An Analysis of the Critical Drivers of Firm Performance for Profitable Grid Owner Companies in Germany

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Abstract

This thesis focuses on the new networking and cooperation phenomenon known as grid owner companies in Germany, in which electricity and gas distribution are governed by rights-of-way contracts. A process began ten years ago to phase out more than 20,000 rights-of-way contracts throughout Germany. Often, a grid owner company is established whose shareholders are the current energy company and the municipality. Moreover, large numbers of rights-of-way contracts between municipalities and energy companies contain options to set up grid owner companies.

The main aims of this thesis are to contribute to the understanding of the practical phenomenon of grid owner companies from a financial and legal perspective by identifying the population of German grid owner companies and by analysing the relationships between the firm size, the legal form, the ownership structure and performance of these companies, measured by the Return On Assets ratio (ROA).

Based on the philosophical stance of positivism, multiple linear regression analysis using ordinary least squares is applied to sample data from 2010 to 2015 in order to analyse the relationships between the firm size, the legal form, the ownership structure and performance of German grid owner companies.

According to the findings, a total of 170 German grid owner companies have been identified. The findings of the research indicate that population and area as proxies for firm size, private participation quota and the legal form of a limited partnership with a limited liability company as a general partner have a positive and significant influence on ROA.

This thesis is the first comprehensive study that is solely dedicated to the new phenomenon known as grid owner companies in Germany and provides fundamental financial insights. In particular, municipalities and energy companies that are faced with the decision on the design of a grid owner company are recommended to choose large grid owner companies with the legal form of a limited partnership with a limited liability company as general partner to achieve a high level of firm performance.

Student Declaration

I declare that the work in this thesis was carried out in accordance with the regulations of the University of Gloucestershire and is original except where indicated by specific reference in the text. No part of the thesis has been submitted as part of any other academic award. The thesis has not been presented to any other education institution in the United Kingdom or overseas.

Any views expressed in the thesis are those of the author and in no way represent those of the University.

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List of Abbreviations

ABS	Association of Business Schools
adj. R^2	adjusted r-squared
AG	Aktiengesellschaft
b_i	regression coefficient
BSE	Bombay Stock Exchange
Co.	Compagnie
DBA	Doctorate in Business Administration
DMC	Doctorate in Media and Communication
DSGV	Deutscher Sparkassen- und Giroverband e. V.
DST	Deutscher Städtetag
DStGB	Deutscher Städte- und Gemeindebund
ed.	editor or edition
eds.	editors
e.g.	exempli gratia
EnBW	Energie Baden-Württemberg AG, Karlsruhe
E.ON	E.ON SE, Essen
et al.	et alia
etc.	et cetera
et seq.	et sequens
EU	European Union
FHM	Fachhochschule des Mittelstands, Germany
Freq.	Frequency
GmbH	Gesellschaft mit beschränkter Haftung
GV-ISys	German Community Directory Information System
GWU	Gemeindewerke Umkirch, Germany

HRA	Handelsregister section A
HRB	Handelsregister section B
i	index
i.e.	id est
IFRS	International Financial Reporting Standard
IHK	Industrie- und Handelskammer
KG	Kommanditgesellschaft
kV	kilovolts
ln	natural logarithm
Max	Maximum
MBV	market-based view
Min	Minimum
N	Sample size
no.	number
OESP	organisation-environment-structure-performance
OLS	Ordinary Least Squares
p	probability
p.	page
pp.	pages
PwC	PricewaterhouseCoopers GmbH, Germany
RBV	resource-based view
ROA	Return on Assets
ROE	Return on Equity
ROR	Return on Revenue
RWE	Rheinisch-Westfälisches Elektrizitätswerk AG, Essen
S&P	Standard & Poor’s
SCP	structure-conduct-performance
SPSS	IBM SPSS software

SSP	strategy-structure-performance
SSRN	Social Science Research Network
Stata/IC	Stata standard version
Std. Dev.	Standard Deviation
Std. Err.	Standard Error
T	T-Statistic
UK	United Kingdom
US	United States
VCE	variance-covariance-matrix
VIF	variance inflation factor
VKU	Verband kommunaler Unternehmen e. V.
vs.	versus
X_i	independent variable
Y_i	dependent variable

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Publications

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Peschke, H. (2016). A theoretical framework that identifies the critical drivers of firm performance in German grid owner companies. *Proceedings of the 6th DBA Annual Doctoral Colloquium, University of Gloucestershire, June 2016, Berlin, Germany*, 66-72.

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1 Introduction and background of the research

1.1 New phenomenon of grid owner companies

In Europe, as in the rest of the world, the electricity and gas distributing industries are vital industry sectors. In Germany, electricity and gas distribution is regularly governed by rights-of-way contracts. According to German Law (section 46 (2) German Energy Industry Act), these are contracts between energy companies and municipalities on the use of public roads for installation and operation of mains that form part of an energy supply grid for general supply in a municipal area. Rights-of-way or concession contracts are of significant economic importance for municipalities and energy companies. Whereas municipalities in Germany charge a concession levy of about 6 billion €, grid operators demand use-of-system charges of approximately 20 billion € per year (Heim, 2015a).

A process began ten years ago to phase out more than 20,000 rights-of-way contracts in numerous cities and municipalities throughout Germany (Bundeskartellamt & Bundesnetzagentur, 2015). As rights-of way contracts have a term of not more than 20 years (section 46 (2) German Energy Industry Act) and most of the rights-of-way contracts were first awarded in the 1990s, their renegotiations are pending. With the expiry of the concession contracts, many municipalities are faced with the strategic decision whether they should renew their rights-of way contracts with private energy companies or decide on a partial or complete remunicipalisation. Often, a cooperation model in the form of a grid owner company is established whose shareholders are the current energy company and the municipality (Kinkel, 2014). Then, a rights-of-way contract between the municipality and the new grid owner company is negotiated. The grid is sold from the previous concessionaire to the grid owner company (asset owner) and the private energy company leases it back. In light of huge budget deficits and dramatic declines in municipal revenues, cooperation models in the form of grid owner companies could become an attractive option to resolve municipal financial problems (Deutscher Städte- und Gemeindebund (DStGB), Deutscher Städtetag (DST), Deutscher Sparkassen- und Giroverband e. V. (DSGV), & Verband kommunaler Unternehmen e. V. (VKU), 2013).

1.2 Decision-making situation

The remunicipalisation of energy grids is one of several options for municipalities. Their commitment to a decentralised energy supply is not dependent on the municipal operation of an energy distribution network (DStGB, 2017). If a new municipal utility has acquired the concession, it will have to purchase the network from the former concessionaire. The determining factor for the calculation is the capitalised earnings method. The network fees are regulated by law (incentive regulation) and generate a reasonable return on the capital of between 5 and 7 percent. The long-term interest rates on corporate debt are significantly lower than the returns on investment. The purchase of the existing distribution network is a profitable and low-risk investment (Wagner & Berlo, 2015). Due to the long-term effects of the decision, a careful decision process is necessary. Furthermore, the decision has many facets, including economic, financial and political dimensions (Fellenberg, Rubel, & Meliß, 2012).

In general, the expiry of a rights-of-way contract opens up the following options for municipalities (Fellenberg et al., 2012):

First, the municipality renews the rights-of-way contract with the previous distribution network operator or private energy company. The new contract is negotiated with a duration of no longer than 20 years (section 46 (2) German Energy Industry Act). Then, the municipality receives the concession levy from the energy company and if applicable allocated trade tax.

Second, the municipality awards the rights-of way contract to another energy company that purchases the grid from the former concessionaire. According to the German Federal Supreme Court, the earnings value is suitable for the purchase price of an energy grid (Bundesgerichtshof, 1999). As in the first case, the municipality receives the concession levy from the energy company and if applicable allocated trade tax.

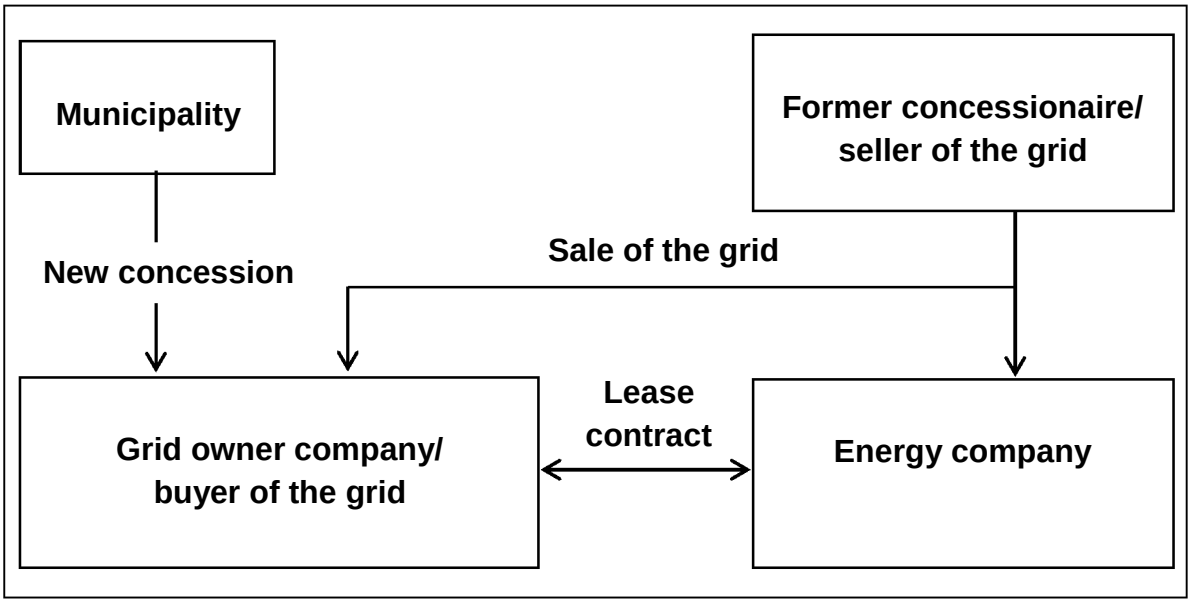
Third, the municipality purchases the distribution network and becomes the distribution network operator. Often, the municipal utility acquires the grid. In order to finance the acquisition of the grid, a security by the municipality is common

practice. The security is restricted to a maximum value of 80 percent of the credit amount (DStGB et al., 2013).

Fourth, the municipality awards the rights-of-way contract to a grid owner company as a cooperation model. Then, the grid owner company purchases the grid from the former concessionaire and becomes the new concessionaire. In turn, the distribution network operator or energy company leases the grid back. Apart from this basic model, a variety of structures of grid owner companies are conceivable. These structures are influenced by different underlying business objectives, energy-economic policies, financial agreements, accounting rules and other relevant factors, which can lead to highly complex cooperation models (Kunze, 2012). The earnings value is suitable for the purchase price of an energy grid (Bundesgerichtshof, 1999).

A grid owner company usually starts with the process of selecting a private partner for a grid owner company as a cooperation model. In practice, the process is often linked to the formal concession procedure. Regularly, an established private energy company with a traditional history as distribution network operator is selected. The choice of the cooperation partner is primarily based on the necessary draft contracts of the potential partners with regard to the cooperation model. In most cases, the bundle of contracts comprises drafts of rights-of-way contracts, company agreements, consortium agreements, lease contracts and loan contracts (Heim, 2015a).

