannattavuuteen. Yksi tärkeistä havainnoista oli yrityksen kokonaispääoman negatiivinen vaikutus suurten yritysten kannattavuuteen. Tämän voi selittää se, että suuret yritykset saattavat harjoittaa laajenemisstrategioita kannattavuuden kustannuksella. Alan suurimpien firmojen markkinaosuuden muutossuhteella havaittiin olevan positiivinen vaikutus kannattavuuteen pienten ja keskisuurten (pk) firmojen kohdalla, mistä voisi päätellä, että kasvava, mutta keskittyneempi ala hyödyttää etenkin pk-firmoja. Likviditeetin ja velkavivun vaikutuksesta saatiin vähemmän merkitsevää näyttöä. Tutkimuksen tulos täydentää olemassa olevaa, firma- ja teollisuuskohtaisia kannattavuustekijöitä koskevaa tutkimustietoa, tuoden näyttöä vähemmän tutkitulta uusiutuvan energian alalta. Tuloksista katsotaan olevan hyötyä niin alan yrityksille, sijoittajille kuin päättäjille.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

CO2	Carbon Dioxide
CSP	Concentrated Solar Power
D/A	Debt to Assets
D/E	Debt to Equity
EBIT	Earnings Before Taxes and Interest
EEG	“Erneuerbare-Energien-Gesetz” (The Renewable Energy Sources Act)
EFL	Electricity Feed-in Law
EU	European Union
EVA	Economic Value Added
FE	Fixed Effects
FIT	Feed-in-Tariff
GDP	Gross Domestic Product
GLS	Generalized Least Squares
GW	Gigawatts
GWh	Gigawatt hours
IEA	International Energy Agency
IRENA	International Renewable Energy Agency
KW	Kilowatts
kWh	Kilowatt hours
MW	Megawatts
NACE	“Nomenclature générale des Activités économiques dans les Communautés Européennes” (Statistical classification of economic activities in the European Communities). ‘Rev.’ indicates Revision
NECP	National Energy and Climate Plan
OLS	Ordinary Least Squares
PV	Photovoltaic
RE	Renewable Energy
RE	Random Effects
ROCE	Return on Capital Employed

ROA	Return on Assets
ROE	Return on Equity
ROI	Return on Investment
ROS	Return on Sales
RQ	Research Question
R&D	Research and Development
UN	United Nations

LIST OF FIGURES

LIST OF TABLES

LIST OF EQUATIONS

1 INTRODUCTION

The fight against global warming and thereby the transition and reinforced efforts towards a cleaner, emission-free energy production accelerated in the EU after the Paris Agreement at the UN Climate Change Conference in 2015. The agreement set the goal of leveling the increase in the global average temperature below 2°C and an additional target to limit the increase to 1.5°C. In 2020, EU Commission proposed a Climate Target plan of cutting CO2 emissions by at least 55 % by the year 2030, and to become carbon neutral by 2050. Amid the transition to carbon neutrality, the importance of Renewable Energy has magnified. Global renewable energy consumption has grown at an average annual rate of 13.7% over the past decade. (Rapier, 2020) In 2020, the renewable energy capacity growth rate peaked at a record high of 45% since the year 1999. (IEA, 2021)

The thesis is focused on studying the profitability determinants of German private, not publicly traded, equity firms in the industry of renewable electricity producers. Profitability is examined on an accounting level, rather than from an investment or a plant operations perspective. German companies are chosen as the target group because the German Renewable Energy (RE) industry is one of the largest in the world and well established due to the long-lasting efforts by the government to promote green energy. One of the motivating factors was that studies focusing solely on the German private RE companies across the sectors and from the accounting profitability perspective were not found. There is data accessible over a longer period even among the private companies and this provides a favorable opportunity to study the profitability determinants of the less studied private companies in the industry.

1.1 Motivation

The research done for this thesis is limited to firms in the renewable electricity business. Germany has significantly promoted renewable electricity with the Feed-in Tariff (FIT) policy for several decades, but the policy scheme will see its end soon. When support systems are ended, actions are needed to keep the RE companies financially stable and in operation. The companies and their investors need to form new and more efficient strategies to match the competition. From the market governance point of view knowing the factors of performance and profitability will also help to form the energy laws and policies for the future to ensure the ongoing production of RE, while an expansion in RE production is needed to comply with the EU climate commitments and to compensate for the loss in energy supply.

The research questions (RQs) this thesis pursues to answer are:

1) According to the literature, what are the factors that determine firm profitability? How much explanatory power do the firm-specific determinants and industry-specific determinants have in profitability?
2) What are the determinants of profitability of the private equity electricity producers operating in the RE sector in Germany? Do the Feed-in Tariffs explain variance in profitability?

To answer the RQ2, two hypotheses were formulated based on the literature review in RQ1:

H1. *The model with industry-specific determinants and the model with firm-specific determinants are both significant at the 5 % significance level. The explanatory power is higher for the firm-specific determinants.*

H2. *The average annual FIT has a significant positive effect on the RE firms' profitability.*

The structure of the thesis is as follows: the second chapter will briefly discuss the background and current state of the RE industry in Germany and describe the RE sources. The third chapter will go through the previous literature about firm-level profitability and profitability determinants, both in general and within the RE industry, the fourth chapter introduces the data and methodology used in the analysis, and the fifth chapter goes through the analysis results. Finally, the last chapter concludes and discusses the limitations of the thesis.

2 CONCEPTS AND BACKGROUND

This chapter will briefly describe the renewable energy sources and paint an overall picture of the RE industry in Germany, as well as some comparisons to Europe.

2.1 Renewable Energy Sources

Renewable, green, or alternative energy all describe energy either in the form of heat, electricity or fuel that is derived from constantly renewing natural sources and processes. RE technology enables energy production while limiting emissions beyond the manufacturing stage. The term renewable energy is also used to describe the specific technology used in energy generation. The sources usually prescribed as renewables are solar, wind, geothermal, ocean, hydro, and bioenergy.

Globally, the installed capacity of renewable energy has increased steadily during the past ten years and especially solar power has expanded. Solar power uses photovoltaic (PV) cells to generate electricity from the sun. PV cells are devices made from silicon or other similar material that can directly convert sunlight into electricity, and they are applicable for both larger commercial electricity generation and household rooftop solar installations. Large-scale solar power plants use Concentrated solar power (CSP) technology, where solar rays are concentrated into a large area of solar cells with mirrors. The solar rays heat fluid, and the steam generated in the process is used to heating (solar thermal) and driving power turbines. The heat can also be stored to be used after sunset. (Irena, 2020; Shinn, 2018)

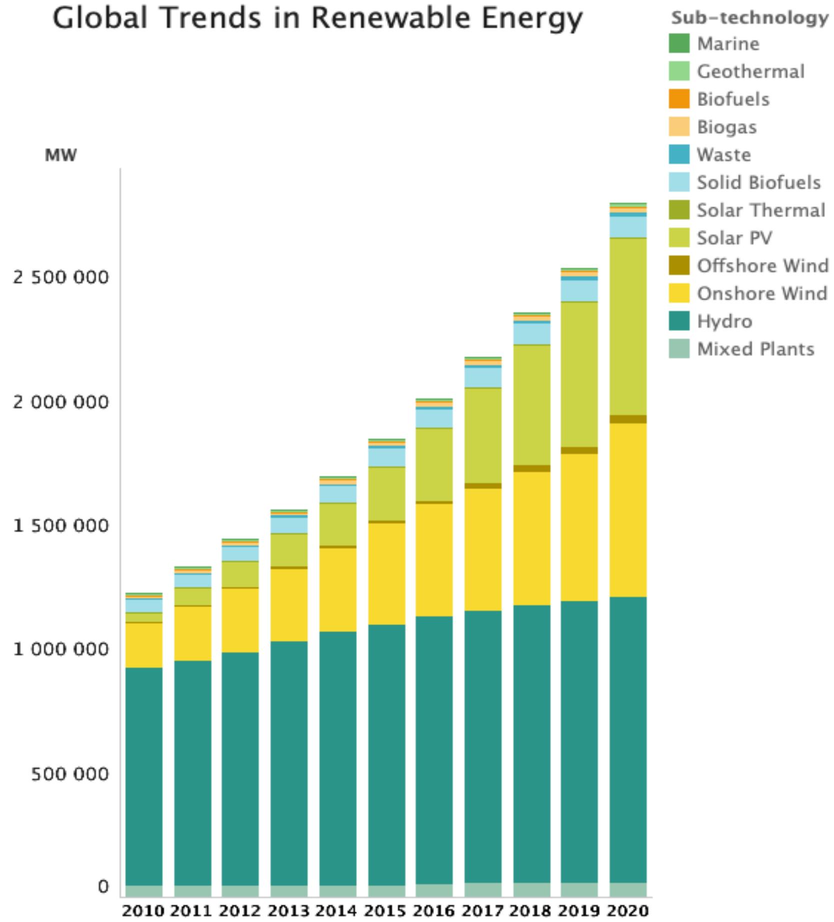

Figure 1. Global trends in renewable energy. Maximum installed capacity in Megawatts.

Source: (Irena Statistics, 2020) Figure made with Tableau.

The total renewable energy generation capacity was 2799 GW in 2020. Hydropower had the largest share of the renewable energy generation capacity with 1211 GW. Water as an energy source has been used since ancient times, and hydropower remains the most popular and cost-effective method for generating electricity due to its long plant life. The basic idea is that flowing water is used to run power turbines connected to the power generators. Impoundment facilities use dams and reservoirs, whereas diversion facilities use the natural run of the river. Pumped storage facilities can store the energy in a period of lower demand in another reservoir where the water can be pumped back through a turbine. The world's largest 22.5 GW hydropower plant in China supplies up to 80 million households. (Office of Energy Efficiency & Renewable Energy, 2021)

China holds the status of the largest installed RE capacity in absolute numbers, and after China are the United States, Brazil, India, and Germany. In Germany, the largest share of renewable electricity is generated from wind. Wind power is over a century-old innovation allowing electricity to be generated from the kinetic energy of air in motion. Wind turbines and wind energy systems convert the rotational energy of the wind into electrical energy. Onshore and offshore wind power capacity has grown from 7.5 GW in 1997 to approximately 564 GW in 2018, and 16% of the electricity generated from renewable sources came from wind in 2016. Offshore turbines' capacity is about 3-5 MW while according to the International Renewable Energy Agency (IRENA) commercially available turbines have reached 8 MW capacity. (Irena, 2020e)

From the global perspective, the share of bioenergy was 10 % of the total final energy consumption and 1.9 % of the electricity generation in 2015. (Irena, 2020a) Electricity from bioenergy might be in the global minority capacity-wise, but in Germany, it is the third-largest renewable electricity source. Traditional bioenergy usually refers to the combustion of wood, animal waste, and charcoal. Modern technologies however also include for example liquid biofuels from bagasse and other plants used in transport, wood pellet heating, and anaerobic digestion of residues for biogas production. Biomass can be burned for heating or electricity generation or converted into oil or gas. (Irena, 2020)

Other RE sources are still in the minority but great potential exists within geothermal energy and marine/ocean energy. Ocean as a renewable energy source includes technologies that convert wave and tidal energy, salinity gradient energy, and ocean thermal energy into electricity. Electricity production from these sources is still at the development phase and not yet commercial. (Irena, 2020c; Shinn, 2018) Deep in the sub-surface of the earth, the heat can reach temperatures close to those on the sun's surface which is the basis of a geothermal energy source. The hot underground water reserves can be pumped through a turbine to create electricity and provide heat, after which the steam and water can be pumped back into the reservoir which is what makes geothermal energy a renewable resource as well. The hottest temperatures are most beneficial for electricity generation, and these are usually located in the tectonically active regions and thus the areas of geothermal energy cover a large share of electricity demand in countries like Iceland, El Salvador and Kenya. The geothermal power plants can equip a temperature of more than 180°C. New technologies are also constantly being developed, as the energy source is considered attractive because the process is not dependent on the weather and the capacity factors are high. (Irena, 2020b)

2.2 Renewable Energy in Germany

Germany's contributions to the global climate agreement and the European 'Green Deal' include the government's Climate Action Programme 2030 adopted in 2019, which targets to decrease greenhouse gas emissions by 55% below the 1990 year's level by 2030. (Wehrmann, 2019) The common goal is to make Europe climate neutral by 2050. According to the analysis by the think tank Agora Energiewende, Germany

Emission of greenhouse gases covered by the UN Framework Convention on Climate

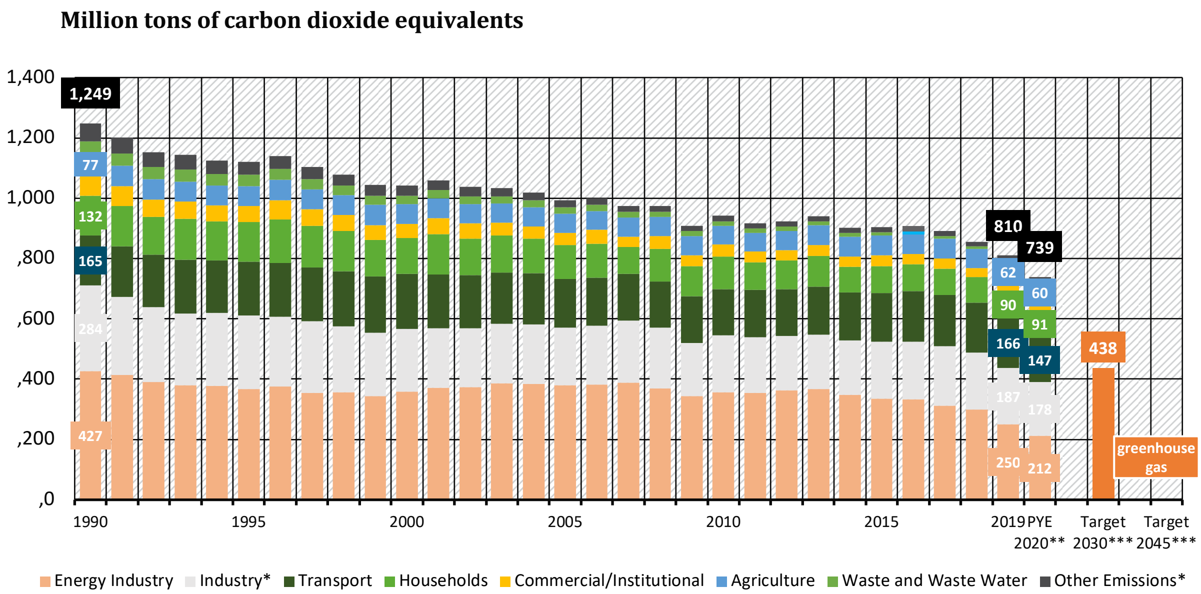

Figure 2. CO2 emissions in Germany

Emissions by UN reporting category, without land use, land-use change, and forestry

*** PYE: Previous-Year-Estimate for 2020*

**** Targets 2030 and 2045: according to the revision of the Federal Climate Protection Act (KSG) as of 12.05.2021*

Source: German Environment Agency, National Inventory Reports for the German Greenhouse Gas Inventory 1990 to 2019 (as of 12/2020) and Previous-Year-Estimate (PYE) for 2020 (Press-Info 07/2021 from 15.03.2021)

(Wilke, 2017)

reached the earlier set target of reducing emissions by 42.3% (of 1990 levels) by 2021, while the decrease in the CO2 megatons was 8.7 %. (Appunn, Eriksen et al., 2021) A large part of this decline is said to be due to a drop in energy usage in the industry caused by the corona pandemic, but the increase in the share of renewable electricity in the grid and the expansion of renewable technologies has certainly contributed to the decrease over the years.

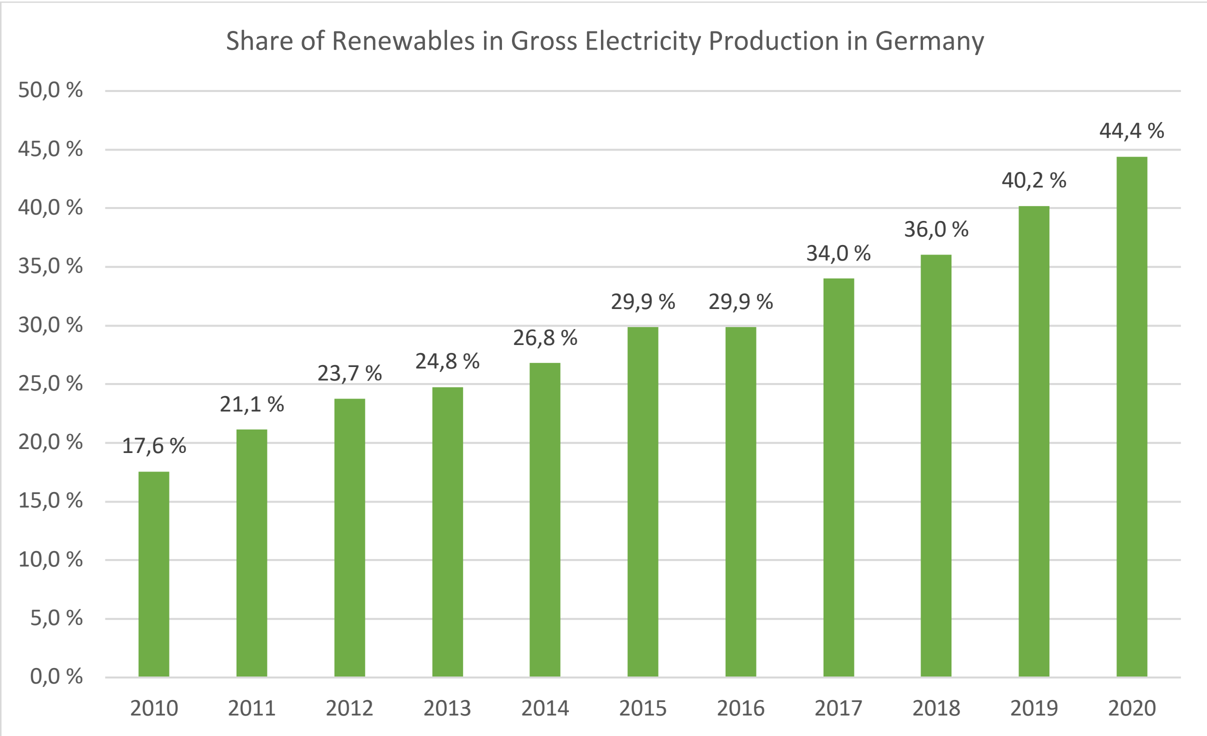

Figure 3. Annual renewable shares in gross electricity production in Germany.

Source: Fraunhofer ISE. Energycharts.info

Germany has outlined the national goals regarding the steps needed to take in the expansion of renewables in the National energy and climate plan (NECP) submitted to the European Commission in 2019. Germany targets a 30 % share of renewables in gross final energy consumption by 2030 and a 19.2 % share in 2021. (European

Commission, 2021) In terms of gross final energy consumption, Germany is currently far from the top when compared to other European countries. 17.4% of Germany's final energy consumption was from renewable sources in 2019. The top countries in Europe in that regard were Iceland, Norway, and Sweden. (Figure 4)

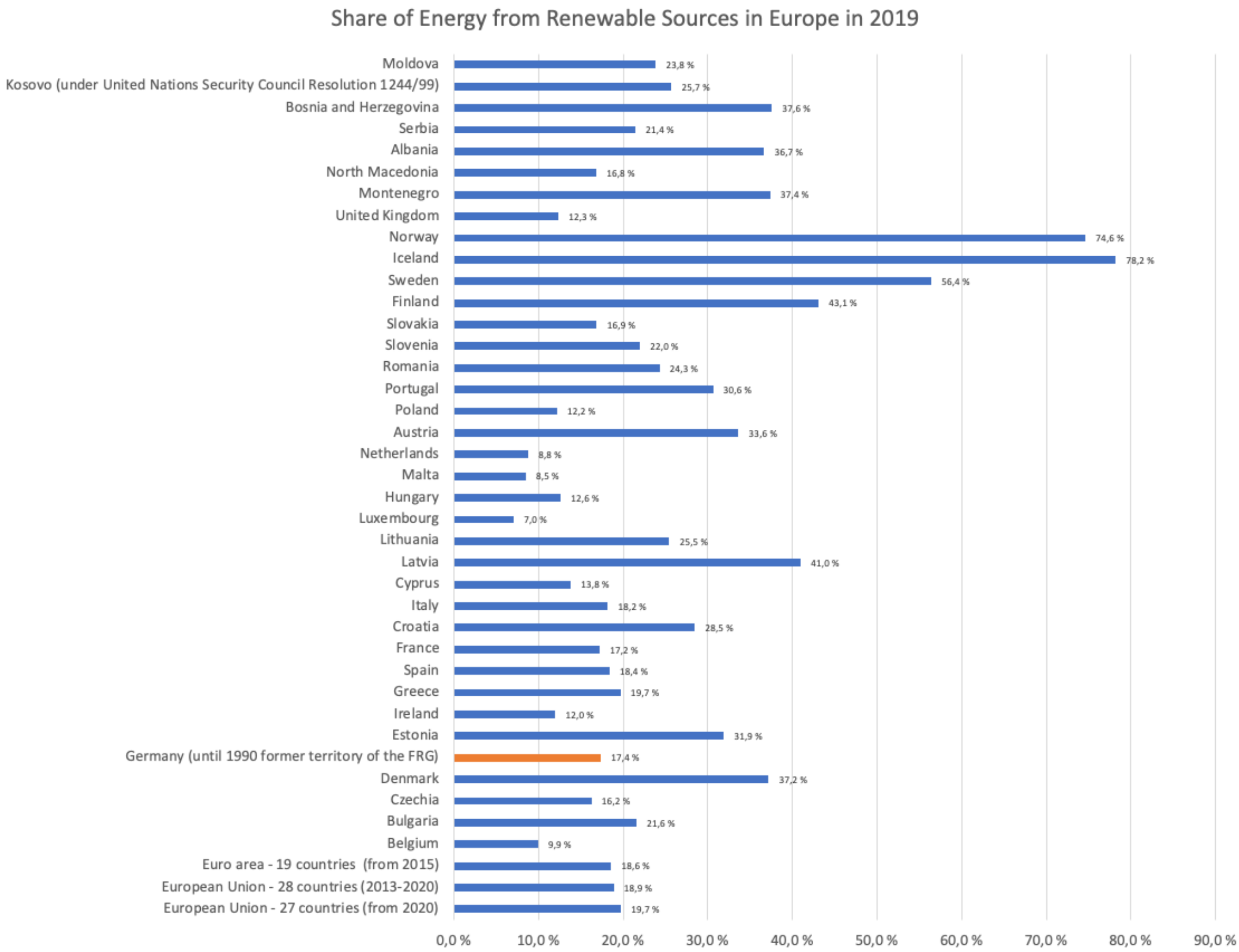

Figure 4. Share of renewable energy in gross final energy consumption in European countries in 2019.

Source: (Eurostat, 2021)

The share of renewable electricity in the gross electricity production in Germany has increased from the 17.6 % in 2002 to approximately 44 % in 2020 (Figures 3 and 5). The share of gross renewable electricity consumption was 46.3 % in 2020, up 3.8 points from the previous year.

When compared to other European countries with 2019 numbers in the RE electricity consumption, Germany's still out of the top 10 while the Nordic countries are leading the way (Norway having 109.1% renewables share in the electricity consumption) (Appunn, Haas et al., 2021) Along with the national plan, Germany set a goal to increase renewables share in gross electricity consumption to 40–45% by 2025 and 65% by 2035, and a minimum of 80% by 2050. (IEA, 2016; Wehrmann & Appunn, 2019; European commission, 2021)

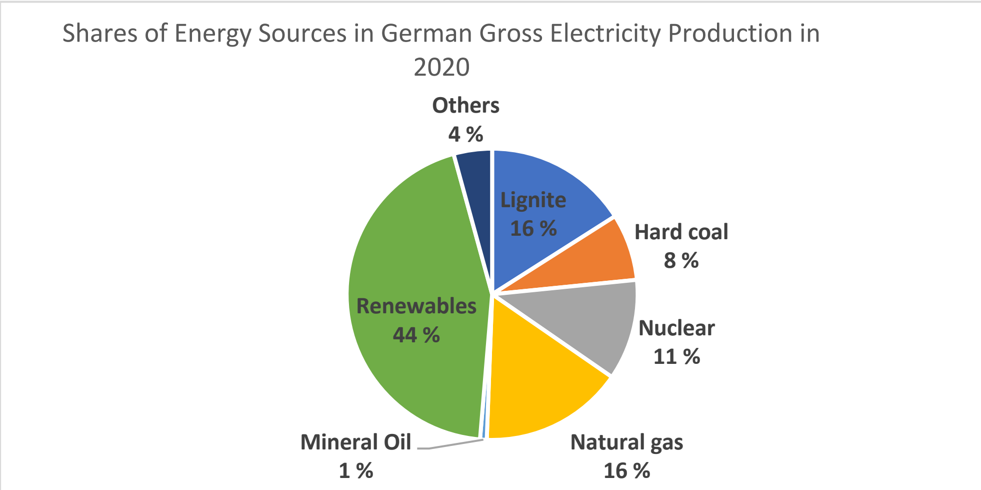

Figure 5. German Electricity Production Mix in 2020.

Source: BDEW 2020, preliminary.

Of the renewables in the electricity production mix, wind onshore power (42%) had the largest share, following by solar (20%) and biomass (7%) (Figure 6). The generation capacity, however, is larger, with a 24.5% share of solar power and 27.5% offshore and onshore wind power capacity of the total power generation capacity. (Figure 7) According to the data from Agora Energiewende (Wettengel, 2021b), in 2020, there was an increase of approximately 25 % in new solar rooftop installations.

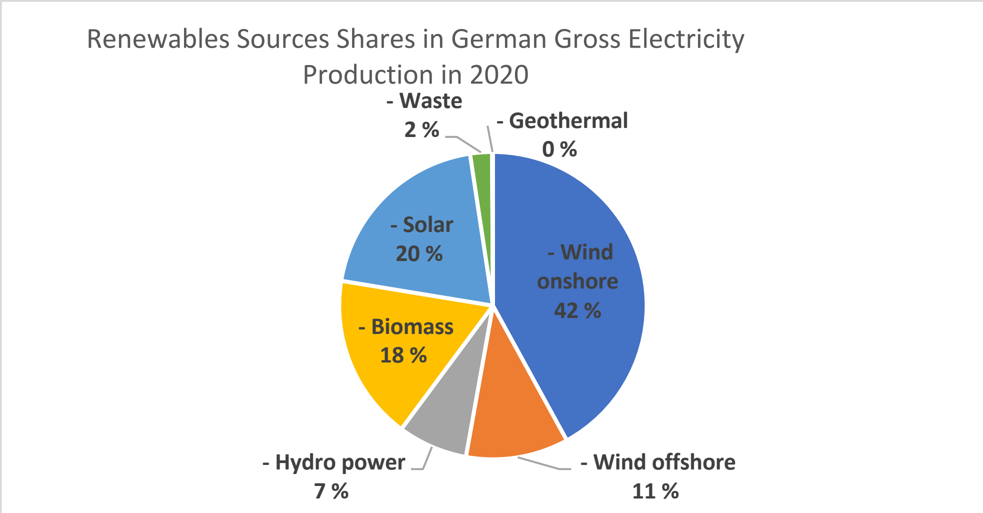

Figure 6. Renewables shares in German Gross Electricity Production in 2020.

Source: BDEW 2020, preliminary.

As in Europe, also in Germany, the biggest increase in the power mix has been in solar and wind power capacity during the past 18 years. (Figure 7) The share of the maximum generation capacity of fossil energies has decreased. Parallel to the national RE goals is the law on Coal and Nuclear phase-out. The newest Coal Phase-Out Act will mandate a gradual phase-out by 2022. Both hard coal and brown coal are to be reduced gradually and by 2038 all coal plants must cease operations. By 2022 the last nuclear facility will shut down. (Gesley, 2020; Appunn, 2021)

Germany is one of the world's top 10 countries regarding investments in green energy over 10 years with $179 billion in investments during the period from 2010 to the first half of 2019. In comparison, the U.K. had investments of $122 billion, and the whole of Europe accounted for an investment of about $698 billion, around 28% of the global total. (UN Environment Programme, 2019)

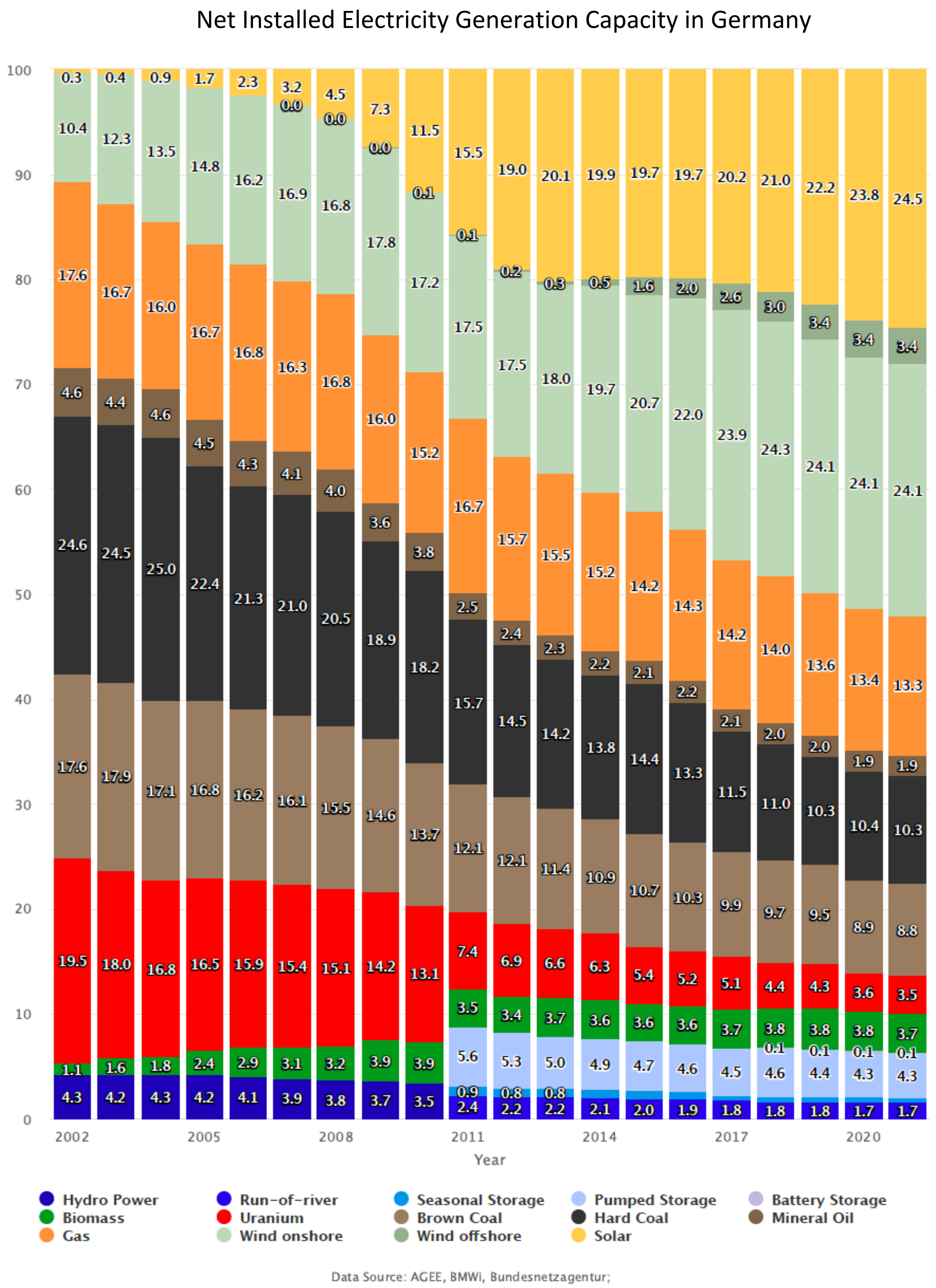

Figure 7. Annual net installed electricity generation capacity in Germany as percentages of the total capacity.