Figure 1: Establishment of a grid owner company



(DStGB et al., 2013)

Finally, after the municipality has decided upon a cooperation model in the form of a grid owner company, the design of the grid owner company has to be determined. The design will involve particular decisions relating to firm size, ownership structure and the legal form of the grid owner company. Thus, a framework that examines the critical drivers of firm performance in German grid owner companies is required. Firm size, ownership structure and the legal form are identified as critical factors that influence the performance of grid owner companies, measured by the Return on Assets (ROA) ratio.

In addition, many recently renewed rights-of-way contracts between municipalities and private energy companies contain options to establish grid owner companies (Tugendreich, 2014).

1.3 Economic environment of grid owner companies

1.3.1 German energy market

According to section 3 no. 18 of the German Energy Industry Act, energy companies are defined as natural persons or legal entities that supply energy to others, operate a power grid or have power of control as owners of a power grid. The operation of a customer facility or a customer facility for self-supply does not

make the operator an energy supply company. As German grid owner companies normally have power of control as owners of power grids, they constitute energy companies too.

The German energy market can be characterised by three sectors: generation, transport and distribution (Meyer-Gohde, P., Meinshausen, S., Schiereck, D., & von Flotow, P., 2013). The transport of energy to consumers is done via powerful transport and distribution grids. The costs of construction, maintenance and modernisation of grids are paid by the energy customers. In general, power grids are electricity or gas grids over one or more voltage or pressure levels (section 3 no. 16 German Energy Industry Act). In particular, grids of general supply are energy supply networks that serve the distribution of energy to third parties and are basically open to the supply of a final customer (section 3 no. 17 and 29c German Energy Industry Act).

Concerning the technical structure of the electricity grids in Germany, transport, transmission and distribution of electricity take place via a hierarchical system of network levels that are separated by their voltage. Connected by transformers, a distinction is made between extra-high voltage networks (380 kV), high voltage networks (110 kV), medium-voltage networks (10 kV) and low voltage networks (400 volts). The transport network level is used to transmit large volumes of electricity between the place of production, for example a coal-fired power station, and metropolitan areas. Then the electricity is distributed by smaller distribution networks. At that level, medium-sized power stations like gas, hydroelectric power plants and wind farms also feed in electricity (Heil, 2018). German electricity grid owner companies normally own medium-voltage and low voltage networks. Concerning the structure of the German gas grids, two market areas exist, namely Gaspool and NetConnect Germany, with sixteen transmission system operators (Bundesnetzagentur & Bundeskartellamt, 2017). In this context, German gas grid owner companies normally own local distribution grids.

Since 2005, the German Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways has been in charge of the regulation of grids in Germany. The agency is responsible for the unbundling of network operations from energy generation or distribution and the non-discriminatory

access to grids. The levels of transmission charges or tariffs have to be approved by the German Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways, too (Bundesministerium für Wirtschaft und Technologie, 2013). According to section 11 of the German Energy Industry Act, distribution network operators are obliged to optimise, enhance and enlarge their grids in order to maintain a high distribution standard. The expansion of renewable energy generation facilities and the compulsory connection to energy grids mean enormous challenges for the distribution network operators (Bundesnetzagentur & Bundeskartellamt, 2017).

In Germany, the distribution of energy was the original responsibility of local government. However, local government has the choice of whether to distribute energy or to assign the task to a third party by rights-of-way contracts (Meyer-Gohde et al., 2013). Thus, the energy sector in Germany developed as a mix of municipal and private companies from the late nineteenth century (Hall, Lobina, & Terhorst, 2013). Still four large power companies dominate the German power market: E.ON, RWE, EnBW, and Vattenfall. They operate across the generation, distribution, and retail supply sectors. Moreover, the ownership of Germany's energy system is concentrated in the hands of these four companies. Whereas regional energy companies, often in the hands of the big four companies and thus largely privately owned, hold and dominate the transmission and distribution assets, municipal companies hold only a minor share of local distribution networks (Wagner & Berlo, 2017).

The energy distribution system in Germany is the most complex in Europe, with around 900 distribution system operators serving about 20,000 municipalities. Apart from many small distribution network operators, the number includes the four large companies as well as about 700 municipally owned utilities and a number of regional companies. The four large distribution network operators in Germany, RWE, EnBW, E.ON, and Vattenfall, operate a significant portion of the distribution grid through concession contracts with municipalities. Under the German Energy Industry Act, these concession agreements have to be renegotiated under non-discriminatory rules and can be cancelled (Bayer, 2015). According to section 46 of the German Energy Industry Act, municipalities are obliged to make public roads available for installation and operation of mains for

the immediate supply of electricity to final customers in the territory in a non-discriminatory manner.

1.3.2 Renewable energies and Germany's energy transition

The promotion of renewable energy sources plays a major role in Germany's energy policy. According to section 1 of the German Energy Industry Act, the supply of energy has to be increasingly based on renewable energies. Renewable energy sources like wind, water, biomass and solar energy are privileged under the German Renewable Energy Sources Act and the German Combined Heat and Power Act. For example, grid owners have to connect renewable energy systems as a priority to their grids and distribution network operators have to purchase energy from renewable energy systems at defined prices (section 3 German Renewable Energy Sources Act). Already the introduction of the feed-in-tariff system through the German Renewable Energy Sources Act in the year 2000 has promoted an enormous buildup of wind, solar and biomass facilities (Becker, 2017).

The development of renewable energies and the atomic disaster in Fukushima in 2011 led to further political initiatives to phase out the use of nuclear energy, to increase the percentage of renewables in energy consumption and to remunicipalise energy activities (Becker, 2017). By the end of the year 2050, 80 percent of the German energy consumption should be provided by renewables (Bundesministerium für Wirtschaft und Technologie, 2013). Already more than 95 percent of the electricity produced by renewable energies is supplied by local grids and therefore they are a critical factor of success (Clemens & Ohrem, 2014; Kinkel, 2014).

In general, electricity grids play an important role in the integration of renewable and other local energies like the electricity produced from cogeneration (Wagner & Berlo, 2015). With the decision of the energy transition in Germany in 2011, electricity is becoming increasingly decentralised. As a consequence, in the course of the energy transition, the grids also become a central element of energy supply as they match large numbers of small decentralised renewable energy systems (DStGB et al., 2013). As the renewable energies are characterised by

fluctuating power generation, grids become smarter. This means that they combine generation, storage and consumption and compensate for power fluctuations by using information and communication technologies (Umweltbundesamt, 2013).

Overall, local distribution networks are essential for the integration of renewable energies and other decentralised energy types such as electricity produced from combined heat and power units. Therefore, the distribution networks are the backbone of a turnaround in German energy policy towards sustainable energy systems (Wagner & Berlo, 2015). The foundation of municipal companies and the reacquisition of expiring rights-of-way contracts in the context of remunicipalisation provide local political actors with the opportunities to participate in and to determine the process of the German energy transition (Heil, 2018).

1.3.3 Trend towards remunicipalisation of energy sector

1.3.3.1 Remunicipalisation

After the liberalisation or privatisation of the energy markets, a trend towards remunicipalisation was identified (Wollmann, 2013). Due to financially stressed situations, budget deficits and austerity policies of municipalities in Germany in the 1980s and early 1990s, it became increasingly popular to privatise and to outsource local public services. As virtually all rights-of-way contracts in the German energy sector were up for renewal between 2012 and the end of 2016, more than 60 percent of all German municipalities considered remunicipalising their local energy infrastructure (Berlo, Templin, & Wagner, 2016).

The prevailing view was that private businesses were more efficient and cost effective than the public sector. While tax revenues declined, municipalities were faced with an expansion of tasks. In order to reduce the enormous debt burden and to generate short-term revenues for maintaining cultural and social infrastructure, the municipalities sold off the “crown jewels of municipal property”. The trend was fostered by the conservative political and economic movement in the realm of neo-liberalism. Today, there are numerous indications for a countermovement to the paradigm of privatisation, especially in the municipal

energy sector (Wagner & Berlo, 2017). Still faced with financial problems and budget deficits, municipalities began to appreciate municipal utilities and influence on local infrastructure with the aim of generating benefits from municipal utilities, companies and public ownership. The development has led to a renaissance of municipal companies in Germany. Furthermore, the spirit of the times speaks in favour of a continuation of the trend in remunicipalisation. Since the global economic and financial crisis of 2008, private-sector solutions and models have been regarded critically. Especially in Germany, the large energy companies have lost their reputation as they have abducted the energy transition. By contrast, state action has regained legitimacy and reputation in the eyes of many German citizens (Bauer, 2012).

As a reaction to the wave of privatisation of the 1990s (Heim, 2015a), the expression “remunicipalisation” is the opposite of privatisation of municipal duties and responsibilities. It denotes the return or re-nationalisation of formerly privatised services of general interest and functions or infrastructure back into municipal hands, either wholly or in part (Lichter, 2015; Monopolkommission, 2013; Ronellenfitsch, 2004; Wagner & Berlo, 2017). Municipal functions and services were previously under private management or long-term concessions (Wagner & Berlo, 2017). Beyond the return of services, an expansion of municipal activities also in previously privately organised sectors is identified, for example the foundation of public utilities (Monopolkommission, 2013). So the term remunicipalisation is used (Berlo et al., 2016). Some authors speak of “a renaissance of the municipal economy”, meaning that the cases of remunicipalisation are significant beyond the energy sector (Bauer, 2012; Becker, 2017).

From the perspective of a municipality, the generic term “remunicipalisation” comprises the following procedures (Libbe, Hanke, & Verbücheln, 2011):

- Founding of municipal companies
- Retransfer of services to municipality or municipal companies
- Retransfer of companies under private legal forms into municipal legal forms
- Increase in municipal participation quota of semi-public companies

With regard to the energy sector, the expression remunicipalisation denotes the expansion of economic activities of municipalities in that sector (Lichter, 2015). It could mean that energy is supplied by municipalities again whereas before it had been supplied by private energy companies. The supply of energy and the operation of distribution networks are services of general interest and the original duties of the municipalities in Germany (Heim, 2015a). However, they can affect parts of the value chain or the entire value chain, from power generation to distribution and network operation (Monopolkommission, 2011). Several new public utilities were founded and large numbers of rights-of-way contracts have been signed between local government and public utilities (Berlo & Wagner, 2013a) or still have to be renewed. To sum up, a trend towards takeovers of electricity and gas grids by municipalities and municipal companies can be observed (Verband kommunaler Unternehmen e. V., 2012).

Although the engagement of local authorities as distribution network operators is relatively high, the whole amount of distribution network operators is rather stable at a high level (Bundesnetzagentur & Bundeskartellamt, 2017). Due to a lack of competition, there cannot be a purely market-based solution in the area of natural monopolies. Hence, the remunicipalisation debate does not focus on the question of market or state. In fact, the question is whether a service has to be provided by a municipal or a private enterprise (Höffler, 2013).

According to Arnold (2012) public authorities try to strengthen their influence on the energy sector and to improve their public budgets by the management of grids. They realise that the element of common interest and public value is an important field for local decision-makers (Wagner & Berlo, 2017).