Source: Fraunhofer ISE. Energy-charts.info

2.3 Renewable Energy Policies in Germany

Germany has been a renewable energy policy pioneer with its energy transition "Energiewende" that started as opposition towards nuclear energy in the late 1970s. The long-term energy transition has included a reorientation of energy policy from the traditional fossil energies towards renewable energies along with the nuclear energy phase-out. The earliest RE policy description in the International Energy Agency (IEA) policy database is from 1985 regarding the Federal States' support for RE (IEA, 2012a). The support of the often sector-specific Federal States' programs for renewables has been considerable even when compared to the federal level support. In 1991 the Electricity Feed-in Law (EFL) was introduced. Its objective was to make sure that electricity produced from renewable energy sources had access to the grid. The electricity from renewable energy power plants was paid a premium price (Feed-in Tariff, FIT), a cost that was borne by the electricity supply utilities and their customers. The law imposed the preliminary and regional suppliers to buy a maximum share of 5% renewable electricity of the total supply each. As the support was highest for the wind and solar plants, the law contributed to the expansion of renewable technologies, especially wind farms. (IEA, 2013)

The Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz, EEG) replaced the EFL in 2000. The EEG obligates the grid operators instead of the suppliers, to buy renewable energy and pay for the Feed-in Tariffs. The tariffs were determined for each sector separately according to the actual production costs, and upon initialization, the main target was to double the share of renewable electricity by 2010. The remuneration level is fixed for twenty years after plant commissioning for individual power plants other than wind power plants. Wind power receives a fixed share of its total production until a certain limit is achieved in the production level, after which the premium decreases. The problem of unequal distribution of costs, which appeared with the EFL as some of the regions were obliged to buy a bigger share of renewable electricity due to the supply in the region, is fixed in a way that all electricity suppliers need to have the same share of renewable electricity. (IEA, 2014)

The FIT system has generally favored small RE plants and plants at the beginning of their operation cycle due to the imposed capacity limits. The renewable energy plant operators not under the FIT scheme can also sell their electricity at a premium. The utilities and suppliers buying green electricity then can offer a choice to their customers, and the surplus is ideally invested in new renewable power plants. According to IEA, several certification schemes exist to monitor that the surcharge is invested in the installing of new RE capacity. (IEA, 2012b)

The plants initially eligible for the FIT remuneration will soon face the end of the support period as Germany is shifting out from the FIT system. As of 2021 there are also debates about completely ending the country's renewables levy (EEG surcharge) that has been paid by the electricity consumers. The current government coalition would raise the price of CO2 emissions steadily, as part of the EU Emissions Trading System and Germany's own national emissions trading and would use the revenues to lower the renewables levy. (Wettengel, 2019; Wettengel, 2021a)

The 2017 amendment to the EEG introduced public tenders that are to aid the shift from FIT to a market-oriented price mechanism. From 2017 onward, onshore and offshore wind, solar and biomass projects have had to bid a price in an auction to ensure contracts for 20 years. (IEA, 2016) The newest amendment from 2021 continues to outline financial participation from municipalities in onshore wind power and defines the emission-neutral electricity supply target by 2050. The amendment also announces follow-up FIT-support for offshore wind turbines with installed capacity up to 100 kW, but the basis of the entitlement will be the annual market value. (Raue, 2021)

3 THEORY AND LITERATURE

This chapter starts by defining the measures of firm performance and profitability and then moves on to discuss the variance in profitability and profitability determinants that will later be used in the analysis of this thesis.

3.1 Measures of Firm Performance and Profitability

When the previous research on the RE firms' profitability determinants was examined, it became clear that the use of terms 'profitability', 'financial performance' and generally 'performance' or 'strategic performance' is intertwined although they all have certain attributes that distinguish them from each other. The concept of performance, in general, can be seen as a framing concept of profitability, and therefore, it was examined more closely to get a definition for it.

The term 'Firm performance' can include concepts like organizational effectiveness, productivity, and flexibility, that reflect the firm's ability to create value for its clients. Performance can also be seen as part of a wider concept of strategic performance where the emphasis is on the value created to all the stakeholders (Harrison & Freeman, 1999). Lebas & Euske (2007) defined performance as a set of quantifiable financial and non-financial indicators that can be illustrated with a causal model reflecting the future outcomes of current actions.

Colase (2009) considered that the word performance itself covers different concepts such as profitability, growth, return, productivity, competitiveness and efficiency. In the Performance Pyramid model by Cross and Lynch (see Tangen (2004)) the financial performance goals of a company, including profitability and cash flow, are at the second-highest level of the pyramid after the top corporate strategy goals. Following the financial performance goals are the day-to-day operational measures including productivity, and on the bottom level are the key performance measures such as quality of products, services, delivery, and waste.

Santos & Brito (2012) write that the management field is in a need of better-defined concepts and measures for firm performance and examination of the dimensions of firm performance. In their study of a multidimensional performance measurement model, they state that firm performance “has at least seven facets: growth, profitability, market value, customer satisfaction, employee satisfaction, social performance, and environmental performance”. Financial performance indicators such as growth, profitability, and market value, are to satisfy shareholders’ claims (Cho & Pucik, 2005). Profitability reflects the firm’s ability to generate future returns, while growth indicates the ability to increase in size. The market value reflects the expectations of the shareholders of the firm’s future performance (Santos & Brito 2012).

Firm performance can be approached as a “latent construct, as a domain of separate constructs or as an aggregate construct” (Miller et al., 2013). In the first approach, the latent construct of firm performance is explained by the shared variance among the dimensions of performance and the research is often evaluating firm performance with factor analyses and other related tools. In the second approach, separate constructs of firm performance exist, and they are loosely related to the overall domain of firm performance. Here the analysis concentrates on distinct dependent variables as indicators of firm performance. In the third approach, the construct is specified theoretically as an aggregate of several dimensions such as using a mathematical combination of different indicators. (Miller et al., 2013)

One presentation of firm performance structure is a latent model, either a unidimensional or a multidimensional one. Both reflect the underlying concepts of firm performance, but the unidimensional model implies that all the indicators are similarly correlated with the performance measure whereas the multidimensional model suggests that each indicator is related to one dimension of firm performance (such as Profitability or Growth) of the overall firm performance. (Miller et al., 2013).

In Figure 8 (adapted from Santos & Brito (2012)), financial performance is seen as a second-order dimension of firm performance. This is based on the conceptual model by (Venkatraman & Grant, 1986), where financial performance is parallel, and intertwined with strategic (also called operational) performance. Financial performance includes the before mentioned seven facets: profitability, growth, and market value and the measures of strategic performance include customers' satisfaction, employees'

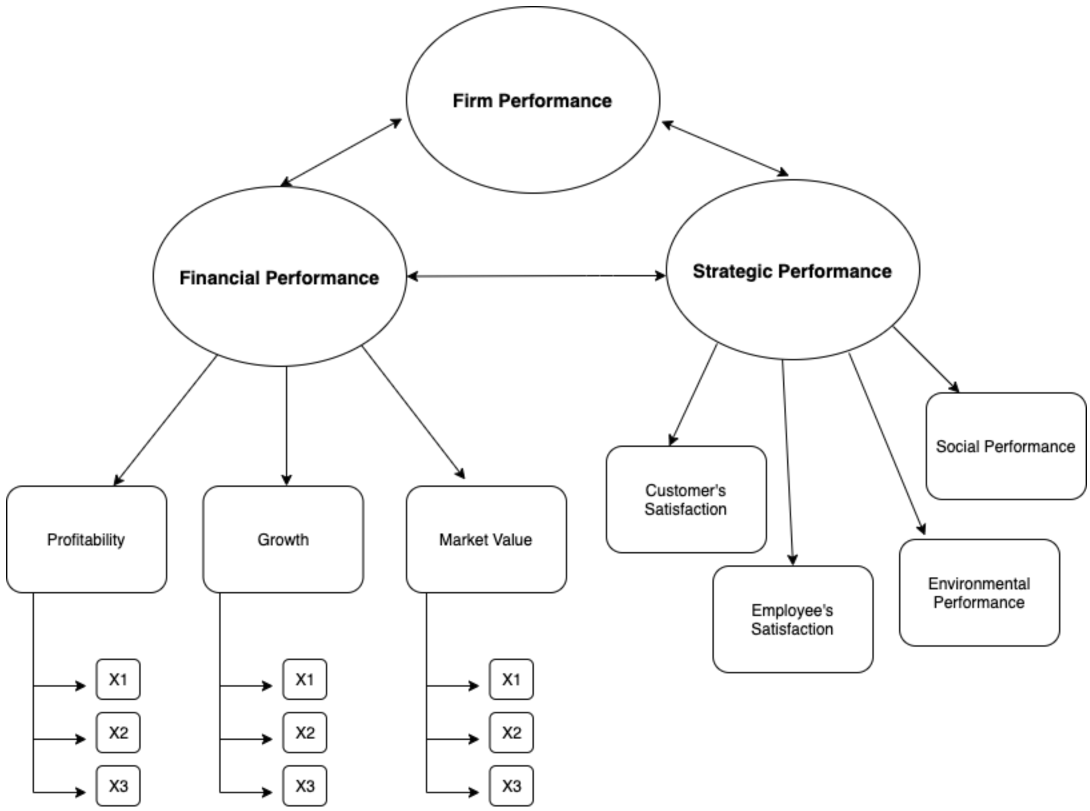

Figure 8. Multidimensional model with higher-order dimensions of firm performance.

Adapted from Santos & Brito (2012).

satisfaction, and environmental and social performance. In Figure 8, financial performance can be interpreted as a latent variable of firm performance with before mentioned dimensions. The dimensions are observed with different variables x1, x2, et cetera. The same presentation could be applied to strategic performance as well.

The traditional measures of financial performance, used in the previous research, are

1) measures of profitability such as Return on Investment (ROI), Return on Sales, Return on Assets (ROA), and Return on Equity (ROE)
2) measures of growth such as growth in revenues and growth in assets

3) measures of the financial market performance such as the market value and market to book ratio as well as other ratios reflecting the market performance

The existing body of research also acknowledges that the profitability measures derived from accounting such as the ones in 1) are subject to for example accounting manipulation, undervaluation of assets, and different depreciation policies, which makes the comparisons between the firms more complicated. (Chakravarthy, 1986) It is also criticized that over-relying on the use of traditional profitability measures is limiting since the measures are not able to reflect the performance from the stakeholder and strategic point of view. However, several factor analyses confirm the usefulness of measures like Return on Sales and ROI, of which the ROE and Return on Total Capital are also used as variants (Santos & Brito, 2012).

A study by Chakravarthy (1986) concluded that no single profitability measure can identify excellent companies from non-excellent ones, and that superior performance can be seen as a firm's ability to generate and manage slack income in a way that contributes to the adaptation of the uncertain future. Chakravarthy (1986) identifies that the strategic performance of a firm requires a pursuit of long-term goals that could affect the profitability short-term and thus the short-term profitability measures cannot capture an invested option that may realize itself in the future rather than in the immediate short-term. This is the case with for example heavy R&D expenditures that may well incur profits in the long-term future, despite their immediate costs. The ability of a firm to generate and manage their slack income that can be invested in such a manner, is, on the other hand, determined by a combination of profitability, liquidity, and solvency.

The stakeholder theory emphasizes strategic performance as a firm's ability to answer the differing claims by the stakeholders (Harrison & Freeman, 1999; Freeman, 2010). Financial performance typically only accounts for the stockholder value maximization, and not the claims from the other groups of stakeholders. Stakeholders are increasingly interested in the firm's performance regarding environmental, social, and governance matters, as well as the reputation of the firm in terms of the quality of management, products, and innovativeness. Here, thus lies the clear difference between the financial and strategic performance, which cannot be explained solely with the traditional measures of financial performance and profitability.

As interesting as it would be to measure the performance in its wider definition, this thesis, however, concentrates on the profitability dimension of the financial performance. The traditional measures of profitability described above, and specifically the accounting profitability measures, are therefore under consideration.

3.2 Explaining Variance in Profitability and Performance

The studies on the determinants of firm profitability or firm performance cover fields such as industrial economics, strategic management, accounting, and finance. These studies seek to explain the variance in profitability with different factors related to the firm, the industry, and the country the firm is operating in, with the use of different research methods such as cross-sectional, time-series, and panel data analysis.

The variance in profitability can be examined on multiple levels: the firm-level, industry-level, and country-level, or for example on the regional or temporal level. The more levels the research data has, the more insight there is to be gained from the research: comparisons e.g., between industries and countries in addition to comparison of firms within one industry. These different perspectives can answer different questions; when the firm-level effects are examined the research can answer the question ‘What can an individual firm do to improve its profitability?’, whereas when the industry-level or country-level effects are examined, the results better answer questions like ‘What are the differences between industries?’ and ‘How much does the industry or the country play a role in determining the firm profitability?’

Early research emphasized the importance of the industry structure and the competitive environment on the firm performance through the Structure-Conduct-Performance paradigm (Bain, 1951) and the famous five competitive forces model (Porter, 1980). The industry characteristics that were recognized as the influencers of firm profitability and performance are the number and size distribution of producers, product characteristics, price control, entry- and exit barriers and information flows between producers and consumers. (Goddard et al., 2009)

Gradually, the outlook has shifted from thinking of industry as the main determinant of profitability towards recognizing individual firm characteristics as important profitability drivers. (Bass et al., 1978) Firm characteristics derive from the strategies of individual firms, their competitive advantage, and internal resources. (Galbreath & Galvin, 2008; Goddard et al., 2009) Furthermore, the multi-directional relationship between the industry structure, business conduct, and firm performance was also seen plausible. (McGahan & Porter, 2002)

Studies using variance decomposition analysis do not consider specific determinants or variables in explaining performance, rather they try to explain how much the variance is explained by which level effects. The studies have confirmed that firm-, industry-, and corporate-parent-level effects all explain variance in firm performance. Among these, the firm-level effects have been found to explain more variance than other effects. (McGahan & Porter, 1997) (McGahan & Porter, 2002)

The resource-based view highlights the importance of firms' internal resources for performance, and that the organizational structure and managerial activities are the sources of heterogeneity in profitability. Internal resources can be both tangible and intangible, property- or knowledge-based, of which the former could include production-related financial and physical metrics and the latter technology and reputation-related resources, as well as intangible skills and capabilities (Goddard et al., 2005; Winter, 2003).

In the manufacturing industry especially, the firm-level effects explain more variance than they do in other industries, whereas the influence of industry- and corporate-parent effects was higher in other industries than manufacturing (McGahan & Porter 1997). Corporate-parent effects are typically examined on firms that are part of a larger group that operates on more than one industry segment. Corporate-parent and industry-specific determinants are found to be related to one another and significant. (McGahan & Porter 1997; McGahan & Porter, 2002; Rumelt, 1991)

Research across industries from the 1980s until 2007 that used the variance decomposition analysis, reported firm-specific effects explaining everything in the range of zero to 66 % of the variance in firm profitability, measured either with ROA, Tobin's q (market value/assets' replacement cost), Return on Sales, Economic value added (EVA = Net operating profit after tax – Capital invested * cost of capital) or the market value. Variance explained by the industry effects was correspondingly reported ranging from zero to approx. 30 %. (Goddard et al., 2009)

More recently, as the earlier research mostly considered the U.S. market, the country-level effects such as the financial and technological infrastructure, regulatory policies, the openness of the economy, and access to markets have also been studied. Country-level effects were measured to explain little, under 1.6% of the variation in profitability in the variance decomposition analysis by Goddard et al. (2009) of firms in 11 European countries.

According to the persistence of profit literature, there is a certain degree of persistence in profit as well, and therefore studies have also used dynamic models with the lagged profit as a control variable allowing intertemporal persistence in profitability. (Goddard et al., 2009; Goddard et al., 2005)

Table 1. Studies on the different level effects explaining firm performance.