Apart from political objectives, the proponents of remunicipalisation see the following economic objectives and expectations:

- Positive budgetary implications by the transfer of profits from municipal companies
- Low energy prices for citizens
- Maintenance and creation of local employment
- Greater influence of the municipality on energy policy

- Support of local added value, especially orders of local companies

Moreover, large German energy companies, like E.ON in North-Hesse, sold their grids to municipalities to reduce their enormous net debts (Kinkel, 2014). Grid owner companies are potential buyers of grids formerly owned by such energy companies. However, the monopoly commission in Germany examined that the actual influence of municipalities on the energy markets in the context of remunicipalisation is lower than expected by them. The scope for setting prices after the (re-)purchase of grids is limited, because the tariffs are regulated by the Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways. The monopoly commission in Germany is of the opinion that municipalities always have the opportunity to set up conditions, even without their own entrepreneurial activities. To sum up, the monopoly commission criticises the entrepreneurial activities of municipalities, because it cannot be justified by efficiency arguments (Monopolkommission, 2011).

Often, municipalities enter into partnerships or cooperations with private energy companies and other municipalities. In particular, the operation of energy distribution networks in cooperations between municipalities and private energy companies has a more than 150-year tradition in Germany (Theobald & Templin, 2018).

Apart from generating profits, the main reasons for searching for a strategic partner are gaining access to additional know-how with regard to the operation of grids and competence as well as minimising economic and financial risks from private energy companies. In general, municipalities do not have the necessary employees or know-how. The involvement of private energy companies as strategic partners facilitates the recovery of municipal influence without losing the advantages of a private participation (DStGB, 2017).

There are no general requirements for the possible forms of strategic partnerships. In practice, depending on the desired degree of involvement of the private partner, cooperation agreements, management models, lease models and private participation models can be distinguished. In general, the highest degree of involvement of the private partner is in the form of a participation model, for

example in the form of a grid owner company (Essing & Kürten, 2015). Establishing a private-public cooperation can have several purposes. For example, the private energy partner could invest additional capital in a joint company that is required for a grid acquisition.

With regard to the operation of grids, complex regulatory issues, e.g. change of supplier processes, network balance or calculations of the efficiency value, are provided by private partners of a cooperation with municipalities (DStGB et al., 2013). Often, the private strategic partner performs the commercial and technical management of the network company due to its necessary know-how in terms of network operation (Essing & Kürten, 2015).

Furthermore, the complexity of the concession award procedure or little experience with the operation of grids encourages small municipalities to enter into municipal or private cooperation projects. Sometimes one company acts as a cooperation partner for several different municipalities, providing them with professional experience and operational know-how (Wagner & Berlo, 2017). An important requirement for the profitability of a grid owner company is the expertise to operate a grid and economic power of the private energy company. In general, large numbers of German municipalities have neither capital nor know-how or experience to operate a grid (Heim, 2015a). Overall, knowledge gaps may be closed by entering into close strategic partnerships (DStGB, 2017).

According to DStGB et al. (2013), remunicipalisation can be a successful forward-looking strategy for municipalities. However, the political stance of local decision-makers on the issue of public ownership defines how conflictual remunicipalisation processes are (Becker, 2017).

Overall, Becker (2017) emphasises that the remunicipalisation trend in the German energy sector rests on a convergence of local service traditions with the dynamics of the energy transition combined with ending rights-of-way contracts.

1.3.3.2 Motives and objectives of municipalities

1.3.3.2.1 Fiscal and tax-related interests

The desire of municipalities to participate in profits from distribution network operation and the recovery of lost influence of municipalities on local infrastructure are often important drivers of remunicipalisation. However, most of the municipalities do not have the required staff and know-how to operate the grids. Hence, they have the possibility to establish cooperation models together with private energy companies as strategic partners (Essing & Kürten, 2015).

According to an empirical study by Lenk, Rottmann, and Albrecht (2011), almost half of the interviewed municipalities with a budget deficit are planning a remunicipalisation. Thus, financial aspects play an important role in the decision of a municipality to remunicipalise local infrastructure and public services (Dietl, 2018; Wagner & Berlo, 2015). Whereas selling off their networks seemed like an attractive source of revenue for municipalities in the past, many municipalities have changed their minds (Diermann, 2010). Often, the municipalities are no longer satisfied with the concession levy on grids in their districts. Moreover, they intend to participate in the profits from the operation and maintenance of energy grids as well as related local business taxes (Heim, 2015b). This requires direct or indirect capital participation of the municipality in the acquisition of the energy grid. For this purpose, frequently grid owner companies are founded that lease the grid to a lessee. Then, the municipal budgets benefit from the lease payments, but are faced with finance costs (DStGB et al., 2013).

First, there is the idea that the long-term investment in grids by the establishment of a grid owner company opens a new and recurrent source of income for municipalities and contributes to the reduction of their budget deficits (DStGB et al., 2013). Not only do third parties benefit from the operation of the grids, but also municipalities that are indirectly owners of the grids (Lichter, 2015; Verband kommunaler Unternehmen e. V., 2012).

Second, the operation of a grid allows for steady and predictable revenues according to the regulations of the German Federal Network Agency for Electricity,

Gas, Telecommunications, Post and Railways over several years. Apart from that, the energy grids have to be maintained on a regular basis and the grids have to be state-of-the-art technology (DStGB et al., 2013)

While in the past, mainly private energy companies benefited from the network operation, municipalities profit from the net income of a grid owner company as a shareholder and also from the trade tax as far as it is operated in the borders of the municipality. However, due to the development of different parameters like depreciations, interests, etc. of the grid owner company, positive income is not self-evident (Heim, 2015a; Verband kommunaler Unternehmen e. V., 2012).

Whereas private energy companies primarily serve private shareholder interests, from the perspective of municipal authorities, grid owner companies should contribute to the municipal budget, i.e. the degree of success is measured by the amount of money that remains within the community. In contrast to the grid operator who is responsible for the maintenance, grid owner companies refer to the ownership of a distribution infrastructure for delivering power to customers aiming at local control over the energy infrastructure (Wagner & Berlo, 2017).

Furthermore, the establishment of a cooperation model in the form of a grid owner company facilitates the consolidation of municipal enterprises into fiscal units (“steuerlicher Querverbund”) (Fellenberg et al., 2012). Sections 4 and 8 of the German Corporate Income Tax Act form the basis of the consolidation of municipal enterprises into fiscal units (DStGB, 2017). The income of profitable grid owner companies is offset with the losses of other municipal activities (public transportation, energy supply, port and airport) (Rosenberger, 2012), and reduces the tax burden of the municipality (Wagner & Berlo, 2015). Often, municipal swimming baths and public transport belong to important infrastructures and services that can be offered in spite of significant losses (Wagner & Berlo, 2015).

1.3.3.2.2 Control and influence over local infrastructures

Municipalities not only benefit financially from the revenues of municipalisation, but they are also interested in gaining or securing control over their local infrastructure. Often, municipalities had lost control or general influence over their

energy issues (Becker, 2017). On the one hand, they become more and more independent from private energy groups and on the other hand, they gain more populism (Fellenberg et al., 2012). In general, new strategic opportunities are expected by municipalities (Heim, 2015a; Verband kommunaler Unternehmen e. V., 2012).

In contrast to a concessionaire that is not a local private energy company, grid owner companies offer the possibility to better coordinate the maintenance and investment activities with the municipalities (Heim, 2015a). However, the influence of local authorities with regard to the local distribution networks seems to be overestimated, because rights-of-way contracts simply refer to the right to use the municipal ways. For example, municipalities cannot determine the energy mix (Fellenberg et al., 2012; Heim, 2015a).

Apart from the general interest of the municipalities in gaining or securing control over their local infrastructure, they strive for control under company law in the case of a grid owner company. A shareholding of more than 50 percent and the right to determine the majority of members of the shareholders' meeting, supervisory board and/or management of the company are typical examples (Heim, 2015a).

1.3.3.2.3 Limitation of liability and economic risks

Municipalities are taking on responsibility for a business that offers opportunities, but that also has technical and economic risks. From the view of the municipalities, limited liability companies ("GmbH") and limited partnerships with a limited liability company as general partner ("GmbH & Co. KG) are the preferred legal structures as they offer protection from the liabilities and the financial risks of a grid owner company (Heim, 2015a).

1.4 Legal environment of grid owner companies

1.4.1 European and German energy law

The EU-directives on the deregulation of the European electricity and gas markets aim at lowering prices to a competitive level and creating competitive electricity

and gas markets in Europe. This should be achieved by the unbundling of the value chain in energy companies, i.e. the separation of network operation and energy distribution to avoid cross-subsidisation, and the discriminatory network access for third parties (sections 6 to 10 German Energy Industry Act; Verband kommunaler Unternehmen e. V., 2012). The electricity and gas distribution networks or grids and the concessions are natural monopolies and are thus subject to market failure. Characteristic of a natural monopoly is the combination of high fixed and low marginal costs, i.e. the production costs are at its lowest level when only one market player exists (Mühlenkamp, 2007).

Based on EU law, the German Energy Industry Act of 1998 is the legal basis of the energy regulation and the liberalised electricity and gas markets in Germany (Meyer-Gohde et al., 2013; Wagner & Berlo, 2017). A key legislative objective in this context was to separate distribution network operation from energy supply, the so-called unbundling (Wagner & Berlo, 2017). In accordance with the EU-directives, it presents objective and non-discriminating principles for the taking up of energy supply and the construction of power plants and power lines (Rudo, 2018). According to section 1 of the German Energy Industry Act, its purpose being federal law is to ensure the safe, reasonably-priced, consumer-friendly, efficient and ecologically harmless public supply of electricity and gas, which is increasingly based on renewable energy. The central policy goal in this context was to separate grid operation from other energy supply activities. To sum up, the amendment of the German Energy Industry Act opens up the German power market for competition. Every customer shall have a free choice of energy supplier (Wagner & Berlo, 2017). Furthermore, the deregulation and liberalisation of the energy market are subject to the German Act Against Unfair Competition and the German Act against Restraints of Competition (Heim, 2015a).

1.4.2 German municipal law

Economic activities by municipalities are subject to municipal law of the 16 German federal states and have to satisfy general requirements (DStGB et al., 2013). The regulations aim at protecting municipalities from risks that diminish their performance. In general, a municipality has the right to carry out an economic

activity if the following requirements are satisfied (for example section 121 of the Hessian Municipal Code):

(1) the public purpose justifies the economic activity,

(2) the nature and extent of the activity corresponds to the financial performance of the municipality and the expected demand and

(3) the purpose is not fulfilled as well by a private third party.

According to section 122 of the Hessian Municipal Code, a municipality may only establish or participate in a private company if the following requirements are met:

(1) the requirements of section 121 of the Hessian Municipal Code are met,

(2) the liability and the contribution obligation of the municipality are limited to an amount that corresponds to its performance,

(3) the municipality has an appropriate influence, particularly on the supervisory board,

(4) it is ensured that the annual financial statements and the management report are prepared and audited in accordance with the provisions of the German Commercial Code for large corporations.

However, the economic activities with regard to the energy sector as part of public services are privileged in some federal states of Germany. For example, contrary to sections 121 and 122 of the Hessian Municipal Code, municipalities may operate generation, storage, distribution and supply of electricity, heat and gas from renewable energies when the activities take place within the municipality or in the regional environment in the form of intermunicipal cooperations (section 121 (1a) Hessian Municipal Code). By the rule, economic activities of municipalities in Hesse with regard to distribution networks are facilitated (Morber & Dietl, 2014).