Effect	**Industry**	**Performance measure**	**Source**
Firm, industry	Manufacturing	ROA	Schmalensee (1985)
Firm, industry, and corporate-parent	Different industries	ROA	Rumelt (1991) Roquebert et al. (1996) McGahan & Porter (1997) McGahan & Porter (2002)
		ROS	Kessides (1990)
		Tobin's q	Wernerfelt & Montgomery (1988)
Firm, industry, and corporate-parent	Energy companies	ROA	Adner & Helfat (2003)
Country/Macro, Dynamic and interactions	Manufacturing	ROA	Goddard et al. (2009) Goddard et al. (2005)

All the studies mentioned in Table 1 found that the firm effects had the largest share in explaining the variance in the performance measure except for the study on the manufacturing industry by Schmalensee (1985) and by Kessides (1990) who used Tobin's q as the dependent variable. They found that industry effects have the largest share in explaining performance. Adner and Helfat (2003) studied 30 firms in the energy industry, and concluded like most of the others, that the firm-effects have the largest share in explaining the variance in profitability. The information gained from these studies will form a basis for the hypothesis construction in this thesis.

3.2.1 Firm-specific Determinants of Profitability

Capon et al. (1990) gathered the results of the 20th century's performance determinant studies in their meta-analysis. This very comprehensive analysis was found while reading a thesis by Lopez (2013) that also researched performance determinants of renewable energy companies worldwide. The most frequently found relationships between the performance measures and the firm-specific determinants of the meta-analysis are extracted from the paper by Capon et al. (1990) to the Table below.

Table 2. Firm-specific determinants of firm-level financial performance extracted from Capon et al. (1990)

Variable	**Nr of studies**	**Significance**	**Positive Relationships (nr of tests)**	**Negative relationships (nr of tests)**
Size (Sales)	48	Ns	54	52
Size (Assets)	48	Ns	314	299
Size (Employees)	7	Ns	7	12
Leverage/Debt	23	-	57	90
Growth in sales	22	+	201	19
Growth in assets	8	+	66	2
R&D Investment	32	+	156	74
Capital Investment	29	-	59	166
Diversification	17	-	82	149
Advertising	20	+	154	26

Market share	42	+	317	75
Geographic dispersion of production (Reg. vs. national)	2	*	1	6
Social responsibility	13	+	66	17
Imports	5	-	3	19
Exports	4	-	3	18
Product/Service quality	20	+	204	62
Price (relative)	18	Ns	57	46
Capacity utilization	15	+	78	12
Vertical integration	14	+	68	24
Marketing expense	15	Ns	34	34
Economies of scale	1	*	1	1
Consumer vs. industrial sales	4	Ns	29	16
Variability in Return	11	+	81	10
Inventory	11	Ns	33	50
Firm control (Owner vs. management)	10	Ns	65	56

+: significantly more positive than negative relationship, significance level 5%

-: significantly more negative than positive relationship, significance level 5 %

* Insufficient number of studies to define a significant relationship

Ns: count of positive vs. negative relationships reported not significantly different, significance level 5 %

Significance, in Table 2, refers to a positive or negative relationship occurring in tests in the analyzed studies in the meta-analysis significantly more often than the other, analyzed and reported by Capon et al. (1990), which does not mean that the variable was non-significant in the studies where the results were collected from. Capon et al.'s (1990) meta-analysis covered results from 320 published studies on financial performance between the years 1921 and 1987 across industries with different performance measures. Table 2 shows that many of the variables have a significant positive impact on the firm performance, with a few exceptions. All three determinants indicating size have had a similar amount of reported positive and negative relationships in the meta-analysis. The more recent studies have found that profitability's relationships with size in sales and size as nr of employees are significantly positive. (Goddard et al., 2005; Asimakopoulos et al., 2009) Goddard et al.'s (2005) study on European firms implied that the relationship between the size in assets and profitability relationship is negative. The authors write that a rapid expansion of successful firms may have a negative influence on the short-term profitability while at the same time the market concentration's positive effect implies that costly strategies may be conducted to gain a bigger share in the market. The leverage-profitability relationship is negative in Goddard et al.'s (2005) study as the results from Capon et al. (1990) indicate. Also, capital investment and diversification have been mostly reported to have a negative effect on performance.

For the variables price, marketing expenses, economies of scale, consumer vs. industrial sales, inventory, and firm control the meta-analysis does not have enough evidence to suggest a significantly more often reported relationship. These variables have been statistically significant in the very few studies collected to the meta-analysis.

The recent results by Goddard et al (2005), Asimakopoulos et al. (2009), and Acquaah & Chi (2007) mainly support the findings of Capon et al. (1990). Goddard et al. (2005) studied manufacturing and service industries in Europe, Asimakopoulos et al. (2009) studied non-financial listed Greek firms, and Acquaah & Chi (2007) analyzed companies from the Fortune magazine's list 'America's Most Admired Companies'. The first two studies EBIT/Total assets as the profitability measure and the last study calculated three different firm-specific profitability measures: the 'percentage deviation of a firm's accounting or market return from the industry's average' using measures ROA, ROS, and Tobin's q. (Acquaah & Chi, 2007)

The significant firm-specific determinants found by the three before-mentioned studies that were not included in the meta-analysis by Capon et al (1990) are listed in the table below.

Table 3. Statistically significant relationships found by (Goddard et al., 2005), (Asimakopoulos et al., 2009) and (Acquaah & Chi, 2007) concerning firm-specific determinants.

Variable	**Relationship**	**Source**
Liquidity	+	Goddard et al. (2005)
Market Share	-	
Current Assets/ Size in Assets	-	Asimakopoulos et al. (2009) Goddard et al. (2005)
Relative employee value added (economic profit per employee)	+	Acquaah & Chi (2007)
Corporate management capabilities	+	Acquaah & Chi (2007)
Technological competence	+	Acquaah & Chi (2007)

The employee value-added variable can be seen as an indicator of productivity, which is calculated as the economic profit divided by the average number of employees, and in the study by Acquaah & Chi (2007) was calculated as the relative deviation from the industry's average. In the same way, was the technological competence calculated based on the measure of R&D intensity (R&D/sales) and compared to the industry average. Liquidity in the study by Goddard et al. (2005) was measured with the Current ratio (current assets/current liabilities). The positive effect of diversification (sales in possible segments per period) is also significant in the study by (Acquaah & Chi, 2007). Asimakopoulos et al. (2009) also found that Current Assets have a negative effect on profitability similarly to Goddard et al. (2005)

Although not mentioned in tables 2 and 3, the lagged dependent variable (the firm profit) is sometimes used as a control variable as well to capture the effect of omitted variables and the persistence of profit as mentioned before (Acquaah & Chi, 2007).

3.2.2 Industry-specific Determinants of Profitability

The same study by Capon et al. (1990) also listed the results of industry-specific determinants. Below are the results extracted from their meta-analysis giving the most frequent relationships occurring between industry determinants and firm-level profitability.

Table 4. Industry-specific determinants of profitability extracted from the meta-analysis by Capon et al. (1990)

Variable	Nr of studies	Significant	Positive relationships (nr of tests)	Negative relationships (nr of tests)
Size (Sales)	5	+	30	5
Size (Assets)	5	Ns	10	14
Growth (Sales)	59	+	624	115
Growth (Assets)	3	+	34	5
Leverage/Debt	1	*	2	0
R&D investment	2	*	3	3
Capital Investment	51	+	574	65
Diversification	5	Ns	25	25
Advertising	43	+	446	33
Geographic dispersion of production (Reg. vs. national)	32	+	288	50
Economies of scale	13	+	93	34
Consumer vs. industrial sales	7	Ns	41	26
Imports	19	-	57	99
Exports	10	-	17	38
Industry Minimum Efficient scale	21	+	204	62
Barriers to Entry	16	+	89	13
Vertical integration	2	-	1	11
Industry concentration	99	+	779	353

+: significantly more positive than negative relationship, significance level 5%

-: significantly more negative than positive relationship, significance level 5 %

* Insufficient number of studies to define a significant relationship

Ns: count of positive vs. negative relationships reported not significantly different, significance level 5 %

Capon's (1990) meta-analysis on the industry determinants (Table 4) shows a significant positive impact of industry growth variables and industry concentration on the firm performance. Industry growth's (sales) positive effect is also supported by Acquaah & Chi (2007), but instead of significant industry concentration, they found that the change in industry concentration had a significant positive effect on the Tobin's q measure. Unlike with firm-specific determinants, the diversification was not shown to have a clear signed effect, and there were not enough reports on industry diversification. Also, industry-wide vertical integration and capital investment variables had opposite effects than firm-specific counterparts had. The reports of the clearly positive effects of industry concentration and the entry barriers on financial performance imply the success of the operators in the industry when competition is limited.

Interactions between the firm and industry variables, especially the interaction between management capabilities and industry growth, and the interaction between relative employee value-added and industry growth, had a significant negative effect on performance in a study by Acquaah & Chi (2007). This implies that the faster the industry is growing the more negative effect the firm-specific determinants have which is also intuitive considering the possibility of increasing competition as the industry grows.

3.3 Evidence from Energy and RE Industries

There are only a few studies on the electricity producers or the energy industry in general, and no studies of profitability determinants on non-listed, private equity firms in the RE industry were found. The article search was made through the LUT University's database search Primo, Google Scholar, and Scopus. The search sentences applied in the screening of the articles were:

- ‘Performance/profitability determinants’
- ‘Determinants of financial performance’
- ‘Firm profitability in renewable energy’
- ‘Factors affecting/influencing the performance/profitability of renewable and/or energy sector/industry/companies/firms (in Germany)’
- ‘Renewable electricity’
- ‘The influence of Feed-in Tariffs on performance/profitability’
- ‘The profitability of electricity-generating firms.’

Relevant articles found and referenced here were altogether nine. More articles about energy investments and similar research topics with a slightly different perspective (often concerning specific investments and production capacities/technologies and/or different policies than the FIT) were found as well but they are not referenced here. The following results are from different studies on listed energy firms.

As it was reported in the meta-analysis by Capon et al. (1990), Westerman et al. (2020) also suggests that diversification has a negative relation with firm profitability (ROA) in the energy industry. The sample included 77 renewable firms and 52 conventional firms. This result is supported by other researchers who explain the effect with agency costs (Aggarwal & Samwick, 2003). In their regression results, Westerman et al. (2020) report that the firm size indicated by total assets, and EBIT/total sales are positively correlated with ROA especially with renewable firms, whereas there is a negative relationship with Debt-to-Assets (D/A) in the case of both the conventional energy and RE firms. Their study was based on a sample of energy firms located in Western Europe over the period from 2009 to 2015, and although the firms included only listed public firms, it can be loosely considered representative of the sample of German firms employed in this thesis.

There is evidence that the higher profitability of the electricity generators is related to higher market concentration (equivalent to industry concentration = a percentage of a market share of the largest firms (usually four) in the electricity generation industry). Furthermore, the firms with larger assets earn higher profits, and the size category is significant and positive, with small, medium, and large firms earning higher profits than very large firms. (Jaraitė & Kažukauskas, 2013a)

A study by Tsai & Tung (2017) on RE firms across the world found that the share of renewables in the overall primary energy consumption has a significant and negative effect on the ROA of renewable energy companies. They also found that the nation's energy consumption impacts ROA negatively, whereas employee growth rate has a positive effect on ROA. Furthermore, the degree of innovation and the development of the technology sector in the country of operations have been found to positively affect the performance of RE firms on the country level. (Gupta, 2017)

Although not directly concerning the general performance of RE companies, a study by Shah et al. (2018) on the effects of macro-level shocks on the return on RE investments is also worth mentioning. They found that oil prices have had both a positive and negative effect on the return on RE investments, depending on the country. In Norway, where the RE sector is very much market-oriented the effect is positive, whereas in the UK the effect is negative and very small since the RE sector is more subsidized. GDP or economic growth was found to have a positive effect on the return on investments (ROI) in the RE industry, but interest rates did not have a significant effect on ROI.

The above-mentioned country-specific macroeconomic and societal determinants are not as relevant in this thesis, since all the firms in the sample are operating inside the same economy, and as non-listed companies, they are not as exposed to macroeconomic movements as the listed companies. Still, the temporal movements of electricity prices and national energy consumption can anyhow affect the performance and thus should be accounted for.

Furthermore, this thesis is interested in exploring the effect the FIT remuneration has on profitability. One study specifically analyzed the effect the FIT has on the performance of photovoltaic (solar) farms (Milanés-Montero et al., 2018). The authors studied firms in Germany, Italy, France, and Spain found that the FIT had a positive, significant influence on the profitability of the firms (ROI). The study also confirmed that among the firm-specific determinants, total assets, and leverage (contrarily to the previously mentioned results) had a significant positive effect on the photovoltaic firms' performance.

A study by Hassan (2019) confirmed the above results on 420 RE companies from OECD countries and reported a significant positive relationship between different RE incentives including FIT, and accounting-based measures of financial performance (Earnings per share, Return on Capital Employed = ROCE). Hassan used net sales as a proxy for the FIT level and binary variables to indicate whether the firm benefits from the FIT or another incentive. Jaraitė & Kažukauskas (2013) examined the impact the different support mechanisms and policies have on the profitability of electricity-generating firms in the EU and the findings indicated that firms in countries implementing The Green Certification (alternative policy to FIT) policies are more profitable compared to FIT-firms.

3.4 Summary of the Previous Findings

The results from the previous studies on the firm- and industry-specific profitability determinants that are of interest regarding the analysis in this thesis: the significant firm-specific determinants recognized by multiple studies and across industries are the size in sales and size in assets with both positive and negative effects, as well as the growth in both sales and assets with a positive effect on profitability. Leverage has mostly been found to have a significant negative effect, whereas a study on solar power firms also reported a significant positive effect. Liquidity has been found to have a positive effect on firm-level profitability. There are consistent results that the industry size in sales and the industry's growth in both sales and assets across industries have a significant positive effect on profitability. Also, market concentration has been found to have a significant positive effect in most of the studies and these results are supported by the studies in the RE industry as well.

The previous results have also shown that the share of renewables in the primary energy consumption has a significant and negative effect on the profitability of RE companies, whereas the oil prices have had both negative and positive effects in previous studies. The economic growth rate (GDP) has had a positive effect on the profitability of RE investments. The RE incentives, including the Feed-in-Tariffs, have been found to have a significant positive influence on profitability. Based on these remarks, the relationships between the determinants and RE firms' profitability are suggested in Table 5.

Table 5. Summary of the important profitability determinants according to the previous literature.

Firm-specific	**Industry-specific**
Size (sales) +	Electricity Consumption -
Size (assets) +	Industry growth +
Liquidity +	Market Concentration +
Leverage -	(Oil) Price level -
Growth in sales +	GDP +
Growth in assets +	FIT +

It is expected that the firm size measured by sales and assets has a positive effect on the profitability of the RE firms although the previous research has reported both effects. Similarly, leverage will be expected to have a negative effect on the profitability of RE firms, since there was more evidence of it having a negative rather than positive effect. The determinants in Table 5 will be included in the quantitative analysis of this research. The determinants are selected based on the previous literature and their availability through public databases. This research is not able to study all the previously significant firm- and industry-specific determinants due to the availability of data, but the most important determinants from the previous research will be included. For example, determinants such as diversification, advertising expenses, and capital or R&D investments along with many more specific variables used in the previous research could not be included in the analysis.

By analyzing these determinants in terms of their significance and effects on the German RE firms, this thesis will be able to compare how the results for the analyzed target group align with the results from the previous studies and to gain more valuable knowledge of the profitability determinants' effects in this less studied field.

4 DATA AND METHODOLOGY

This chapter introduces the data, variables, and methodology used in the analysis.

4.1 Data Screening

The company data with the key financials were collected from the Amadeus database using the NACE Rev. 2 industry classification code 3511, production of electricity. Amadeus database is published by Bureau van Dik/Moody's Analytics and has comparable financial data on the largest 565,000 public and private companies in 43 European countries. The industry classified companies were sorted by their names and trade descriptions according to activities in generating or transmitting renewable electricity from any of the RE sources. The conventional electricity production companies (fossil energy) with RE-activities were excluded from the data. This choice decreases the number of observations while it was believed to give more presentative data on the RE companies only.

The financial data was unconsolidated to avoid double counting of subsidiaries and parent companies. Altogether data from 733 companies that had financial accounts available in Amadeus for the period of 9 years between 2010-2018 were retrieved. The data included a lot of missing values, and this was taken into account in the analysis. Feed-in tariffs and the industry and energy statistics for the same nine-year period were obtained from the European Commission's Eurostat statistics database, World Bank database, and OECD database.

The criteria for choosing the companies for the sample:

- Active and not bankrupt
- Operating in Germany
- Generating electricity in the RE industry (solar, wind, biomass, hydro, and geothermal)

- No conventional electricity production
- Not publicly listed

Among the firms of which the specific RE sector could be confirmed by their trade description or by the name of the firm, it was recognized that the data included companies in all the above-mentioned RE sectors except for geothermal power. Some of the firms represented multiple RE technologies. The data consisted of companies from all the size categories from Small to Very Large.

Table 6.The size categories by Amadeus.

	Very Large	*Large*	*Medium*	*Small*
Operating revenue	=> 100m €	=> 10m €	=> 1m €	All companies not included in the former
Total Assets	=> 200m €	=> 20m €	=> 2 m €	
Employees	=> 1000	=> 150	=> 15	
Nr of firms in the data	9	392	278	54

The data was divided into two groups, the first representing the Small and Medium-sized companies (SMEs), and the second Very Large and Large companies and these two groups would be analyzed separately. This was a decision made due to the nature of the data since the largest companies would act as outliers in the joint analysis, and out of interest to compare the differences between the SMEs and Large firms. As there were only nine very large companies included in the data, the analysis will be effectively done for the large firms in the second size category. The inclusion of binary variables controlling for size, RE sector, and corporate-parent effects was also considered but due to the methodological purposes, this option was left out (the Fixed Effects panel data models cannot estimate time-invariant variables).

4.2 Variables

Based on the previous research, the Return on Equity (ROE), Return on Assets (ROA), and Return on Capital Employed (ROCE) (an alternative for Return on Total Capital and used in the previous study and available in Amadeus) were selected as the dependent variables, measuring the firm profitability. The formulas of the dependent variables are presented below.

Equation 1. Return on Equity

$$ROE = \frac{Net\ Income}{Average\ Stockholders\ Equity}$$

Equation 2. Return on Assets

$$ROA = \frac{Net\ Income}{Average\ Total\ Assets}$$

Equation 3. Return on Capital Employed

$$ROCE = \frac{Net\ Income}{Average\ Total\ Assets - Current\ liabilities}$$

ROE implies the average annual return generated for the equity owners, ROA is the return generated in relation to the total assets in the firm and gives a measure of how efficiently the company is using its assets. ROCE is a good measure for comparing companies in capital-intensive industries (with a lot of debt) as it indicates how good use the company is making of its overall available capital. ROE often appears to be higher than ROA and ROCE, but this is not always a good thing. A very inflated ROE can mean that the equity account is small compared to net income and may indicate excessive debt. An outsized ROE can also be an indicator of inconsistent profits, as the denominator may be very small after years of losses which can make ROE higher. This will be taken into account when removing outliers.

Based on the literature review the independent variables were selected including both firm-specific determinants and industry-specific determinants. The electricity price was used instead of the oil price (as in (Jaraitė & Žukauskas, 2013b)) as the firms analyzed were electricity generators and likely dependent on the electricity price level. From the industry-specific determinants, the change from the previous year's share of RE in the final electricity consumption was chosen to proxy for the industry growth. Market concentration was also added as a growth rate (change from the previous year). The annual average Feed-in Tariff rates for solar, geothermal, biomass, wind, and hydro were included for the same time period to see whether they explain any variance in the dependent variable. Initially, the idea was to apply the FIT rates to the firms that are known to receive the FIT support and compare the results with the control group, but since it was not possible to find this information from the public databases directly or derive it from the available variables, the FIT relationships are not examined or compared in detail - rather an effort is made to include them in the model and to test whether they explain part of the variance.

Some of the variables had to be log-transformed to reduce their size and to facilitate the analysis so that their distribution is less skewed in either direction. This was also done to avoid multicollinearity. Some variables were modified into a more informative format such as Debt was transformed into two different variables Debt-to-Equity ad Debt-to-Assets (D/E and D/A) indicating the leverage of the firm. All the independent variables are listed in Table 7. Net Income was chosen as the control variable for this analysis as it is in the numerator of the profitability ratio.

Table 7. List of variables derived from data and variables with log-transformation applied.

Original variable	Specification	Analyzed variable	Source
Net Income	Profit after all expenses, in thousands €	Control variable	Amadeus
Total Assets	$LOG\_Assets = LOG(TotalAssets)$	Company Size (assets)	Amadeus
Total Assets	$Assets\_G = \frac{TotalAssets_t - TotalAssets_{t-1}}{Total\ Assets_t} * 100$	Growth in Assets	Amadeus

Sales	$Sales\_G = \frac{Sales_t - Sales_{t-1}}{Sales_t} * 100$	Growth in Sales	Amadeus
Sales	$LOG\_Sales = LOG(Sales)$	Company Size (sales)	Amadeus
Debt	$D\_E = \frac{Debt_t}{Shareholder\ funds_t}$	Leverage (Debt/Equity)	Amadeus
Debt	$D\_A = \frac{Debt_t}{Total\ Assets_t}$	Leverage (Debt/Assets)	Amadeus
Current ratio	$CurrentRatio = \frac{Current\ Assets_t}{Current\ Liabilities_t}$	Liquidity	Amadeus
Average annual power price for households	Elecpriceh (€/kWh Taxes and renewable levies included)	Price level	Eurostat
Annual final electricity consumption	$ElecCons\_G = \frac{ElecCons_t - ElecCons_{t-1}}{ElecCons_{t-1}} * 100$ (GWh)	Change of annual final electricity consumption	Eurostat
Economic growth (GDP per capita)	GDPG (Annual percentage growth rate of GDP per capita in Euros. GDP per capita is the gross domestic product divided by midyear population.)	Economic Growth	World Bank
Market concentration (annual)	$Marketconcentration\_G = \frac{Marketconcentration_t - Marketconcentration_{t-1}}{Marketconcentration_{t-1}} * 100$ (Market share of the largest generator in the electricity market)	Industry/Market concentration	Eurostat
Share of renewables	$Elecreshare\_G = \frac{Elecreshare_t - Elecreshare_{t-1}}{Elecreshare_{t-1}}$ *100 (Share of renewable energy sources in gross power consumption)	Industry growth	UBA Arbeitsgruppe Eneurbare Energien-Statistik (AGEE-Stat)

Average annual Feed-in-Tariff per renewable energy source	FITavg (Average annual FIT for all renewable energy sources)	Level of RE incentive	OECD Statistics OECD.stat

4.3 Descriptive statistics

The following tables present the descriptive statistics per analyzed group for all the variables after the major outliers were removed. From Tables 8 and 9, it can be seen that the number of observations N differs in each variable. There are only 488 observations at the minimum for the variable Sales_G in the SMEs and 249 in the large firms, which is why the analysis with large firms is performed without this variable.

Table 8. Descriptive Statistics for the SMEs.

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
CurrentRatio	1,062	1.320	0.813	0.000	0.702	1.869	3.608
Netincome	910	43.514	139.702	−290.132	−39.599	130.055	385.324
D_A	1,523	0.833	0.153	0.418	0.737	0.951	1.270
D_E	1,315	2.837	2.349	−3.287	1.157	4.247	8.877
LOG_Sales	694	7.004	0.652	5.445	6.639	7.442	8.556
LOG_Assets	1,634	8.827	0.815	6.488	8.278	9.473	10.873
Assets_G	1,092	−5.954	3.727	−14.918	−8.180	−3.608	3.256
Sales_G	488	1.780	13.179	−35.871	−8.158	11.301	40.249
Elecreshare_G	2,696	10.672	6.054	0.317	6.356	15.022	20.000
Marketconcentration_G	2,696	−1.391	5.278	−9.375	−5.057	1.490	6.338
GDPG	3,033	2.085	1.273	0.418	1.268	2.602	4.180
ElecCons_G	2,696	0.035	1.419	−2.165	−0.540	0.480	3.032
Fitavg	3,033	0.154	0.029	0.115	0.126	0.176	0.193
Elecpriceh	3,033	0.283	0.022	0.241	0.264	0.298	0.305
Elecpriceh_G	2,696	2.832	3.728	−1.788	0.380	4.421	10.795
ROE	877	7.384	16.862	−37.857	−2.087	15.638	57.278
ROA	957	1.039	2.797	−6.129	−0.757	2.853	8.237
ROCE	879	3.948	3.433	−4.724	1.685	6.082	12.647

The variables that are common to all firms have a constant number of observations except for the ones that are transformed into the form of the percentage of growth and thus lack one time period per each firm. The number of observations for the dependent variables ROA, ROCE, and Net income (394, 424, and 416) is low in the sample of large firms especially due to the removal of outliers.

Both samples, the SMEs, and large companies have average profitability ratios quite well above zero while there are negative ratios in the first quantile of ROEs and ROAs. The average Debt to Equity (D_E) ratios are high for both samples implying a debt of over two times the amount of equity. The average Debt to Assets (D_A) implies that around 80 % of assets are financed with debt and the high D/E signals that the firms are very reliant on debt and operational income. The average negative assets growth rate (Assets_G) indicates that the investing in assets among both size groups has been slowing down during the years analyzed.

Table 9. Descriptive Statistics for Large companies.

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
CurrentRatio	1,070	1.263	0.886	0.000	0.539	1.767	3.889
Netincome	416	536.546	870.148	−1,715.000	−44.091	1,034.094	2,780.630
D_A	1,315	0.852	0.148	0.429	0.760	0.973	1.288
D_E	1,136	3.051	2.938	−5.431	0.792	4.712	11.245
LOG_Sales	404	8.543	0.901	6.231	8.028	9.216	10.993
LOG_Assets	1,215	10.381	0.440	9.246	10.135	10.663	11.521
Assets_G	878	−5.162	4.447	−16.586	−7.534	−3.282	7.458
Sales_G	249	2.116	12.840	−29.960	−6.934	11.510	36.213
Elecreshare_G	3,208	10.672	6.053	0.317	6.356	15.022	20.000
Marketconcentration_G	3,208	−1.391	5.278	−9.375	−5.057	1.490	6.338
GDPG	3,609	2.085	1.273	0.418	1.268	2.602	4.180
ElecCons_G	3,208	0.035	1.419	−2.165	−0.540	0.480	3.032
Fitavg	3,609	0.154	0.029	0.115	0.126	0.176	0.193
Elecpriceh	3,609	0.283	0.022	0.241	0.264	0.298	0.305
Elecpriceh_G	3,208	2.832	3.728	−1.788	0.380	4.421	10.795
ROE	1,048	7.704	16.897	−37.857	−1.915	16.088	57.278
ROA	394	2.259	3.507	−6.645	−0.119	4.274	11.106
ROCE	424	4.754	3.985	−5.799	1.854	7.074	15.057

When the data was examined, it was noted that the market was less concentrated at the end of the analysis period in 2018 than it was at the beginning in 2010, and the market has been decentralizing since the year 2013, as is indicated by the negative statistics of the variable Growth in Market Concentration (Marketconcentration_G).

The methodology behind the quantitative analysis and the specification of the model used in the analysis are presented in the next section.

4.4 Panel Data Models

As the collected data included both a time-series dimension and a cross-sectional dimension, it was thereby transformed into a panel data form. Each individual (firm) is observed repeatedly for each time period in the vertical dimension with a length of the number of individuals I * the number of time periods T, and the dependent and independent variables K are presented in the horizontal dimension. The overall size of the matrix equals I * T * K observations. In this form of presentation, it is justified to apply a model that makes use of the longitudinal structure.

In a simplified form, a function for a linear panel data model is

Equation 4. Linear Model Function

$$Y_{it} = \beta_0 + \sum_{k=1}^{K} \beta_k * X_{it}^k + e_{it}$$

where i corresponds to the individual in the cross-sectional dimension with $i = 1, \dots, N$; and *t* corresponds to each time period in the temporal dimension with $t = 1, \dots, T$. β_0 is an intercept, β_k is the K*1 vector of estimated coefficients and X_{it}^k is the matrix of inputs of every independent variable for an *i*th observation at time *t*, and e_{it} is a vector of errors/residuals.

Linear models can be estimated with the Ordinary Least Squares (OLS) estimator.

The assumptions of the OLS linear regression model are:

1) The model is linear in the coefficients and the error term
2) The error term has a zero mean (needed for the model to be correct on average and to have unbiased estimates)
3) All the independent variables are uncorrelated (exogeneity) with the error term (the contrary case of endogeneity leads to biased estimates)
4) There is zero autocorrelation/serial correlation in the error term (autocorrelation leads to lower precision of the estimates)
5) There is no heteroscedasticity in the error term meaning that the error term should have constant variance (heteroskedasticity leads to lower precision of the estimates)
6) There is no perfect multicollinearity (multicollinearity leads to lower precision of the estimates)
7) The error term is normally distributed (is needed to perform statistical tests reliably)

(Brooks, 2014)

When fitting a model and estimating the model parameters, ideally one wants the model to be able to estimate such results that reflect the real-life conditions. The chosen estimator (the method for estimating the sample parameters = the model used) should be consistent, unbiased, and efficient to give reliable estimates. A consistent estimator has a sampling error that decreases as the sample size approaches infinity. An unbiased estimator's beta has an expected value equal to the parameter beta (the coefficient) it estimates. The bias is reflected in the errors of the model. The smaller the standard error the more confidently the coefficient is likely to be the same on average when the calculation is repeated. OLS estimator is the best of the linear estimators if any linear combination of the regression coefficients is estimated more precisely by OLS than by any other linear unbiased estimator. (Brooks, 2014)

What is typical to panel data and distinguishes it from a simple time-series regression, is the presence of unobserved heterogeneity due to the cross-sectional dimension.

Unobserved heterogeneity is the time persistent differences between the individuals also termed individual effects that cannot be estimated with the simple OLS regression. This is because, in the case of unobserved heterogeneity, the individual effects would be correlated with the independent variables in the regression, and this type of endogeneity would result in unbiased estimates. (Brooks, 2014)

If there is no heterogeneity present in the data, then a pooled OLS regression can be used in the case of panel data as well. When heterogeneity is present in the data, which is typically the case, another model should be used that takes it into account. The fixed effects (FE) "within" estimator has a slightly different model function:

Equation 5. Fixed Effects Model Function.

$$Y_{it} = \beta_0 + \sum_{k=1}^{K} \beta_k * X_{it}^k + e_{it} + a_i$$

The within estimator models the time-invariant heterogeneity in the unknown parameter a_i. The data is transformed by time demeaning all the variables, a.k.a. subtracting the variables' individual means over time from all the variables. The result is a formulation in terms of deviations from the individual means. The a_i term as well as the constant β_0 (Equation 5) that is simply the individual mean, and all the time-invariant independent variables cancel out in this calculation. This eliminates the problem of the individual effects, hence "fixed" (Brooks, 2014).

The coefficients of the FE model can be interpreted as the effect that the unit of change from the individual mean of the respective independent variable has on the same individual's dependent variable from its mean. The main downside of the FE estimators is, that one cannot include time-invariant independent variables, since they would be canceled in the model estimation. This simplifies the estimation process but fails to account for the time-invariant variables although they could potentially be significant in determining the values of the dependent variable.

A third model, the random-effects model, can estimate time-invariant variables. In the random-effects model, individual differences are allowed, but the variation between the individuals is assumed to be random and not correlated with the independent variables. The random individual effects are modeled as the error term u_i.

Equation 6. Random Effects Model Function.

$$Y_{it} = \beta_0 + \sum_{k=1}^{K} \beta_k * X_{it}^k + e_{it} + u_i$$

Now the intercept corresponds to the mean of the unobserved heterogeneity and the error term u_i is the random time-invariant heterogeneity specific to the individual. In the random effects model, the generalized least squares (GLS) estimator is used. The data is "quasi time-demeaned" a.k.a. a part of within individual variation is taken out so that what remains of the individual variation in the error term is random. For a more comprehensive introduction to the Random Effects model, see (Greene, 2003)

It is also possible to account for "time effects" in the FE model. Time-fixed effects should be included if it is assumed that the average value of Y_{it} changes over time but not cross-sectionally. Hence, with time-fixed effects, the intercept in the model equation would be allowed to vary over time but would be assumed to be the same across individuals at each given point in time. A "two ways" model would include both time-fixed and individual-fixed effects. (Brooks, 2014) In the analysis of this thesis, time-fixed effects are not assumed and thus will not be considered.