It has to be emphasised that the economic activity or participation of the municipality must be particularly subject to the economic principle (section 121 (1a) Hessian Municipal Code). As the engagement of the municipalities requires significant investment, the expected profitability plays an important role (Dietlein & Ogorek, 2018). The economic principle means that the greatest possible return is to be reached with as little effort and expense as possible. However, to protect the

municipal budget, liability and financial risks of the municipality have to be limited (Heim, 2015a). So, economic activities of municipalities are not an end in itself. They are rather subject to the economic principle and must be profitable (Theobald & Templin, 2018)

Section 121 (6) of the Hessian Municipal Code governs that before deciding on the establishment, acquisition or substantial expansion of economic enterprises, as well as direct or indirect participation, the municipal council must be fully informed about the opportunities and risks of its intended business activities and of their expected impact on the craft and the market to teach medium-sized businesses. Before referral to the municipal council, the local chambers of trade, chambers of industry and commerce as well as associations should be given the opportunity to comment on their business. The statements are to be communicated to the municipal council (section 121 (6) Hessian Municipal Code).

1.4.3 Rights-of-way contracts

Public services or services of general interest may be operated as a concession. Usually, a private or public company enters into a fixed-term temporary agreement with the municipality and is awarded the right to operate and maintain a public service. It could also mean that existing public infrastructure can be used. Contrary to a concession, a lease contract also gives the right to operate and maintain a public service, but the municipality is still responsible for the investments. In turn, the concessionaire has to pay either a fixed or variable remuneration (Heim, 2015a).

Rights-of-way contracts play an important role in the remunicipalisation of distribution grids as the connection of citizens to energy networks is only possible through mains laid below public streets (Heim, 2015a). Rights-of-way contracts in the electricity and gas sectors are governed by section 46 of the German Energy Industry Act. These are “contracts between energy utilities and municipalities on the use of public roads for installation and operation of mains that form part of an energy supply grid for general supply in a municipal area” (section 46 (2) German Energy Industry Act). With the amendment of the German Energy Industry Act in 2005, rights-of-way contracts no longer govern the transfer of supply rights in a

municipal area, but only the transfer of rights-of-way. Furthermore, the municipal authority is no longer responsible for determining the basic supplier.

With the amendment to the German Energy Industry Act in 2005, connection and supply obligations now directly arise from this act: The grid operator is only obliged to connect final consumers, peer or downstream electricity and gas supply grids as well as lines, generation and storage facilities to its grid on certain terms and conditions (section 17 (1) German Energy Industry Act). Moreover, grid operators must publish general terms and conditions for grid connection in municipal areas in which they operate energy supply grids for the general supply of final consumers and connect anybody to the grid on these terms and conditions (section 18 (1) German Energy Industry Act). The same applies to grid access (section 20 German Energy Industry Act).

The basic supplier is the energy utility that supplies the greatest number of domestic customers in a grid area of general supply (section 36 (2) German Energy Industry Act). Every three years, the grid operator must identify the basic supplier in a grid area and notify the competent authority accordingly (section 36 (2) German Energy Industry Act). In case of termination of a rights-of-way contract, the current concessionaire is obliged to surrender the distribution facilities necessary for grid operation to the new concessionaire, i.e. the new energy utility, against payment of an economically adequate fee (section 46 (2) German Energy Industry Act).

Rights-of-way contracts do not specify what service the energy utility is to provide, who the recipient of the service is nor at what price the services are provided. The contracts do not specify an obligation to connect consumers or other energy utilities to the electricity or gas grid or to supply them with energy; as a consequence, prices for services are not determined either. The concessionaire (grid operator) is not necessarily identical to the basic supplier in terms of function. The operator of an energy supply grid is only responsible for distributing electricity or gas and operating, maintaining and, if applicable, expending the supply grid (section 3 German Energy Industry Act), but not for supplying a specific area. Supply of a specific area lies in the hands of the basic supplier, i.e. the energy utility that uses the grid operator’s supply grid for supplying energy to customers.

Consequently, it is the grid area that is of relevance, not the municipal area. Thus, there is no connection between rights-of-way contracts or concession contracts and energy supply.

According to section 48 (3) of the German Energy Industry Act, energy companies, including grid owner companies, who have signed rights-of-way contracts with municipalities are obliged to pay concession levies to municipalities. The basis of the permissible amount of the concession levy is the German Concession Tax Ordinance. Section 2 (2) of the German Concession Tax Ordinance sets maximum amounts per kilowatt hour, based on the number of inhabitants of a municipality. The energy company is free to charge concession levies below the maximum amounts. For special contract customers, the German Concession Tax Ordinance also admits deviating conditions (Heil, 2018).

Overall, rights-of-way or concession contracts have significant economic importance for municipalities and private energy companies. Whereas municipalities in Germany charge a concession levy of about 6 billion €, the grid operators demand use-of-system charges of approximately 20 billion € per year (Heim, 2015a).

1.4.4 Concession award process

According to German energy law, rights-of-way or concession contracts are generally restricted to a term of no longer than 20 years (section 46 (2) German Energy Industry Act). When such a contract expires, municipalities will carry out a formal concession procedure to determine the future owner of the electricity and/or gas grid. Often, public companies compete with private companies in such procedures.

Before carrying out a concession award process, the municipality should decide whether it wishes to carry out a conventional concession award process or to request cooperation models in order to remunicipalise the grid. The choice of a cooperation partner can already be made before the concession award process (two-stage procedure) or connected to it (one-step procedure) (DStGB, 2017). The concession award process is subject to regulation (section 46 German Energy

Industry Act) and periodically competition for the grids is intended (DStGB et al., 2013). Due to the dominant position of the municipalities with regard to rights-of-way contracts, the concession award process is also subject to antitrust law forcing the municipalities to have a transparent and non-discriminatory procedure. Even municipal companies may not be given preferential treatment (Bundesgerichtshof, 2013). However, the German Act against Restraints of Competition is not applicable to rights-of-way contracts and concession procedures as section 46 of the German Energy Industry Act conclusively governs all relevant issues and the municipality acts as an offeror (Kermel, 2012).

According to section 46 (3) of the German Energy Industry Act, municipalities have to announce the expiry of their electricity or gas rights-of-way contracts at the latest two years in advance and to publish their announcement in the German Federal Gazette and the Official Journal of the European Union.

The process of granting a concession is divided into a series of steps (DStGB, 2017):

- All potential concessionaires are requested to provide evidence of their fundamental suitability to operate the grid
- Suitable potential concessionaires are asked to submit indicative offers
- Individual discussions are held with the tenderers
- A request for final offers to be submitted is made
- Choice of the best offer by applying defined selection criteria
- Approval of the decision by the municipal council

In principle, the concession award procedure comprises two steps. First, the municipality grants a concession to an energy company, i.e. the municipality and the energy company enter into a rights-of-way contract. The rights-of-way contract governs the right of the energy company to use the public ground and the duty to pay the concession levy in return. With regard to the choice of an energy company, the municipality has to take the objectives of section 1 of the German Energy Industry Act into account. Thus, a safe, reasonably-priced, consumer-

friendly, efficient and ecologically harmless public supply of electricity and gas, which is increasingly based on renewable energy, is aimed at (sections 1 and 46 (4) German Energy Industry Act).

Second, in case the rights-of-way contract is granted to a new concessionaire, it has to buy the grid from the former concessionaire at an adequate remuneration (section 46 German Energy Industry Act).

After having conducted a transparent and non-discriminatory concession process according to section 46 (2) of the German Energy Industry Act and made the decision in favour of the cooperation company between the municipality and a private energy company, the rights-of-way contract between the municipality and the cooperation company could be closed. Then, the cooperation company purchases the energy grid from the former concessionaire and operates it. With regard to the operation of the grid, several types of cooperation models are possible (DStGB, 2017).

However, cooperation companies in Germany are subject to German and European Antitrust Law as well as the law of the home country of the parties if they fulfill certain requirements with regard to the turnover and market shares of the undertakings concerned. They may be subject to merger control as well as to the prohibition on cartels (Heim, 2015a).

1.4.5 Regulation

From the perspective of the German Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways, the purpose of regulation is to establish fair and effective competition in the supply of electricity and gas. In order to achieve these goals, the German Federal Network Agency has to ensure non-discriminatory third-party access to energy networks and to monitor the use-of-systems charges levied by distribution network operators (Bundesnetzagentur, 2018a).

In general, energy policy in Germany is developed and implemented at the federal and regional level. Within the government, the responsibility for energy policy is divided between the Federal Ministry of Economic Affairs and Energy and the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety. Since 2014, the responsibility for the power sector has been mainly concentrated in the Federal Ministry of Economic Affairs and Energy, with the exception of nuclear safety and climate protection. On the federal level, the German power sector is chiefly regulated by the German Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways, and by the German Federal Cartel Office. Both authorities are assigned to the Federal Ministry of Economic Affairs. The power to regulate the power sector arises from the German Energy Industry Act (section 29 et seq. German Energy Industry Act). The Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways is responsible for the development of the electricity, gas, telecommunications, postal, and railway markets. This comprises regulation of competition and unbundling of the electricity and gas transmission and distribution grids. Thus, the German Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways ensures non-discriminatory network access and controls the use-of-system charges levied by the transmission system operators and distributers. Furthermore, in Germany 11 state regulatory authorities exist and they also play an important role in the regulation of the energy sector. They are also responsible for the regulation of revenues. In general, grids covering more than one state and networks with more than 100,000 customers are regulated by the Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways, others by the state regulatory authorities. The Federal Cartel Office is charged with ensuring market competition in Germany, primarily through the control of abusive practices by dominant companies. On the federal level, the cartel authorities and civil courts address allegations of excessive rates for end customers in their states (Bundesnetzagentur, 2018b).

1.4.6 Incentive regulation of electricity and gas networks

In contrast to the majority of sectors with competition in Germany as a free market economy, a few sectors like electricity and gas grids are natural monopolies, in which competition is limited or does not exist (Lichter, 2015). However, the

operation of energy networks is a capital-intensive business and the network operators need a long-term planning horizon as well as reliable economic framework conditions for investments. An important feature of the German regulation system is that the costs of grids and thus the use-of-system charges vary from one distribution territory to another (Bayer, 2015).

With the specific regulatory approach known as *incentive regulation*, the German Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways prevents network operators from making monopoly profits, and cares for fairly calculated prices for access to electricity and gas networks in Germany in favour of the customers. As there is no ultimate regulatory approach for regulated sectors, the German Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways is continuously improving the incentive regulation approach for use-of-system charges (Bundesnetzagentur, 2018c). In contrast to a pure cost-based approach, incentive regulation means that the German Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways forces the distribution network operators to operate their grids efficiently and provides incentives to reduce unnecessary costs for the future by allowing them to collect efficiency gains (section 21a German Energy Industry Act). Section 21a of the German Energy Industry Act and the German Incentive Regulation Ordinance constitute the legal basis of the periodically performed incentive regulation, the determination of the revenue cap and finally the network charges. According to section 3 (2) of the German Incentive Regulation Ordinance, a regulatory period normally takes five years. The revenue cap and finally the network charges of the distribution network operator are calculated as follows (Bundesnetzagentur, 2018c):

1. Calculation and examination of the cost base according to section 6 (1) of the German Incentive Regulation Ordinance in the third year before the incentive regulation period, the so-called base year.

2. Determination of the potential for efficiency gains by comparing efficiency levels between distribution network operators and using these for reductions in revenue.

3. Determination of the individual revenue cap based on the verified costs and the results of the efficiency comparison.

4. Determination of the network charges based on the individual revenue cap.

Sections 4 to 10 of the German Electricity and Gas Network Charges Ordinances regulate the cost categories that are part of the network charges, especially operating costs like personnel expenses, borrowing costs, etc. from the profit and loss account and imputed costs like depreciations, trade taxes, etc. Furthermore, the German Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways determines the return on equity rates as investments in grids are essential. Operating electricity or gas grids offers relatively stable returns on equity (Heim, 2015a). The current rates are 6.91 percent for new facilities (capitalised after 1st January 2006) and 5.12 percent for old facilities (capitalised before 1st January 2006). The rates reflect the interest rates in the capital markets and consist of a base rate (2.49 percent), based on the ten-year average for risk-free investments, and an appropriate risk premium as a compensation for the risk that arises from the investment in grids (3.15 percent). The application of the return on equity rates is limited to a maximum of 40 percent of the value of operating assets. Exceeding amounts are subject to the base rate. Overall, the rates guarantee that the distribution network operators are in a position to take on the large investments required for the energy transition. Thus, they will remain in place for the duration of each five-year regulatory period (Bundesnetzagentur, 2018c).

1.5 Research motivation

The researcher works in the accounting department of a private energy company in the federal state of Hesse in Germany. In the past few years, he has supported several concession award procedures that have led to the establishment of new grid owner companies in the central and southern parts of Germany. Depending on the aims and ideas of municipalities and the private energy company, different structures of grid owner companies have evolved. Moreover, these structures are influenced by different underlying business objectives, energy-economic policies,

financial agreements, accounting rules and other relevant factors, which can lead to highly complex cooperation models (Kunze, 2012).

During several founding processes, the researcher concluded that decisions on firm size, ownership structure and legal form play an important role for municipalities and private energy companies. On the one hand, these critical factors are regularly part of a company's founding process. On the other, German municipal law focuses on firm size, ownership structure and legal form of municipal companies and requires that economic activity or participation of the municipality must be particularly subject to the economic principle (sections 121 and 122 Hessian Municipal Code). However, the relationships between these factors and the financial performance of grid owner companies seem to be widely unresearched. Accordingly, it is difficult to recommend a particular structure of a grid owner company in order to meet the requirements of the municipal law. Furthermore, a comparison between different German grid owner companies is difficult as there is no register or compilation that comprises all grid owner companies with their characteristics yet. The fact that many recently renewed rights-of-way contracts between municipalities and private energy companies contain options to establish grid owner companies (Heim, 2015a) also inspires the researcher to gain a deeper understanding of the new phenomenon known as grid owner companies in Germany.

1.6 Purpose of the research

This research focuses on the new practical phenomenon known as grid owner companies in Germany from a financial and legal perspective. It aims to identify grid owner companies in Germany that were founded in the past few years and to analyse the impact of a grid owner company's firm size, ownership structure and legal form on firm performance, measured by the ROA, i.e. the return on assets ratio, by applying regression analysis.

Municipalities and private energy companies in Germany should be supported by financial analyses when they are faced with the strategic decision of whether they should renew their rights-of way contracts or they should establish a grid owner company. As large numbers of recently renewed rights-of-way contracts between municipalities and energy companies contain options to establish grid owner companies (Kunze, 2012), a quantitative aid to decision-making is needed. According to German municipal law, for example section 121 (1a) of the Hessian Municipal Code, economic activity or participation of the municipality must be particularly subject to the economic principle. Hence, profitability of grid owner companies is not only an important aspect for private energy companies, but also for municipalities. However, this research is not a normative, regulatory analysis with regard to the question of whether services of general interest should be provided by private or public suppliers. Furthermore, the thesis does not analyse the impact of financial performance or design of German grid owner companies on the consumer prices for electricity or gas as they are determined by the suppliers of energy.

The theoretical foundations as well as the empirical findings should be the basis for practical implications and recommendations. Beyond academic interest, the research on grid owner companies might provide municipalities, energy companies, business associations, research institutes, managers, consultants and policymakers with meaningful information on the new phenomenon.

1.7 Research objectives and research questions

The purpose of this research as described in the previous section may be translated into the following research objectives:

Research objective 1: To determine the population of German grid owner companies.

Research objective 2: To analyse the relationships between firm size, ownership structure and legal form as critical drivers of firm performance of grid owner companies in Germany.

Research objective 3: To recommend an optimal design for profitable German grid owner companies.

Corresponding to the research objectives above, the following research questions have to be addressed:

Research question 1: What is the population of German grid owner companies?

Research question 2: How do firm size, ownership structure and legal form affect the firm performance of German grid owner companies?

Research question 3: What is the optimal design for profitable grid owner companies in Germany?

The research on German grid owner companies has to be distinguished from the research on the so-called public-private partnerships. According to Boardman, Siemiatycki & Vining (2016), a public-private partnership is a long-term contract between a government agency and a consortium of private sector firms that comprises the provision of various project services and at least some private capital by the private sector partners. Comparable to a grid owner company, the private sector partners establish a special-purpose vehicle as a distinct legal entity to deliver the services and to limit the financial liability of the parent companies. In general, the private consortium is responsible for the construction, financing,

operation and maintenance of the new established infrastructure (Boardman et al., 2016). Whereas public-private partnerships are a worldwide phenomenon, grid owner companies are a typical German phenomenon in the context of rights-of-way contracts.

1.8 Significance of the thesis

Remunicipalisation of energy grids in the context of a rights-of-way award process is an extremely practice-relevant topic (Essing & Kürten, 2015). This thesis makes enormous contributions to the practical and theoretical research on German grid owner companies.

First, local distribution networks owned by grid owner companies and run by distribution network operators are important for all citizens, enterprises and institutions as they connect customers to the grids and ensure that the citizens, enterprises and institutions are provided with vital energies like electricity, gas or water. Whereas distribution network operators are responsible for maintenance, repair and service of grids, grid owner companies own distribution networks, connect new development areas and make investments in grids. This also comprises investments in new grid technologies like smart grids and electric vehicle charging stations. Thus, grid owner companies with their local distribution networks are an essential part of a citizen's everyday life in Germany and important for the development of technologies providing public services.

Second, the phenomenon of grid owner companies is of high financial importance for municipalities and energy companies. Municipalities in Germany charge a concession levy of about 6 billion euros and grid operators demand use-of-system charges of approximately 20 billion euros per year (Heim, 2015a). Often, a rights-of-way contract is awarded to a grid owner company by the municipality and the grids are leased to a grid operator. The lease payments of the grid operator usually represent the source of income of a grid owner company. Finally, the net income of a grid owner company is distributed to its shareholders or partners, namely municipalities and energy companies. In general, municipal budgets profit from the dividends of a grid owner company. The dividends of a grid owner company could contribute to the reduction of municipal budget deficits or they

could be offset with the losses of other municipal activities like public transportation, energy supply, port and airport (Rosenberger, 2012), and reduce the tax burden of the municipality (Wagner & Berlo, 2015). By its grid construction activities, provided by local companies, a grid owner company also contributes to regional added value. Furthermore, private or public energy companies profit from the dividends of a grid owner company. Although large numbers of energy companies as former concessionaires lost rights-of-way contracts in favour of grid owner companies (Berlo & Wagner, 2013b), they still benefit partially from the dividends paid by grid owner companies as shareholders or partners. Thus, energy companies stabilise their income and partially compensate for the profits from lost rights-of-way contracts.

Third, the phenomenon of grid owner companies is of high political importance for municipalities. They do not only benefit financially from the income of a grid owner company. They also regain control over their local infrastructure. Often, municipalities had lost control or general influence over their infrastructure and energy issues (Becker, 2017). Whereas energy companies as former concessionaires were responsible for the investment decisions on local distribution networks, municipalities regain influence on local infrastructure through the boards of grid owner companies. Besides, grid owner companies offer the possibility to better coordinate the maintenance and investment activities with the municipalities (Heim, 2015a).

Fourth, the research on grid owner companies is also driven by current policy debates. Local distribution networks are essential for the integration of renewable energies and other decentralised energy types such as electricity produced from combined heat and power units. The development of renewable energies and the atomic disaster in Fukushima in 2011 led to further political initiatives to phase out the use of nuclear energy, to increase the percentage of renewables in energy consumption and to remunicipalise energy activities (Becker, 2017). By the end of 2050, 80 percent of the German energy consumption should be provided by renewables (Bundesministerium für Wirtschaft und Technologie, 2013). More than 95 percent of the electricity produced by renewable energies is supplied by local grids and therefore a critical factor of success (Kinkel, 2014). Therefore, local distribution networks owned by grid owner companies are the backbone of a turna-

round in German energy policy towards sustainable energy systems (Wagner & Berlo, 2015).

Fifth, local grids owned by grid owner companies play an important role in the expansion of broadband supply in Germany. According to the German Act to facilitate the deployment of high-speed digital networks, grid owner companies generally have to install glass fibre optic cables when they invest in grids, especially when a new residential area is developed. By this, the available opportunities for synergies in broadband expansion are better used. Thus, local distribution networks owned by grid owner companies are not only the backbone of a turnaround in the German energy policy towards sustainable energy systems. They are also the backbone of a turnaround in the German broadband supply policy towards a nationwide broadband supply in Germany. Thus, the research is also interesting for policymakers in the telecommunications sector, the Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways, German telecommunication enterprises, and broadband customers.

To the researcher's best knowledge, this thesis is the first comprehensive theoretical and practical study that is solely dedicated to the new phenomenon of grid owner companies in Germany. It provides fundamental financial insights as no one has studied the financial aspects and causal relationships of German grid owner companies before. Whereas authors like Heim (2015a) and Tugendreich (2014) have described German grid owner companies, studied their legal foundations and compared different cooperation models, it is the first time that the financial dimension of German grid owner companies has been empirically researched. An empirical analysis is conducted that addresses the relationships between firm size, ownership structure, legal form and firm performance of German grid owner companies. Although for example the Hessian Municipal Law requires municipal participation by grid owner companies to adhere to the economic principle, no one before has analysed the influence of firm size, ownership structure and legal form on the financial performance of German grid owner companies.

By providing a new approach to study the phenomenon of German grid owner companies from a financial perspective, a new contribution to knowledge is made.

Narrative studies are brought together and empirical analyses on the financial performance with its critical drivers are carried out.

As German municipal law focuses on firm size, ownership structure and legal form of municipal companies and requires that economic activity or participation of the municipality must be particularly subject to the economic principle (sections 121 and 122 Hessian Municipal Code), the economic and financial situation of grid owner companies is of general interest. Hence, German municipal law requires that grid owner companies meet the economic principle. Thus, the financial performance of German grid owner companies seems to be worth investigating. Furthermore, the general understanding of German grid owner companies is widened.

Based on a systematic literature review, the underlying research is also driven by research gaps in the existing theoretical and empirical literature. In general, only a few authors have addressed grid owner companies as an object of research and the characteristics of existing grid owner companies. This is remarkable as grid owner companies have a considerable financial and political impact on municipalities, energy companies and other stakeholders. The existing contributions to the literature mainly focus on the legal framework of grid owner companies, the analysis of different cooperation models and the discussion of individual German grid owner companies. Despite the up-to-date nature and the financial dimension of the topic, the research on German grid owner companies is rather scant. First, the diverse population of German grid owner companies with its chronological emergence and geographical dissemination has not been determined yet. This also comprises the analysis of different legal forms of German grid owner companies. Second, although municipal law requires that grid owner companies meet the economic principle, for example sections 121 and 122 of the Hessian Municipal Code, financial aspects like the performance of German grid owner companies and their critical drivers have not been the subject of research yet. In this context, the relationship between different critical drivers and the firm performance of grid owner companies is of special interest. As the economic principle refers to high financial or economic performance, the critical drivers and causal relationships between these drivers and firm performance of German grid owner companies need further empirical investigation.