Other models worth considering are those that include both fixed and random effects, allowing the estimation of time-invariant variables. The Hausman-Taylor estimator applies instrumental variables in the estimation of the random effects model to overcome the usual problem of the correlated individual effects. (Hausman & Taylor, 1981) The correlated random effects model, or the "Mundlak model" is similar to the Hausman-Taylor model in a way that it provides an option for estimating the random effects model even if the assumptions of the random effects model do not hold. Instead of introducing instruments, it models the individual effects as a linear function of the means of all the independent variables across time. (Mundlak, 1978; Wooldridge, 2010)

With panel data, also the dynamic effects of the variables can be explored. For example, a lagged dependent variable can be added to the model after which the effects of the independent variables imply the entirely new information’s effect on the dependent variable. Also, autocorrelated errors can imply that the dependent variable is endogenous, and the lagged effects should be examined.

Based on this methodological study, the analysis in this thesis attempts to estimate the models with both FE and RE estimators, and these models will then be evaluated according to their properties. The correlated random effects models and dynamic models, alas, are outside the scope of this analysis.

5 ANALYSIS AND RESULTS

This chapter presents the results from the profitability determinants analysis on the data of the German renewable electricity firms. First, the correlation tables of the independent variables are examined, and then the results of the panel data analysis are given. The structure of the panel data analysis is illustrated in Figure 9. As mentioned before, the data was divided into two size categories, Small and Medium-sized Companies, and Large companies. The profitability is observed with three variables, profitability ratios ROE, ROA and ROCE. These are the dependent variables in the regression. For each of the dependent variables, and both size categories, the analysis is run first with firm-specific determinants alone, then with industry-specific determinants alone, and finally, with both determinants together. In this way, the consistency of the determinant’s effects can be evaluated, and the explanatory power of different level determinants assessed. The models used in this analysis are the Panel Data Fixed Effects and Random Effects models.

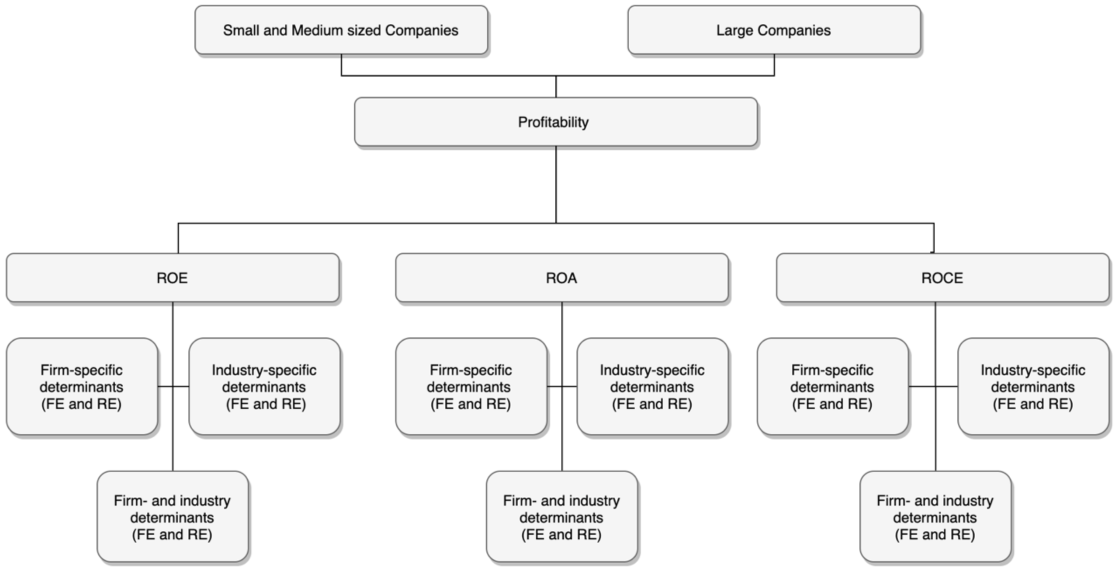

Figure 9.The structure of the analysis.

5.1 Correlation Analysis

The variables that have a significant correlation over the absolute of 0.6 are removed from the analysis to avoid multicollinearity. The Pearson correlation matrix for the SMEs shows that there is a strong and statistically significant positive correlation of 0.89 (at the 5 % significance level) between the leverage variables D/A and D/E, and since this much correlation would lead to multicollinearity in the independent variables, the D/E will be left out of the analysis of the SMEs.

Significance at 5 % level means that the p-value is less than 0.05. P-value indicates the probability of the result occurring if the null hypothesis was true. (This applies to all

Table 10. Correlation matrix for the SMEs

	CurrentRatio	Netincome	D_A	D_E	LOG_Sales	LOG_Assets	Assets_G	Sales_G	Elecreshare_G	Marketconcentration_G	GDPG	ElecCons_G	Fitavg	Elecpriceh
CurrentRatio														
Netincome	0.20***													
D_A	-0.35***	-0.25***												
D_E	0.11**	0.00	**0.89*** **	0.06	0.38***	-0.02	0.03							
LOG_Sales	0.04	0.20***	0.05											
LOG_Assets	0.02	0.02	-0.01	0.55***										
Assets_G	0.23***	0.14***	-0.17***	-0.04	0.06*									
Sales_G	0.02	0.11*	0.01	0.08	0.00	0.27***								
Elecreshare_G	-0.01	-0.05	0.04	0.01	0.03	0.14***	0.41***	0.01						
Marketconcentration_G	-0.01	-0.04	0.02	-0.04	0.00	-0.05	-0.14**	-0.06*	0.08***					
GDPG	-0.04	0.02	0.02	0.01	0.01	0.06	0.06	-0.01	0.34***	0.04*				
ElecCons_G	-0.02	0.00	0.04	-0.02	0.03	0.07*	0.14**	-0.01	0.54***	0.60***	0.57***			
Fitavg	-0.05	-0.22***	0.10***	0.00	0.00	-0.03	-0.03	-0.01	0.33***	0.45***	0.22***	0.07***		
Elecpriceh	0.04	0.16***	-0.09***	-0.01	-0.02	-0.02	-0.07	0.04	**-0.64*** **	-0.60***	-0.52***	**-0.62*** **	**-0.77*** **	
Elecpriceh_G	-0.01	-0.14***	0.06*	-0.03	0.00	-0.01	0.00	-0.03	0.15***	0.70***	-0.17***	0.18***	0.70***	-0.37***

Note: *** = significant at 1% level, ** = significant at 5 % level, *significant at 10% level the tests in the analysis) In this case, with the 5 % significance level, the probability is equal to or less than 5 % that the resulting correlation coefficient would have appeared if the true correlation coefficient was in fact zero.

There is a strong negative and significant correlation (-0.64) also between the Electricity price (Elecpriceh) and the growth rate of the Share of Renewables in Electricity consumption (Elecreshare_G). Elecpriceh also correlates with the growth rate of Electricity consumption (ElecCons_G) (-0.62) and the annual average Feed-in Tariff price (Fitavg) (-0.77). When the correlation is tested with the Electricity price transformed as a growth rate, the situation does not change, thus the variable is removed from the analysis of both size categories. The industry variables are global variables; thus the correlation coefficients are the same for both size groups. In the sample of large firms, the leverage variables D/A and D/E do not show a strong correlation and they can both be included in the analysis.

5.2 Panel Data Analysis

The analysis was done with the statistical software R. To decide between RE and FE estimators, the Hausman test was run. Hausman test tests the presence of individual effects by comparing the FE and RE models' coefficients. If there are no significant differences, the individual effects are random and thus either of the estimators can be used. The alternative hypothesis (p-value<.05) is that the FE and RE coefficients are different from each other and the FE estimator only is consistent.

Tests of heteroskedasticity and autocorrelation were run, and they indicated that heteroskedasticity and autocorrelation were present quite regularly. Autocorrelation can be caused by the endogeneity of the independent variables, or if a variable that is correlated with the dependent variable, is left out of the function. If autocorrelation or heteroskedasticity were observed in the FE model, the robust standard

Table 11. Correlation matrix for Large firms.

	CurrentRatio	Netincome	D_A	D_E	LOG_Sales	LOG_Assets	Assets_G	Sales_G	Elecreshare_G	Marketconcentration_G	GDPG	ElecCons_G	Fitavg	Elecpriceh
CurrentRatio														
Netincome	0.22***													
D_A	-0.34***	-0.19***												
D_E	0.01	0.11*	0.45***											
LOG_Sales	-0.09	0.38***	0.01	-0.03										
LOG_Assets	0.03	0.13*	0.01	-0.01	0.42***									
Assets_G	0.03	0.00	-0.01	0.06	-0.14*	-0.15***								
Sales_G	-0.06	0.16	0.11	0.04	0.08	0.06	0.23***							
Elecreshare_G	0.01	-0.04	0.02	-0.09**	0.03	0.01	0.06	0.33***						
Marketconcentration_G	-0.06*	-0.11*	0.02	-0.11***	0.05	-0.05	-0.06	-0.13*	0.08***					
GDPG	0.02	-0.04	0.04	-0.03	0.03	0.01	0.05	0.20**	0.34***	0.04*				
ElecCons_G	0.01	-0.06	0.04	-0.08**	0.05	0.01	-0.01	0.14*	0.54***	0.60***	0.57***			
Fitavg	-0.15***	-0.29***	0.02	-0.18***	0.05	-0.06*	0.03	-0.05	0.33***	0.45***	0.22***	0.07***		
Elecpriceh	0.04	0.16***	-0.09***	-0.01	-0.02	-0.02	-0.07	0.04	**-0.64*** **	-0.60***	-0.52***	**-0.62*** **	**-0.77*** **	
Elecpriceh_G	-0.01	-0.14***	0.06*	-0.03	0.00	-0.01	0.00	-0.03	0.15***	0.70***	-0.17***	0.18***	0.70***	-0.37***

Note: *** = significant at 1% level, ** = significant at 5 % level, *significant at 10% level errors were applied, specifically Arellano's (1987) heteroskedasticity and serial correlation robust estimates of standard errors. (Bai et al., 2021) In the case of the random effects model, White’s heteroskedasticity robust standard errors (White 1980) were used when heteroskedasticity was present in the data.

The following Tables present the results from the Fixed Effects and Random Effects model estimation separately for the SMEs and Large firms. There are separate Tables for each dependent variable. The first two models in each Table are with firm-specific variables only, the second two with industry-specific variables, and the final two are combined models that include both firm-specific and industry-specific variables together.

Table 12-14 present the results of the analysis with the SMEs. Table 12 shows that the models with firm-specific determinants, and the dependent variable ROE, uses 222 observations, and the models with industry-specific determinants use 746 observations. The model with both determinants also uses 222 observations. Hausman test (with p-values under the threshold .05) implies that individual effects are present in the data and the FE estimator should be used for all the models.

In the FE model with firm-specific determinants, only the Net Income variable is significant with a small positive effect, but in the RE model also leverage variable D/A is significant with a positive coefficient but quite a large standard error. Standard errors are in parentheses below the estimated coefficients. LOG of assets (LOG_Assets) alike is significant in the RE model with a large negative effect. Growth of assets (Assets_G) is statistically significant with a positive effect on ROE in the RE model. However, there are inconsistencies when the FE and RE models are compared by the Hausman test and thus the FE model only is consistent. The robust estimates of standard errors are applied to all the models as autocorrelation and heteroskedasticity are present in every model except for the models with industry-specific determinants. In that model, the heteroskedasticity test does not reject the null hypothesis of homoskedasticity. The heteroskedasticity test results apply for both FE and RE models.

Table 12. Panel Data Models for the SMEs, y = ROE

	Dependent variable:					
	ROE					
	(FE firm)	(RE firm)	(FE ind)	(RE ind)	(FE both)	(RE both)
CurrentRatio	1.573	0.857			1.434	0.837
	(1.647)	(0.696)			(1.771)	(0.715)
Netincome	**0.055*****	0.059***			**0.053*****	0.059***
	(0.012)	(0.004)			(0.011)	(0.004)
D_A	13.329	19.487**			24.475	21.270**
	(26.528)	(9.370)			(27.102)	(10.012)
LOG_Sales	8.878	2.505			4.909	2.424
	(9.380)	(2.295)			(9.437)	(2.516)
LOG_Assets	−5.590	−7.170***			7.736	−7.153***
	(8.279)	(2.464)			(13.782)	(2.738)
Assets_G	0.146	0.327**			0.037	0.324*
	(0.279)	(0.162)			(0.310)	(0.167)
Sales_G	0.013	−0.0005			0.027	−0.003
	(0.038)	(0.025)			(0.046)	(0.028)
Elecreshare_G			**0.316*****	0.319***	0.052	0.047
			(0.074)	(0.076)	(0.072)	(0.071)
Marketconcentration_G			**0.438*****	0.440***	**0.232****	0.158
			(0.136)	(0.129)	(0.105)	(0.108)
GDPG			0.025	0.001	0.317	0.036
			(0.443)	(0.477)	(0.356)	(0.407)
ElecCons_G			**−1.343*****	−1.359***	−0.851	0.045
			(0.516)	(0.512)	(0.881)	(0.471)
Fitavg			**−162.755*****	−152.253***	**−110.755****	−19.224
			(23.972)	(18.074)	(50.823)	(22.112)
Constant		33.326***		23.935***		34.995***
		(9.468)		(2.335)		(10.383)
Observations	222	222	746	746	222	222
Hausman (p)	0.0329		1.488e-12		0.0026	
Heteroskedasticity (p)	1.443e-12		0.6913		3.559e-09	
Autocorrelation (p)	1.435e-05	0.03335	1.779e-05	0.3079	0.0001	0.0776
R^2	0.742	0.761	0.149	0.118	0.762	0.768
Adjusted R^2	0.575	0.753	−0.241	0.112	0.593	0.755
F Statistic	55.067*** (df = 7; 134)	644.229***	17.901*** (df = 5; 511)	84.443***	34.490*** (df = 12; 129)	655.920***

Note: Robust SEs used — *p<0.1; **p<0.05; ***p<0.01

All the models are significant but the FE model with industry-specific determinants only (FE ind) explains less variance in ROE than the model with only firm-specific determinants (FE firm). The goodness of fit -measure R2 is 0.149 for the FE industry-determinant model, which indicates that the model explains approximately 14.9 % of the variance in ROE. The 'FE firm' models explain around 70 % of the variance in the dependent variable according to R2. The adjusted R2 that penalizes the addition of variables that do not significantly improve the model, is largely negative in the FE industry model, meaning the model includes variables that do not explain the variance in ROE according to this data and with the FE estimator. The adjusted R2 is better for the RE model, but it should be noted that Greene (2003, p. 209) writes in his textbook that the R2 measures in generalized regression models such as the random effects model are "purely descriptive" and there is no appropriate counterpart.

The average FIT price has a significant large negative effect on ROE according to the 'FE ind' models and the Market concentration growth rate (Marketconcentration_G) has a significant positive effect on ROE. One unit increase in the average FIT is, however, unlikely as the range of the variable is from 0.11 to 0.19, and the variation analyzed here is within-firm -variation. Also, the variable indicating the growth of the share of renewables in electricity consumption (Elecreshare_G) is significant with a positive effect on ROE. ElecCons_G is significant with a larger negative effect on ROE. The effects of Elecreshare_G and ElecCons_G are lost in the FE model with both firm- and industry-specific determinants (FE both), but Marketconcentration_G and Fitavg coefficients remain similar. The 'FE both' model does not improve notably from the 'FE firm' model in terms of the explanatory power (R2) and the only statistically significant variables in the 'FE both' model are Net income, Market concentration growth rate, and FIT average.

In the analysis with the dependent variable ROA (Table 13), the models have more observations, firm determinants models and models with both determinants use 264 observations, industry models 936 observations. The Hausman test supports the use of the FE estimator for all the models and the explaining power of the models is similar to models with ROE as the dependent variable.

Table 13. Panel Data Models for the SMEs, y = ROA.

	Dependent variable:					
	ROA					
	(FE firm)	(RE firm)	(FE ind)	(RE ind)	(FE both)	(RE both)
CurrentRatio	0.649*	0.288**			0.580*	0.307**
	(0.335)	(0.130)			(0.301)	(0.138)
Netincome	**0.008*****	0.011***			**0.008*****	0.010***
	(0.002)	(0.001)			(0.002)	(0.001)
D_A	−4.752*	−1.170			−3.137	−0.907
	(2.556)	(0.945)			(2.621)	(1.113)
LOG_Sales	**3.890****	0.671**			2.788	0.573
	(1.604)	(0.342)			(1.753)	(0.355)
LOG_Assets	−0.739	−1.361***			3.658*	−1.245***
	(0.710)	(0.343)			(2.004)	(0.344)
Assets_G	0.023	0.064**			−0.008	0.066**
	(0.022)	(0.027)			(0.028)	(0.027)
Sales_G	0.007	0.010***			0.013*	0.011**
	(0.006)	(0.004)			(0.007)	(0.005)
Elecreshare_G			**0.081*****	0.079***	0.004	−0.002
			(0.016)	(0.016)	(0.013)	(0.014)
Marketconcentration_G			**0.122*****	0.107***	0.048*	0.008
			(0.031)	(0.027)	(0.026)	(0.018)
GDPG			0.188*	0.182*	**0.146****	0.051
			(0.103)	(0.098)	(0.068)	(0.061)
ElecCons_G			**−0.607*****	−0.520***	**−0.398****	−0.024
			(0.117)	(0.111)	(0.191)	(0.088)
Fitavg			**−46.639*****	−43.275***	**−30.410****	−2.316
			(5.296)	(3.839)	(14.077)	(3.576)
Constant		8.819***		6.180***		8.498***
		(1.672)		(0.522)		(1.699)
Observations	264	264	936	936	264	264
Hausman (p)	0.0028		<2.2e-16		0.0026	
Heteroskedasticity (p)	1.19e-07		0.1647		4.027e-07	
Autocorrelation (p)	0.0596	0.007	0.0733	0.0014	0.01	0.0067
R^2	0.777	0.780	0.177	0.144	0.796	0.781
Adjusted R^2	0.649	0.774	−0.167	0.140	0.668	0.771
F Statistic	83.173*** (df = 7; 167)	873.520***	28.388*** (df = 5; 659)	139.129***	52.554*** (df = 12; 162)	861.457***

Note: Robust SEs used — *p<0.1; **p<0.05; ***p<0.01

Similarly, Net Income has a small positive effect on ROA, and Log of Sales has a larger positive effect at the 5 % significance level. D/A and liquidity variable CurrentRatio are significant only at the 10 % significance level.

Again, the Market concentration growth rate shows a significant positive effect, and the average annual FIT shows a significant negative effect on ROA in the ‘FE ind’ model. Here again, the variable Elecreshare_G is significant with a positive effect on ROA and ElecCons_G is significant with a negative effect on ROA. Heteroskedasticity is present in all the models except for the model with industry-specific determinants only, and autocorrelation is present in every model, while the ‘FE firm’ model can be considered a borderline case. The ‘FE both’ model has variables Net income, Electricity consumption growth rate, and average FIT significant at the 5 % significance level. Also, as an exception to the models with ROE and ROCE, GDPG or the economic growth rate has a significant positive effect on ROA. The overall results in terms of the goodness-of-fit of the models with ROA are similar to those with ROE as the dependent variable. There is a small improvement in the adjusted R2s. The CurrentRatio variable is significant and positive only at the 10 % significance level with ROA.

With the dependent variable ROCE (Table 14), again the Net income is significant with a similar effect. Additionally, for the first time, D/A is statistically significant at the 5 % significance level with a negative effect on ROCE, and LOG_Sales is significant with a positive effect. The significant effect of the D/A is lost in the model with both determinants. There is a similar number of observations used by the models than with ROA, but the number of observations for industry models is less than with ROA, with 860 observations. Hausman's test again supports the use of FE for all the models. The explanatory power of all the models is similar to models with the previous dependent variables. Heteroskedasticity and autocorrelation are present in all the models except for the ‘RE ind’ model. In the ‘FE ind’ model again, the same coefficients are significant with similar effects. In the ‘FE both’ model the variables Net income, Log of Sales, Market concentration growth rate, and Electricity consumption growth rate are significant with similar effects as in the models before.

Table 14. Panel Data Models for the SMEs, y = ROCE.

	Dependent variable:					
	ROCE					
	(FE firm)	(RE firm)	(FE ind)	(RE ind)	(FE both)	(RE both)
CurrentRatio	0.574^{*}	0.221			0.500	0.153
	(0.328)	(0.263)			(0.476)	(0.276)
Netincome	**0.004*****	0.007^{***}			**0.004*****	0.007^{***}
	(0.001)	(0.001)			(0.001)	(0.001)
D_A	**−4.131****	−0.151			−2.528	−1.465
	(2.206)	(1.635)			(2.986)	(1.811)
LOG_Sales	**8.081*****	2.300^{***}			**6.959*****	3.053^{***}
	(1.478)	(0.530)			(2.067)	(0.700)
xLOG_Assets	−0.882	-2.154^{***}			3.494	-3.015^{***}
	(0.572)	(0.535)			(2.456)	(0.694)
Assets_G	0.044	0.082^{**}			0.012	0.079^{**}
	(0.028)	(0.036)			(0.031)	(0.035)
Sales_G	0.010	0.021^{***}			0.015	0.016^{**}
	(0.006)	(0.006)			(0.009)	(0.007)
Elecreshare_G			**0.114*****	0.107^{***}	0.020	0.010
			(0.020)	(0.021)	(0.012)	(0.017)
Marketconcentration_G			**0.178*****	0.154^{***}	**0.061****	−0.001
			(0.043)	(0.038)	(0.030)	(0.022)
GDPG			0.088	0.092	0.144^{*}	0.015
			(0.141)	(0.136)	(0.085)	(0.079)
ElecCons_G			**−0.646*****	-0.520^{***}	**−0.486****	0.076
			(0.153)	(0.147)	(0.236)	(0.108)
Fitavg			**−54.524*****	-46.588^{***}	-31.859^{*}	10.495^{*}
			(7.565)	(5.362)	(17.270)	(5.478)
Constant		7.511^{***}		9.499^{***}		9.655^{***}
		(2.521)		(0.715)		(2.733)
Observations	261	261	860	860	261	261
Hausman (p)	8.969e-06		<2.2e-16		1.466e-06	
Heteroskedasticity (p)	5.013e-13		0.6848		<2.2e-16	
Autocorrelation (p)	0.3852	0.0021	0.0366	0.0017	0.0589	0.0072
R^2	0.720	0.640	0.155	0.132	0.740	0.653
Adjusted R^2	0.555	0.630	−0.222	0.127	0.575	0.636
F Statistic	60.122^{***} (df = 7; 164)	375.571^{***}	21.834^{***} (df = 5; 594)	88.492^{***}	37.702^{***} (df = 12; 159)	392.343^{***}

Note: Robust SEs used *p<0.1; **p<0.05; ***p<0.01

Tables 15-17 present the results from the analysis of the large firms. In the analysis of large firms, the number of used observations is significantly lower and stays around 100 observations with all the dependent variables. Here, Growth in Sales (Sales_G) variable was not included due to the previously mentioned problem of low observation count. D/E could be included in the firm-specific determinants as it was not correlated with the other leverage variable D/A.

With the dependent variable ROE (Table 15), the Hausman test indicates that the FE estimate should be used for all the models. Unlike with the SMEs, the Current Ratio variable indicating liquidity is significant at the 5 % significance level with a large negative effect in the 'FE firm' model. Also, the Net income is again significant with a similar coefficient than with the SMEs. In the same model, the variables Log of Sales, as well as Log of Assets are significant. The size variables LOG_Sales and LOG_Assets have opposite effects; the size in sales has a positive effect, but the size in assets has a negative effect on ROE. The effects of the size variables are present in the 'FE both' model as well. R2 shows that the 'FE firm' model explains 75.8% of the variation, with the adjusted R2 of 52.4 %. Both FE and RE industry models show that FITavg has a largely negative and significant effect and that Marketconcentration_G has a positive significant effect on ROE. Also, the Elecreshare_G has a positive effect again and the ElecCons_G has a negative effect like in the analysis with the SMEs.

In the analysis with the dependent variables ROA and ROCE (Tables 16 and 17), the same variables are significant in the 'FE firm' model except for the absence of a significant effect of the variable CurrentRatio. Debt to Assets (D_A) is statistically significant at the 5 % significance level in the 'FE firm' model with a large positive effect on ROCE, on the contrary to the result with the SMEs. According to the Hausman test, the FE models are consistent with the dependent variables ROA and ROCE. In the 'FE ind' models, the R2 statistic was higher with ROA and ROCE than with ROE, and even the adjusted R2 climbed on the positive side in the 'FE ind' model with ROA as the dependent variable. The adjusted R2 in the 'FE ind' model with ROA indicates that the variables explain around 4.7% of the variance in ROA. In the industry models, the variable Market concentration is no longer significant with ROA and ROCE, but FITavg is significant and negative in the analysis with both ROA and ROCE.

Table 15. Panel Data Models for Large firms, y = ROE.

	Dependent variable:					
	ROE					
	(FE firm)	(RE firm)	(FE ind)	(RE ind)	(FE both)	(RE both)
CurrentRatio	**−3.245****	−2.219**			−2.850	−2.416**
	(1.513)	(1.006)			(1.954)	(1.148)
Netincome	**0.011*****	0.011***			**0.010*****	0.011***
	(0.003)	(0.002)			(0.003)	(0.002)
D_A	10.485	−12.096			8.289	−10.124
	(21.431)	(31.410)			(25.071)	(33.154)
D_E	1.700	1.976			1.571	1.973
	(1.660)	(1.436)			(1.346)	(1.492)
LOG_Sales	**12.386*****	4.073			**14.502****	2.259
	(4.174)	(3.658)			(5.786)	(3.494)
LOG_Assets	**−16.704****	−8.770*			**−21.314****	−6.690
	(7.425)	(4.959)			(10.662)	(4.700)
Assets_G	0.191	0.272			0.158	0.244
	(0.156)	(0.171)			(0.154)	(0.187)
Elecreshare_G			**0.457*****	0.418***	0.012	−0.024
			(0.144)	(0.144)	(0.122)	(0.123)
Marketconcentration_G			**0.643****	0.590**	−0.135	−0.023
			(0.270)	(0.242)	(0.178)	(0.205)
GDPG			−0.767	−0.360	0.570	0.619
			(0.834)	(0.913)	(0.710)	(0.715)
ElecCons_G			**−2.550*****	−2.338**	0.225	−0.650
			(0.847)	(0.922)	(0.590)	(0.799)
Fitavg			**−289.273*****	−256.122***	36.929	−55.507*
			(46.056)	(33.859)	(43.354)	(28.630)
Constant		67.231**		42.176***		65.338**
		(31.084)		(4.718)		(29.171)
Observations	115	115	359	359	115	115
Hausman (p)	0.0031		1.185e-08		4.26e-05	
Heteroskedasticity (p)	6.186e-14		0.0401		6.286e-13	
Autocorrelation (p)	0.0186	0.1173	0.5085	0.0029	0.0452	0.1397
R^2	0.758	0.720	0.232	0.164	0.775	0.740
Adjusted R^2	0.524	0.701	−0.131	0.152	0.517	0.710
F Statistic	25.897*** (df = 7; 58)	263.163***	14.707*** (df = 5; 243)	64.607***	15.237*** (df = 12; 53)	281.471***

Note: Robust SEs used — *p<0.1; **p<0.05; ***p<0.01

Elecreshare_G and ElecCons_G are again significant in the ‘FE ind’ models for both dependent variables ROA and ROCE.

GDP growth rate is not significant in any model in the analysis of large firms and interestingly leverage is significant only once at the 5 % significance level in the FE models with both the SMEs and large firms. In the ‘FE both’ model in the case of the large firms, all the firm-specific determinants that are significant in the ‘FE firm’ model, are also significant in this model with similar coefficients, but none of the industry-specific variables are significant in the ‘FE both’ models with any of the dependent variables. With large firms, the adjusted R2 decreases when the industry-specific determinants are added to the FE model.

5.2.1 Hypotheses Testing

The hypotheses (as presented in the introduction) for the analysis supported by the literature review were:

H1. *The model with industry-specific determinants only and the model with firm-specific determinants only are both significant at the 5 % significance level. The explanatory power is higher for the firm-specific determinants.*

H2. *The average annual FIT has a significant positive effect on the RE firms’ profitability.*

To conclude, according to the analysis results based on this specific data and the estimates given by the Fixed Effects model, there is enough evidence to support H1. All the models were significant with all three dependent variables in both firm size categories. The explanatory power indeed was higher for the models with the firm-specific determinants. it appears that the size indicated by assets matters when the firm is large and that the size in assets has a negative effect on the profitability of large firms, but the effect is not significant for the small and medium-sized companies.

Table 16. Panel Data Models for Large firms, y = ROA.

	Dependent variable:					
	ROA					
	(FE firm)	(RE firm)	(FE ind)	(RE ind)	(FE both)	(RE both)
CurrentRatio	0.012	−0.135			−0.084	−0.233
	(0.128)	(0.207)			(0.159)	(0.175)
Netincome	**0.002*****	0.002***			**0.002*****	0.002***
	(0.0003)	(0.0002)			(0.0003)	(0.0002)
D_A	−0.357	−4.034			0.137	−3.271
	(3.022)	(2.661)			(2.766)	(2.507)
D_E	−0.075	0.105			−0.098	0.093
	(0.202)	(0.104)			(0.193)	(0.091)
LOG_Sales	**2.677*****	1.962***			**2.584*****	1.733***
	(0.555)	(0.506)			(0.698)	(0.561)
LOG_Assets	**−5.041*****	−3.715***			**−4.576*****	−3.161***
	(0.762)	(0.716)			(0.956)	(0.817)
Assets_G	0.040*	0.042*			0.035	0.043*
	(0.023)	(0.025)			(0.024)	(0.025)
Elecreshare_G			**0.112*****	0.088***	−0.011	−0.004
			(0.034)	(0.034)	(0.020)	(0.019)
Marketconcentration_G			0.116*	0.067	−0.037	−0.007
			(0.067)	(0.060)	(0.030)	(0.035)
GDPG			−0.301	−0.352	−0.065	−0.065
			(0.195)	(0.231)	(0.158)	(0.116)
ElecCons_G			**−0.735*****	−0.503**	0.094	−0.033
			(0.210)	(0.236)	(0.115)	(0.138)
Fitavg			**−87.543*****	−72.850***	−3.499	−11.418**
			(11.108)	(8.086)	(5.805)	(5.822)
Constant		26.194***		11.561***		23.618***
		(6.379)		(1.099)		(6.551)
Observations	111	111	391	391	111	111
Hausman (p)	5.701e-08		1.071e-06		0.0002	
Heteroskedasticity (p)	0.2226		0.0851		0.0018	
Autocorrelation (p)	2.878e-07	0.8882	0.5979	1.632e-05	4.194e-07	0.7341
R^2	0.912	0.885	0.326	0.201	0.918	0.895
Adjusted R^2	0.831	0.877	0.047	0.191	0.827	0.882
F Statistic	84.815*** (df = 7; 57)	780.103***	26.662*** (df = 5; 276)	100.195***	48.709*** (df = 12; 52)	825.308***

Note: Robust SEs used *p<0.1; **p<0.05; ***p<0.01

Table 17. Panel Data Models for Large firms, y = ROCE.