Furthermore, the findings of the thesis will not only be unique; they will also have significant practical and policy implications.

For the first time, the total population of German grid owner companies will be determined and data on important characteristics of grid owner companies will be gathered. This comprises federal state, legal form, date of foundation, divisions, balance sheet and profit and loss account items as well as other characteristics. Thus, the distribution and regional concentration of grid owner companies in Germany as well as comparisons between different types of grid owner companies are possible. According to German municipal law, for example section 121 (1a) of the Hessian Municipal Code, economic activity or participation of the municipality must be particularly subject to the economic principle. Hence, profitability of grid owner companies is not only an important aspect for private energy companies, but also for municipalities. As a violation of the economic principle might result in a violation of municipal law, the findings of the thesis are of high importance for municipalities and their supervisory authorities. Overall, the knowledge of the population of German grid owner companies facilitates further research on these companies.

The financial performance of grid owner companies is the object of the research. Especially, the relationships between critical drivers and financial performance of grid owner companies will be analysed by regression analyses. For the first time, statistical methods are applied to German grid owner companies. Based on the philosophical stance of positivism, for the first time an existing technique, namely multiple linear regression analysis using ordinary least squares, will be applied to sample data from 2010 to 2015 in order to analyse the relationships between the firm size, the ownership structure, the legal form and performance of German grid owner companies. Overall, an existing technique is applied to a new context and the applicability of regression techniques to the new phenomenon of German grid owner companies is shown.

Better and comprehensive information about the population as well as on the causes and effects with regard to the financial performance of grid owner companies are essential to municipalities when they are faced with the strategic decision of whether to renew their rights-of-way contracts or to establish a grid

owner company. As many recently renewed rights-of-way contracts between municipalities and energy companies contain options to establish grid owner companies (Kunze, 2012), a quantitative aid to decision-making of municipalities as well as energy companies will be made by regression analyses.

The knowledge of the population, their characteristics and the relationships between firm size, legal form, ownership structure and firm performance of German grid owner companies enable municipalities and energy companies to take well-informed decisions on the foundation and the design of grid owner companies. Through this thesis, they are provided with an analysis of the impacts of their choices of firm size, legal form and ownership structure on the financial performance of German grid owner companies. Moreover, the knowledge of critical drivers of firm performance of German grid owner companies facilitates the approval decisions of regulatory authorities. According to German municipal law, for example section 127a of the Hessian Municipal Code, municipalities have to submit their decisions on the establishment, the first-time participation as well as the substantial increase in participation in an enterprise to the supervision of local authorities. The written notification has to be made without delay no later than six weeks before the realisation. From the notification, the supervision of local authorities has to identify whether the relevant legal requirements have been met (section 127a Hessian Municipal Code). Therefore, the notification has to contain the relevant supporting documents, for example whether the requirements of sections 121 and 122 of the Hessian Municipal Code are met. As these sections require that economic activity or participation of the municipality must be particularly subject to the economic principle (sections 121 and 122 Hessian Municipal Code), the theoretical and empirical findings of this thesis may support municipalities in preparing the notification and demonstrating that the economic principle is met. Furthermore, it can be necessary to include decisions of municipal bodies, draft contracts or advisory opinions (Dietlein & Ogorek, 2018). Likewise, advisory opinions can be based on the findings of the thesis and finally supervision of local authorities can be convinced of the financial performance of relevant German grid owner companies. In general, the findings of the thesis will support legislators and supervision of local authorities in assessing whether a grid owner company meets the economic principle or not. By the ROA a valid measure of

financial performance is given and by the firm size, ownership structure and legal form three critical drivers or indicators are presented.

As an original contribution to knowledge, the findings of this thesis will also create transparency and reveal which models of German grid owner companies currently prevail. The chronological development of established grid owner companies is presented. Moreover, the geographical distribution of German grid owner companies shows which grid owner companies already exist in the respective region. This knowledge offers the possibility to think about cooperations with existing grid owner companies in order to establish large grid owner companies.

Beyond academic interest, the research on grid owner companies might provide municipalities, energy companies, business associations, research institutes, managers, consultants and policymakers with meaningful information on the new phenomenon. As the economic principle plays an important role with regard to grid owner companies, the question of what factors determine profitability might be one of high importance for researchers and practitioners like investors, managers, etc. In particular, municipalities that are faced with the strategic decision of whether they should renew their rights-of-way contracts or establish a grid owner company will profit from the findings. The research supports their decision-making processes. Furthermore, energy companies could profit from the findings of the thesis as they also adhere to the economic principle.

The thesis does not analyse the impact of financial performance or design of German grid owner companies on the consumer prices for electricity or gas as they are determined by the suppliers of energy. However, as the financial performance or design of German grid owner companies might influence the use-of-system charges and thus consumer prices, the findings of the thesis might be of interest for German consumers of electricity or gas supplied by local grids.

Overall, the thesis provides municipalities and energy companies with the necessary information to assess which model of grid owner company suits them best and what their financial impact is. Moreover, recommendations on the optimal design of grid owner companies are made.

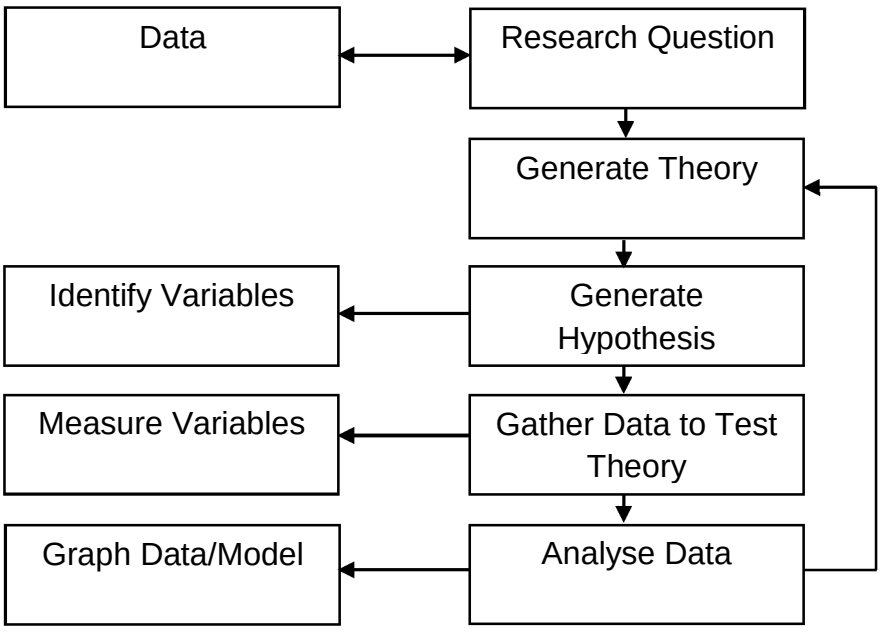
1.9 Structure of the thesis

This thesis is structured as follows:

Chapter 1 provides an introduction to the significant and practice-relevant topic of German grid owner companies combined with a contextualisation focusing on the economic and legal environment. The thesis is divided into four further chapters. Chapter 2 contains a systematic review of the existing literature on grid owner companies as well as on the relationships between firm size, ownership structure, legal form and firm performance. Moreover, the research hypotheses are derived. Chapter 3 is dedicated to the research methodology and the research methods. The most common research designs and research philosophies are discussed and the final research design is presented. Then, the chosen methods and types of data as well as the data gathering process and data analysis procedures are discussed. In Chapter 4, the empirical findings are reported and analysed. Based on the findings, chapter 5 offers a discussion of the essential findings and future research directions. This includes conclusions and recommendations on German grid owner companies.

In general, the research process is structured as follows (Field, 2013):

Figure 2: The research process



1.10 Summary

- As a consequence of the expiration of thousands of rights-of-way contracts in Germany, grid owner companies have become a new phenomenon in the German energy sector.

- Remunicipalisation of municipal energy grids in the context of a rights-of-way award process is an extremely practice-relevant topic.

- The financial performance and political impact of German grid owner companies is of high importance for municipalities, energy companies and other stakeholders.

- As more than 95 percent of the electricity produced by renewable energies is supplied with local grids, grid owner companies with their local distribution networks are the backbone of a turnaround in German energy policy towards sustainable energy systems.

- This thesis is the first comprehensive theoretical and practical study that is solely dedicated to the new phenomenon of grid owner companies in Germany and provides fundamental financial insights. No one has studied financial aspects and causal relationships of German grid owner companies before.

- Better and comprehensive information about the population as well as on the causes and effects of the financial performance of grid owner companies are essential to municipalities and energy companies and required by municipal law, too. This comprises the relationships between firm size, ownership structure, legal form and financial performance of German grid owner companies.

- The thesis provides municipalities and energy companies with the necessary information to assess which model of grid owner company suits them best and what the financial impacts are.

2. Literature Review and Hypothesis Development

2.1 Introduction

The following systematic literature review focuses on the new phenomenon known as grid owner companies in Germany. This chapter gives an account of the literature with regard to German grid owner companies, and is divided into two main parts. The first section discusses the phenomenon of grid owner companies. The second section turns to the concepts of firm size, ownership structure, legal form and firm performance. The focus is on the measurement of the influence of firm size, ownership structure and legal form on firm performance of German grid owner companies. Based on the findings in the literature, the research hypotheses are derived.

As many grid owner companies were only established within the last few years, the scientific endeavour of describing and analysing the phenomenon of grid owner companies is in its early stages. As with any new phenomenon, the first phase of research is often descriptive and seeking to categorise in some way. This literature review is a systematic, explicit and reproducible method for identifying, evaluating and interpreting the existing body of recorded work produced by researchers, scholars and practitioners (Fink, 2013).

At first glance, the systematic literature review appears to be more author-based than theme-based. On the one hand, the research on grid owner companies and in particular on the relationships between firm size, ownership structure and firm performance of German grid owner companies is new territory. Therefore, the systematic literature review mainly analyses narrative or descriptive work of the few authors who conduct research on grid owner companies in the context of remunicipalisation. On the other hand, the literature on firm performance and the relationships between several critical drivers and firm performance is manifold. However, no one has applied the concept of firm performance to German grid owner companies or researched the relationships between firm size, ownership structure and firm performance of German grid owner companies to date.

2.2 Aims

The aim of the following systematic literature review is to undertake a systematic review of academic and practice research from 2010 to 2019 on the new phenomenon known as grid owner companies as well as on the influence of firm size, ownership structure and legal form on firm performance in order to support municipalities and energy companies in their decision-making processes.

Overall, this systematic literature review shows that grid owner companies in Germany are already the subject of research by academics and practitioners, but rather from a narrative perspective and with regard to the advantages and disadvantages of the process of remunicipalisation of public services. However, there are neither official nor informal figures on how many German municipalities have actually gone the way of remunicipalisation or established a grid owner company (Heil, 2018).