	Dependent variable:					
	ROCE					
	(FE firm)	(RE firm)	(FE ind)	(RE ind)	(FE both)	(RE both)
CurrentRatio	−0.293*	−0.351*			−0.409	−0.372**
	(0.175)	(0.199)			(0.258)	(0.186)
Netincome	**0.003*** **	0.002***			**0.002*** **	0.002***
	(0.0003)	(0.0003)			(0.0004)	(0.0003)
D_A	**7.113** **	−1.149			3.943	−2.678
	(3.435)	(2.637)			(8.211)	(2.520)
D_E	−0.196	0.114			−0.151	0.134
	(0.204)	(0.102)			(0.306)	(0.100)
LOG_Sales	**2.458*** **	3.145***			**2.864** **	3.503***
	(0.821)	(0.679)			(1.216)	(0.632)
LOG_Assets	**−5.819*** **	−4.397***			**−7.060** **	−4.941***
	(1.100)	(0.835)			(3.046)	(0.825)
Assets_G	0.040	0.040			0.041	0.034
	(0.025)	(0.026)			(0.030)	(0.027)
Elecreshare_G			**0.108*** **	0.092**	−0.009	−0.014
			(0.039)	(0.037)	(0.022)	(0.021)
Marketconcentration_G			0.136*	0.094	−0.059	−0.061*
			(0.079)	(0.068)	(0.045)	(0.035)
GDPG			−0.190	−0.260	−0.152	−0.174
			(0.203)	(0.237)	(0.184)	(0.148)
ElecCons_G			**−0.901*** **	−0.582**	0.283	0.357***
			(0.242)	(0.260)	(0.377)	(0.130)
Fitavg			**−91.133*** **	−66.683***	11.606	10.710**
			(13.324)	(9.423)	(22.618)	(5.159)
Constant		24.276***		13.227***		27.035***
		(5.886)		(1.265)		(5.838)
Observations	118	118	415	415	118	118
Hausman (p)	6.072e-06		2.44e-05		2.235e-08	
Heteroskedasticity (p)	0.0292		0.6794		0.4192	
Autocorrelation (p)	7.336e-07	0.9011	0.972	7.069e-05	1.024e-05	0.6199
R^2	0.882	0.861	0.275	0.129	0.893	0.877
Adjusted R^2	0.769	0.853	−0.061	0.119	0.772	0.863
F Statistic	63.899*** (df = 7; 60)	677.960***	21.451*** (df = 5; 283)	64.116***	38.182*** (df = 12; 55)	748.646***

Note: Robust SEs used — *p<0.1; **p<0.05; ***p<0.01

Net income and Log of sales appear to have a consistent and significant positive effect on profitability ratios with both firm size categories based on the analysis.

Leverage or liquidity did not appear as statistically significant at the 5% significance level in most of the cases in neither large firms' nor SME's analysis, although liquidity was once more significant in the analysis of large firms with a negative effect. When D/A was significant, it was negative for the SMEs and positive for the large firms. When industry-specific determinants were analyzed separately, economic growth indicated by the GDP growth rate did not appear significant with large firms, but once in a combined model with SMEs at the 5 % significance level.

Growth from the previous year in the share of renewables in electricity consumption appeared to have a significant positive effect on the profitability ratios. The change from the previous year's market concentration had a significant and positive effect in many cases with the SMEs. The change from the previous year's electricity consumption had a significant negative effect on profitability ratios in both samples of SMEs and large firms. However, in the sample of large firms, these effects disappeared when both the firm-specific and industry-specific determinants were included in the FE model.

Based on the analysis, H2 should be rejected. The annual average FIT did have a significant effect but opposite to what was expected. The variable had a negative effect on profitability with both firm size categories in altogether eight tests out of the total twelve. However, the share of FIT-supported firms in the data was unknown in the analysis done in this thesis and the negative effect could be on the firms that were not receiving any FIT at the time of the analysis.

5.3 Results Summary and Implications

The Table below gathers the results of this research and compares them with the results from the previous studies. Only the effects from the FE models are presented in Table 18 as the Hausman test supported the FE estimator in all cases.

Table 18. Comparison of results with the previous research.

	SMEs			Large firms		
Determinant's effect from previous studies	**Effect**	**Occurrence n (number of tests)**	**Sign.**	**Effect**	**Occurrence n (number of tests)**	**Sign.**
Net Income	+	6	<.05	+	6	<.05
Size (sales) +	+	3	<.05	+	6	<.05
Size (assets) +	+	1	<.1	-	6	<.05
Liquidity +	+	3	<.1	-	1/1	<.05/.1
Leverage -	-	1/1	<.05/.1	+	1	<.05
Growth in sales +	+	1	<.1		*Not included*	
Growth in assets +	Ns	Ns	Ns	+	1	<.1
Change in the Electricity Consumption -	-	5	<.05	-	3	<.05
Change in the share of RE in gross electricity consumption (industry growth) +	+	3	<.05	+	3	<.05
Change in the Market Concentration +	+	5/1	<.05/.1	+	1/2	<.05/.1
FIT average +	-	5/1	<.05/.1	-	3	<.05
GDP +	+	1/2	<.05/.1	Ns	Ns	Ns
Electricity Price -		*Not included*			*Not included*	

Note: Significance level 5% = p<.05, 10 % = p<.1 or Ns = not significant.

For both size categories, a total of six tests per variable were conducted. The 'Occurrence' column shows the number of tests where the variable was significant. It can be observed that the results mostly concur with the previous studies. However, some interesting implications can be drawn from the results. Based on this data, it appears that the size indicated by assets matters when the firm is large and that the size in assets has a negative effect on the profitability of large firms, but the same variable is not significant at the 5 % significance level for small and medium-sized companies. This result is supported by the research of Goddard et. al (2005) that suggested that the rapid expansion of firms may have a negative influence on profitability implying that the large firms may follow costly strategies to gain a bigger share in the market. The author of this thesis suggests that one explanation could be that in an investment phase the profitability lags. The capital investment intensity (data which was not available for this analysis) is also proven to be a determinant of profitability and could explain the negative effect of the assets in case the effect of the capital investment intensity is significantly negative for larger firms as was pointed out by the previous research. From the same perspective, one may draw a conclusion that based on these results, the smaller firms may not pursue the same strategies when expanding or if expanding at all. According to the descriptive statistics (Table 8), the growth in assets has slowed down during the years of this analysis indicating that there is not much expansion in that regard.

Liquidity had a positive effect on the profitability of the SMEs in three tests, but only with a 10 % significance level. Two of the tests, however, showed a negative and significant effect of liquidity on the profitability of large firms, once at the 5 % significance level, and then at the 10 % level. The leverage variable’s effect was the opposite, negative with small firms and positive with the large firms, however, significant with a 5 % level in only one of the tests per group. The positive relationship between the liquidity and profitability of the SMEs may be an implication of the power of slack income that the firms can invest to generate profit, as was previously discussed in the theoretical section. It may also just imply a careful economy. Then again, leveraging profit might be the chosen strategy for large firms that have the position to take more risks, but the positive effect of leverage with the large firms was reported only once at the 5 % significance level. Nonetheless, too many conclusions should not be drawn about the determinants with a significance at the 10% level as the probability of falsely rejecting the true null hypothesis of no effect is already higher.

Growth in assets was not statistically significant with a 5 % significance level in any of the tests with neither sample groups, although with a one positive signed effect at the 10 % significance level for large firms. This implies that the company's growth in terms of assets seems not to affect the profitability directly at least within this sample. The change in electricity consumption had a negative effect as suggested by previous analysis (in past studies was analyzed as energy consumption instead of electricity consumption). This might reflect the increasing competition in the industry, as the demand has only increased during the time period of the analysis in terms of the final electricity consumption in the country. Furthermore, as was mentioned before, the trend of the market concentration growth rate in the data of this analysis showed that the competition is intensifying in the industry.

The change in the share of renewables in the final electricity consumption was positive in three of the tests with both samples suggesting that the RE industry growth has a positive effect on profitability as recognized in the previous studies as well. The market concentration growth rate appeared to have a positive effect, as suggested by former studies, on both SMEs' and large firms' profitability, although more significantly and often present with the SMEs. The positive effects of the industry growth and the change in market concentration on profitability seem logical - as the industry grows the sales grow as well, and the firms already well-positioned have a chance to increase profits. In conclusion, this analysis implies that the successful operators in the renewable electricity industry in the country are benefiting from the more concentrated and growing industry, and the effects appear more significant with the SMEs.

The average Feed-in-Tariff had a negative effect in most of the tests with the SMEs and in three tests with large firms opposing the expectations and the previous result by Hassan (2019) and Jaraitè et al. (2013). Their analysis found the FIT having a positive effect on the profitability of electricity firms, but they had data on the companies that in fact received the support and could use this information in the analysis. The share of FIT-supported firms in the data was unknown in the analysis done in this thesis. Thus, the negative effect could be on the firms that were not receiving any remuneration at the time of the analysis and that were affected negatively by the remuneration competitors receive.

If supported by continuous and repetitive studies, the results of this analysis should be useful in terms of understanding the profitability determinants of private equity firms in the renewable electricity field and in the countries that have applied Feed-in-Tariff remuneration to boost the production of renewable electricity. However, there are certainly many other determinants that could explain firm profitability, such as managerial capabilities, other management-related variables, and investment intensity as mentioned before. Furthermore, the corporate and dynamic effects explained in the second chapter, and the more technical variates related to the capacity of the power facility et cetera could also be inspected once the data is available.

6 CONCLUSIONS

The objective of this thesis was to examine the profitability determinants of renewable energy firms. The case market selected for the analysis was that of the German private equity firms in the renewable electricity industry. According to the results from the panel data analysis, all three models (firm determinants, industry determinants, both) with all three dependent variables (ROE, ROA, ROCE) were significant. The model with firm-specific determinants had higher explanatory power than the model with the industry-specific determinants only. The analysis concluded that the results mostly concurred with the previous studies with a few exceptions.

6.1 Answering the Research Questions

The first research question (RQ1) asked how much explanatory power the firm-specific and industry-specific determinants have in the firm-level profitability. Based on the previous studies, the firm-specific determinants succeed in explaining more variance in the accounting profitability measures than the industry-specific determinants.

Research methods have included variance decomposition and panel data analyses among other methods. Several statistically significant profitability determinants have been found and based on these studies also the independent variables for the analysis in this thesis were selected, considering their availability and relevance. The profitability measures (dependent variables) mostly used in the previous studies are Return on Equity, Return on Assets, Return on Investment, and Return on Total Capital. The use of the measures differs across research and profitability has been defined in various ways as either part of the larger construct of firm financial performance and as one of the dimensions of a higher-order firm performance. This research chose to measure profitability with ROE, ROA, and ROCE.

The previous studies on the profitability of renewable energy firms have found that firm size, growth in sales, leverage, and liquidity had positive effects on RE firms' profitability. Among the industry determinants, the energy consumption and share of renewables in energy consumption have had a negative effect on profitability, but the market/industry concentration had a positive effect according to the results from the previous research. Studies that analyzed the relationship between the FIT and profitability found that the FIT had a positive effect on profitability. Also, economic growth had been found to have a positive effect, but electricity prices, on the other hand, had a negative effect on profitability.

Considering the second research question (RQ2) of 'what are the firm-specific and industry-specific profitability determinants that affect the RE electricity producers in Germany', a panel data analysis was conducted with data of 733 German private equity electricity producers. Fixed effects and Random Effects models were chosen as the estimates for the panel data regression analysis based on the nature of the data. The models were run on two separate size categories, small and medium-sized firms, and large firms.

The first hypothesis (H1) was that both models with industry- and firm-specific determinants are significant and that the firm-specific determinants explain more variance in profitability than the industry-specific determinants. Based on the low explanatory power (R2) in the industry models and the very little improvement in R2 on behalf of the industry-specific variables in the models that combined the firm-specific and industry-specific variables, it could be concluded that the explanatory power of the industry variables was low. However, all the models with either firm- or industry-specific determinants were significant with both the SMEs and large firms, and with all three dependent variables. Based on this information the H1 can be accepted.

The second hypothesis (H2) stated that the FIT variable is significant and has a positive effect on the profitability of the analyzed RE firms. There is evidence from the analysis that the FIT is significant, but surprisingly, with a negative effect. Therefore, based on the results from this analysis, the H2 is rejected. However, the analysis could not account for the firms that benefited from the FIT support, hence, the negative effect of the average FIT calculated with the annual FIT level of all the RE sectors can be misleading. It would require further research and repetitive studies to understand the reasons behind these differences.

The results mostly corroborate with the previous findings in the existing literature. One of the interesting findings was that the size measured by assets had a negative effect on the profitability of large electricity producers. This result is supported by the research of Goddard et. al (2005) that suggested the rapid expansion of firms may have a negative influence on profitability implying that costly strategies may be conducted to gain a bigger share in the market. In this thesis, it was suggested that this could be a result of an investment phase when profitability lags. The descriptive statistics showed that the growth rate in total assets was on the average negative for both the SMEs and large firms, not indicating intense investment activity, and it would thus be interesting to examine the effect of the capital investment intensity and whether it manages to explain profitability. The analysis showed that according to this data, especially the large firms among the German private equity firms in the RE sector were affected by the negative effect of the size in assets whereas the variable was not consistently significant for the small and medium-sized firms.

Additionally, the change in the share of renewables in electricity consumption had a positive effect, and as a proxy for the industry growth, it also supported the positive effect found in the previous research efforts on the topic. The analysis showed that within the RE-data sample, smaller firms tend to benefit from the concentrated market more consistently than the large ones. It was speculated that since the share of renewables and the change in the market concentration had a positive effect on profitability in the analysis, it could imply that the successfully strategized and stable small and medium-sized operators in the industry are benefiting from the concentrated market and the growing industry. The negative relationship between the growing electricity consumption and profitability found in both cases with the SMEs and large firms could be explained by the growing competition in the electricity industry overall.

The variables indicating leverage or liquidity were not as significant as with the previous research with publicly listed firms, and it appears that leveraging does not enhance the profitability of the private RE firms. Liquidity had a positive effect with the small and medium-sized companies, but a negative effect with the large companies. The leverage variable's effect was the opposite, negative with small firms and positive with the large firms, however, only significant in one of the tests. It was speculated that the contrary effects of these variables with the SMEs and large firms could be a result of different strategies of the large firms and SMEs.

6.2 Contribution

This research adds to the previous findings on profitability determinants in the RE sector by focusing on the determinants of the profitability within German RE producers that are unlisted, private equity firms.

Companies that operate in the field of renewable energy can use the information of this study in forming new market-oriented strategies, preparing for the likely growth in the industry in the upcoming years, and matching the growing competition in the industry as well. According to this analysis, much of the profitability is in the hands of the company itself, and differing market strategies might have a role in this outside the official accounting numbers. Some of the firms' profitability was positively affected by the more concentrated market which is the opposite of what has been the development in the industry during the past years.

Based on the results, one could suggest, that a growing number of direct investors would be needed in the RE industry, as the growth in terms of assets has been slow during the 9 years for the analyzed firms, and the high D/E ratio of the analyzed companies implies that debt is preferred over equity, yet at the same time, debt does not appear to have a consistent effect on profitability. All these insights could also be of use to the policymakers that have the responsibility of determining the rules for the industry.

6.3 Limitations and Future Research

One of the limitations of the analysis was the quality of data as the number of observations was limited in the data of large companies especially. The analysis did not include the largest companies as they were in the smallest minority in the data. Also, according to the names and descriptions of the companies, the data did not include companies producing energy from geothermal sources. The sample sizes differed depending on the model, as is the case with unbalanced panel data. Due to the presence of autocorrelation and heteroskedasticity, robust estimates and standard errors were used to give unbiased results. Although the FE models in this analysis have given seemingly consistent results based on the tests, the differing sample sizes could have affected the results, and hence, they should be assessed with caution. In most of the models with industry-specific determinants, the adjusted R2 measure showed that some of the variables explain very little variance in the dependent variable. This was also evident when the firm-specific and industry-specific variables were modeled together since the industry-specific variables improved the model very little in terms of explanatory power.

In the future, a dynamic model with a lagged dependent variable included in the model could give interesting results, and as suggested by theory it might well be the case that profit persists over time. This was also supported by the presence of autocorrelation in many of the models. Also, one could think of adding instrumental variables, and other possible profitability determinants recognized in the previous research, given that there is data available. This would provide a possibility to learn about the effects that the omitted variables have on the currently significant independent variables and to find a better fit for the data. A transformation in the model function or a correlated random effects model could be one possibility to be able to estimate an unbiased random effects model. This would make the comparison of the results and the addition of time-invariant variables possible. Finally, a nonlinear approach might as well be reasonable should it be established that nonlinear relationships between profitability and possible explanatory variables exist.

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