Different types of grid owner companies have to be identified and their characteristics have to be analysed with regard to the decision-makers, i.e. municipalities and electricity or gas companies. This research will contribute to the understanding of the practical phenomenon grid owner companies from a general theoretical perspective. The author aims to find out whether and how German grid owner companies could become an attractive option for private energy companies and for municipalities, especially to resolve their financial problems.

2.3 Grid owner companies

2.3.1 Methodology of review

Searches were conducted on the following four online databases: Business Source Ultimate, Beck-Online, Google Scholar and SSRN.

Business Source Ultimate is a full-text database that contains the most important scholarly business journals. Beck-Online is a German legal expert database by C. H. Beck that is one of the oldest and most prestigious publishing houses in Germany (Verlag C. H. Beck, 2019).

In Google Scholar one can search for scholarly literature: “articles, theses, books, abstracts and court opinions, from academic publishers, professional societies, online repositories, universities and other web sites” (Google, 2019). According to its own statement, SSRN is a “multi-disciplinary online repository of scholarly research and related materials” (SSRN, 2019).

The searches were conducted over a period of about 5 years (from 10th November 2014 to 17th March 2019).

Due to the fact that a grid owner company is primarily a German phenomenon, the search terms are mixtures of English and German words.

In general, central key words which refer to the topic are:

- grid/grid owner company (German: Netz(eigentums)gesellschaft)
- public private partnership
- electricity/gas
- remunicipalisation (German: Rekommunalisierung)
- cooperation model (German: Kooperationsmodell)
- rights-of-way contract or concession contract (German: Konzessionsvertrag)

The search for the key word “public private partnership” alone was not conducted, because the literature with regard to that topic is manifold and grid owner companies in Germany are rather linked to the key word “concession contract”.

Several searches were carried out:

Key words: “Public Private Partnership” and “Netzgesellschaft”
Time: From 2010 to 2019
Results: 42 citations (Google Scholar), 0 citations (SSRN), 11 citations (Beck-Online)

Key words: “Netzgesellschaft” und “Konzession”
Time: From 2010 to 2019
Results: 107 citations (Google Scholar), 0 citations (SSRN), 484 (Beck-Online)

Key words: “Netzgesellschaft” und “Rekommunalisierung”
Time: From 2010 to 2019
Results: 76 citations (Google Scholar), 0 citations (SSRN), 113 (Beck-Online)

Key words: “Pachtmodell” und “Konzession”
Time: From 2010 to 2019
Results: 697 citations (Google Scholar), 0 citations (SSRN), 160 citations (Beck-Online)

Key words: “Remunicipalisation”
Time: From 2010 to 2019
Results: 12 citations (Business Source Ultimate), 6 citation (SSRN), 2 citations (Beck-Online)

The following inclusion and exclusion criteria were applied:

Table 1: Inclusion/Exclusion Criteria

Parameters	***Inclusion Criteria***	***Exclusion Criteria***
Location	Germany	Non-Germany
Time Frame	From 2010 to 2019	Before 2010
Outcome	Literature concerned with grid owner companies and remunicipalisation	Literature not concerned with grid owner companies and remunicipalisation
Study Type	Academic and practitioner literature	Newspaper articles, websites

The time frame from 2010 to 2019 is chosen, because before 2010 only a few rights-of-way contracts were phased out and only a few grid owner companies were established. Furthermore, literature that dates before 2010 often deals with the so-called unbundling of energy companies. The unbundling of energy companies is a legal requirement, but in most cases it is not linked to the phase out of rights-of-way contracts. So, it is not part of the research questions.

While empirical literature from studies undertaken within the last 10 years are generally accepted as current (Nenty, 2009), literature from classic and important studies in the area should also be reviewed.

Newspaper articles are excluded from the search, because they do not comply with general quality criteria of academic or practical literature.

In general, the relevance of a piece of literature to the review depends on the relevance of its research questions. The quality of its methodology is not an exclusion criterion, because otherwise the scope of literature would have been too narrow due to the fact that grid owner companies are a rather new phenomenon.

If a grid owner company was not a new phenomenon, a systematic literature review with regard to English literature would be carried out by the quality assessment criteria of the ABS journal ranking. In general, a quality assessment contributes to a high degree of reliability and validity in the findings. Furthermore, the following systematic literature review also focuses on German literature. The ABS journal ranking could not be applied, because it does not include German literature.

2.3.2 Critical analysis of literature

Menges and Müller-Kirchenbauer (2012) focus on the trend of going back to municipal utilities in the German energy system from an economic perspective. The remunicipalisation of energy companies is linked to the discussion of decision options for local authorities in Germany when concession contracts expire. After having explained the expression remunicipalisation and possible reasons for remunicipalisation, the authors analyse the economic effects of remunicipalisation activities. Their economic analysis shows that a general economic favourability of remunicipalisation does not exist. Remunicipalisation activities, for example the purchase of grids and their valuation, rather than cooperation models or grid owner companies are analysed. According to Menges and Müller-Kirchenbauer (2012), remunicipalisation in practice could be implemented by lots of different legal structures, characterised by the ownership structures and the degrees of independence. With regard to the economic aspects of remunicipalisation, Menges

and Müller-Kirchenbauer (2012) point out that the question of ownership structure of grids, i.e. whether a private, a public or a mixed ownership structure, has less relevance. From their perspective, the question of whether local government remunicipalises or not rather depends on the costs of operating the network and tariff regulation.

The analysis of Menges and Müller-Kirchenbauer (2012) mainly contains narrative arguments. By referring to several empirical studies and verbal arguments, they examine remunicipalisation activities and their contribution to welfare. Although the journal article deals with economic or welfare effects, it lacks calculations or figures. From the empirical studies, citied by Menges and Müller-Kirchenbauer (2012), just verbal arguments are taken, but no empirical data. Even with regard to their final statement that whether local government remunicipalises or not rather depends on the costs of operating the network and tariff regulation, no supportive data can be found.

But with regard to the content, the statement is comprehensible. The tariffs which are approved by the German Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways represent future cash inflows. The costs of operating the network are the payoffs. So, the decision on whether to remunicipalise or not could be modeled by the cash flows in a net present value or an equilibrium model. However, the statement of Menges and Müller-Kirchenbauer (2012) that the question of ownership structure has less relevance, neglects the owner's influence on the cash flows. Depending on the owner's investment decisions, cash inflows and cash outflows, for example administrative expenses, vary. In conclusion, Menges and Müller-Kirchenbauer (2012) primarily focus on remunicipalisation as an alternative to the renewal of concession contracts and as a basis for grid owner companies, but not on the grid owner company itself.

Arnold (2012) describes and analyses cooperation models in the context of concession contracts. Although Arnold (2012) states that lots of municipalities try to increase public revenues and to reduce their budget deficits by purchasing or managing energy grids, he does not analyse any economic effects of cooperation models. His focus is solely on legal aspects of cooperation models as an alternative to concession contracts. He shows the legal boundaries of cooperation

models. As a basis of his analysis, Arnold (2012) provides an overview of different cooperation models in practice and systematises them by the degree of cooperation, ranging from a legal cooperation to a joint venture. He distinguishes and evaluates the following forms of cooperation:

- Cooperation model: There is no joint company. Local government is or becomes the owner of an energy grid and rents it out to a private energy partner. In case the local government is not the owner of the grid yet, it has to purchase it from the former owner and it has to take the purchase price risk. The private energy partner operates the grid because it has got the relevant expert knowledge and manpower. Local government generates revenues from the lease payments. The lease payments are often based on a formula that transfers all risks, especially the operating risk, to the private energy company. Then, the return of local government is comparable to a financial investor. In practice, the lease payment formula refers to rates of return of the German Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways, either fixed or variable. According to Arnold (2012), the cooperation model is associated with the risk that either local government or a private partner tries to enforce its interests against the other cooperation partner, because there are no contractual agreements.

- Joint venture with a lease contract (= grid owner company case): Local government establishes a joint venture with a private energy company. The joint venture purchases the grid from the former owner or the private energy company as the former owner contributes it in kind in return for corporate rights. Then, a lease contract is signed between the grid owner company and the private energy company. Moreover, the private energy company becomes the new distribution network operator. Arnold (2012) is of the opinion that, similar to the cooperation model, local government remains a pure financial investor, because the private partner takes all the relevant risks as a distribution network operator. In reality, the statement of Arnold (2012) can be disproved. Although local government has transferred lots of risks to the private partner by the lease contract, it is charged with the risk of a real investor, because investments in the grids are financed either by

capital from both partners or by borrowed capital and decisions on the structure of the grid have to be made. Depending on the company agreement and its percentage of ownership, local government eventually profits from the revenues of the lease contract.

- Joint venture with a private partner and network operations: Local government and a private partner establish a company that receives the rights-of-way contract and operates the network, too. In this case, local government has the possibility to decide on local infrastructure and to profit from the net income as a shareholder of the company. Moreover, local government also bears the highest risks of all cooperation models, namely the owner risk and the regulatory risks of a distribution network operator in accordance with its percentage of ownership.

- Public utility: Local government establishes a public utility with different segments. Beyond the role of a grid owner and a distribution network operator, local government tries to establish further business segments like supply, generation, trading and other activities. Local government has the opportunity to establish a company alone or together with a private partner.

Having described different cooperation models, Arnold (2012) discusses several economic and legal decisions to be made with regard to cooperation models. First, he analyses the question of which partner provides which part of equity, depending on the legal structure of an agreement. He concludes that partnerships and private limited companies offer almost unlimited freedom of contract. Second, Arnold (2012) analyses the allocation of risks and chances between the partners. In general, the partners bear the risks and chances of cooperation according to their percentage of ownership. Nevertheless, an almost full release from risks is often found in practice by the provision of a fixed guaranteed or a minimum guaranteed rate of return on the equity for municipalities. The duration of the guarantee either depends on the duration of the lease contract or the period of regulation. Arnold (2012) makes clear that the provision of a fixed guaranteed or a minimum guaranteed rate of return is an important decision-making factor when municipalities have to make a decision on who becomes partner of a cooperation model. Unfortunately, the author solely describes without giving best practice

examples or calculations of different rates of return. Third, Arnold (2012) deals with the influence of both partners, i.e. the allocation of voting rights in different boards of a company, like shareholders' meeting, supervisory board, etc., and the rights to appoint management and board members. Whereas in Germany, shareholders of private limited companies are almost free in designing board structures, the German Stock Corporation Act is quite restrictive, because the voting rights are linked to the percentage of shares. The idea behind this is that the influence of a single partner should be in accordance with its percentage of ownership. Finally, Arnold (2012) states that in practice, local government often has the majority in boards of a joint venture, but is relieved of risks by the private partner. As before, he does not prove his arguments by statistical data, etc. While analysing cooperation models from a legal perspective, Arnold (2012) always refers to the arm's length principle, especially when discussing rates of return and the allocation of voting rights.

The practitioner Rosenberger (2012) deals with the tax aspects of rights-of-way contracts. He presents the tax effects of rights-of-way contracts in general. His emphasis is also on the foundation of grid owner companies by municipalities and private partners. Rosenberger (2012) examines different legal structures of grid owner companies, especially private limited companies and partnerships. According to him, the most important criteria with regard to the choice of the legal structure of a grid owner company are contingent liabilities, leadership opportunities, participation in net income and net loss, capital structure, tax effects and obligations to disclosure. Rosenberger's qualitative or narrative contribution belongs to the legal and tax literature. Concrete financial figures of practical examples of grid owner companies are lacking.

The narrative study of Chen (2012) has two primary purposes. Beginning with the statement that the supply of power is an important task of municipalities in Germany, it mainly focuses on possible forms of organisation of energy companies with municipal participation from a legal perspective. The author scrutinises the different laws and legal requirements, for example European law, energy law, etc., that are relevant for semi-municipal entities. Chen (2012) emphasises the municipal freedom of choice of the legal structure and discusses semi-municipal organisations with the legal structure "GmbH" (limited liability company) and "AG"

(public limited company). He also analyses the various duties as a distribution network operator and pricing requirements in the energy sector. Due to the fact that Chen's work is a doctorate in law, financial aspects are hardly addressed. Neither grid owner companies nor their financial aspects are part of Chen's work. However, grid owner companies could belong to the category of semi-municipal entities. So, they could also have legal structures like private limited companies or public limited companies and at least the results of Chen's doctoral thesis concerning legal structures could be applied to grid owner companies. Finally, financial data or even key figures of companies, especially grid owner companies, are missing.

In his narrative work, Kunze (2012) analyses the fundamental options for local authorities when they are faced with the situation that their rights-of-way contracts will phase out. The focus of his work is on the aims of municipal activity and he also addresses the potential risks that are associated with municipal engagement. Kunze (2012) makes clear that the decision is not a Boolean operator. In fact, there are many forms of cooperation which are associated with different risks and chances. On the one hand, municipalities could sign a rights-of-way contract with the former distribution network operator and on the other, local authorities could find a new distribution network operator. Furthermore, the author presents three common basic cooperation models:

a) Joint venture with a private partner and network operations: Local government and a private partner found a company that receives the rights-of-way contract and operates the network, too. In this case, local government has the possibility to decide on local infrastructure and to profit from the net income as a shareholder of the company.

b) Joint venture with a private partner, but without network operations: Local government and a private partner found a company that receives the rights-of-way contract, but does not operate the network. The network is operated by a third company. Compared to a), local government has less possibility to decide on local infrastructure and to profit from the net income as an owner of the company.

c) Joint venture with a lease contract (= grid owner company case): Local government founds a company together with an energy company. These companies have primarily an ownership function. The net assets are sold from the previous grid operator or grid owner to the new grid owner company and then the grid operator leases them back. Compared to the other models above, in the case of a grid owner company, municipalities are faced with the lowest risk. As far as the lease payment is more than the total costs of the company, the net income is positive and municipalities can benefit from the company's payout.

Kunze (2012) points out that the power of influence of the distribution network operator on the energy price is very low. The price consists of different components. According to Kunze (2012), generation and distribution amount to 38 percent, net cost is about 24 percent and the remaining 38 percent are taxes. The distribution network operator can only affect the network costs. Although Kunze (2012) uses a theoretical or narrative method to analyse the fundamental cooperation models, he does not refer to any empirical grid owner company. So, his work remains a conceptual description of possible models. Neither financial data nor economic effects of grid owner companies are discussed.

After having presented the basics of local energy supply and developed arguments for the municipalisation of grids, the study of Meyer-Gohde et al. (2013) examines the financial consequences of remunicipalisation measures in the German electricity sector. According to the authors, the grid-connect electricity sector has got the largest potential for remunicipalisation, because it is a profitable sector, and there was a significant increase in privatisation in the past. Moreover, Meyer-Gohde et al. (2013) present two case studies of remunicipalisation: the public utility in Umkirch (GWU) and the public utility in Landsberg. They have gathered their data using interviews. Unfortunately, they do not mention who has been interviewed or how many people. In this context, difficulties in determining the purchase price of grids are discussed. Besides, the authors empirically analyse the cost structure of utilities. Although grid owner companies are not part of their work, they identified critical aspects which can be applied to grid owner companies, too. According to Meyer-Gohde et al. (2013), the most important risk can be seen in determining the purchase price of a grid. They show that an

incorrect price determination means a long-term financial burden to local government. However, a fair purchase price could lead to a positive contribution to the budgets of municipalities. So, they emphasise the financial risks associated with a remunicipalisation. Grid owner companies often purchase grids from the former energy company. The purchase has to be financed by equity or debt that has to be provided by the owners or third parties like banks.

Hall et al. (2013) pay attention to the resurgence of public ownership in municipal service delivery. The focus of their article is on the interplay between the political and economic determinants of policy change in public service provision by especially analysing the remunicipalisation of energy operations in Germany from 2000 to 2012. They discuss political and economic factors supporting the trend towards remunicipalisation. In this context, they distinguish between the implications for practice and theory. Two important aspects of the development are greater efficiency of public sector provision, and greater degree of control over the effective achievement of public policy objectives (Hall et al., 2013). In conclusion, they do not refer to grid owner companies as a new phenomenon. They rather analyse remunicipalisation as a new trend from a macroeconomic perspective. So, neither organisational structures nor financial data of grid owner companies has been analysed in their work.

In an empirical survey, Berlo and Wagner (2013a) take stock of the new foundation of public utilities in Germany during 2005 and 2012 by analysing different characteristics, e.g. place, legal structure or ownership structure. The survey is added to by interviews of six experts from academia or practice. The also evaluate how the aims of the foundations can be reached. To show how opponents of the foundation of new public utilities act, they give the example of the foundation of the grid owner company “Münsterland Netzgesellschaft GmbH & Co. KG”. As in the academic work described above, the focus is not an accounting or financial one.

In another short study, Berlo and Wagner (2013b) deal with the strategies of private energy companies when they are faced with expiring concession contracts. They emphasise that municipalities could better pursue their political and financial interests in their energy engagements when they are partner of a grid owner

company or a distribution network operator. Because of the profits from network operations, it seems better than awarding the concession for twenty years to a private energy company. Due to the fact that concession contracts have to be renewed every twenty years, municipalities often do not have the necessary knowledge and experience. So, they need economic and legal advice. According to Berlo and Wagner (2013b), large national energy companies apply special methods and strategies to maintain concession contracts and prevent municipalities from founding their own companies. Berlo and Wagner (2013b) analyse several examples, but they do not explicitly refer to grid owner companies.

The narrative article of Michaels and Kohler (2013) is a commentary on the judgment of the provincial high court of Düsseldorf in Germany (Oberlandesgericht Düsseldorf, 2013). The decision of the provincial high court refers to the foundation of a public-private cooperation in the form of a grid owner company before the granting of a concession. The foundation of a grid owner company is not affected by public procurement law. However, the decision of the court has little relevance to the financial analysis of grid owner companies.

In their guide to financing distribution networks, DStGB et al. (2013) deal with the financing of takeovers of distribution networks in the context of remunicipalisation. Among a variety of financing models, the financing of grid owner companies is also part of the analysis. According to DStGB et al. (2013), the financing of grid owner companies is manifold. With regard to debt, a grid owner company has the possibility to take out a loan from a bank, from the partners or shareholders or from a third party. It could be a corporate or a project financing. Among other things, economic conditions and risk allocation determine the design of financing. The more risks investors are exposed to, the more the expected return on capital provision. Due to the regulatory requirements, the equity of a grid owner company usually amounts to 40 percent of the earnings value of the grid. The other 60 percent is debt (DStGB et al., 2013). As the focus of this thesis is not on the financing structures of grid owner companies, the statements of the authors do not become part of the analysis.

Based on the theoretical work of Kunze (2012) and others, Kinkel (2014) analyses the process of remunicipalisation of energy supply in North-Hesse in Germany and characterises the involved challenges for municipalities. The author uses 12 expert interviews. The method grounded theory has been used to analyse the gathered data. Referring to Kunze (2012), Kinkel (2014) also describes the different options of a municipality to cope with the end of the rights-of-way contract:

- Renewal of the rights-of-way contract with the former distribution network operator
- New contract with a new distribution network operator without municipal participation
- New contract with a new distribution network operator and municipal participation

Furthermore, she also presents the basic models of cooperation. Concerning a joint venture with a lease contract, she states in accordance with Kunze (2012) that in a grid owner company political influence and net income is least, because the grid operation is provided by a grid operator company (Kinkel, 2014).

With regard to practice, Kinkel (2014) investigates the examples of three public utilities in North-Hesse in Germany. She explores how the process of remunicipalisation can be designed and to what extent subordinate processes are linked to certain challenges. Neither grid owner companies nor financial or accounting figures are emphasised by her. In conclusion, the focus of her work is on the remunicipalisation of public utilities.

In her journal article that focuses on the legal context, Tugendreich (2014) gives an overview of different models of cooperation or strategic partnerships with regard to the renewal of rights-of-way contracts. She states that there are no general legal requirements concerning the form of cooperation between local government and a private partner. Moreover, lots of different ways of cooperation exist, depending on the degree of involvement of the private and public partner. For example, minority interest of municipal government, minority interest of the private partner, 50:50 or silent partnership. According to her, there could be a wide spectrum from just a contract of business or technical services up to a partial ownership.

Tugendreich (2014) distinguishes between the following models of cooperation:

- Management Model: Local government founds its own public legal entity and receives the rights-of-way contract. A private partner only provides business or technical services for the public legal entity and its energy grid.
- Rental Model: A private partner rents the local grid from the public company that is owned by the local government and he also assumes the rights and duties of the rights-of-way contract.
- Joint venture: Local government founds a company, either alone and then sells the shares or together with a private partner. The percentage of ownership of the local government and the private partner is manifold. The joint venture is also the distribution network operator.
- Joint venture with a lease contract (= grid owner company case): Local government founds a company together with an energy company. These companies primarily have an ownership function. The net assets are sold from the previous grid operator or grid owner to the new grid owner company and then the grid operator leases them back. Compared to the other models above, in the case of a grid owner company, the municipality is faced with the lowest risk. As far as the lease payment is more than the total costs of the company, the net income is positive and the municipality can benefit from the company's payout.

In his narrative bachelor thesis, Busshardt (2014) analyses the remunicipalisation of public services in countries of the Organisation for Economic Co-operation and Development. He found various underlying causes and a varying degree of involvement of citizens and municipal government. The construction of an analytically reduced property space of the dimensions "cause" and "actor" has been his primary contribution to research. Neither the organisation nor the effects of grid owner companies are central topics of his work.

Meier (2014) examines the value of energy grids when local government does not renew a concession contract with the former concessionaire and the new concessionaire has to buy the grid. The value of an energy grid and hence the

purchase price is not legally defined and is highly controversial. Meier (2014) analyses the impact of legal norm interpretations on the valuation of energy grids. Having established a theoretical framework, he shows empirical examples of valuations and applies his theoretical framework to those practical examples. The foundation of grid owner companies is also associated with the purchase of grids. In his doctoral thesis, Meier (2014) does not explicitly focus on grid owner companies when determining the value of grids from a legal perspective.

In his pioneering doctoral thesis in the field of legal studies, Heim (2015a) presents and analyses the legal requirements of corporate, energy and municipal law as well as the legislation on pricing when municipalities are faced with the strategic decision to whom they should grant the concession contract. Heim (2015a) emphasises that the aim of the current wave on concession award processes is no longer to find a potential distribution network operator, but rather to grant the rights-of-way contract to a cooperation company with the municipality as majority shareholder and an experienced private energy company as strategic partner. The choice of the private energy company as strategic partner is often based on the draft contracts of the private energy company, comprising drafts of the rights-of-way contract, shareholders' agreement, consortium agreement, lease contract and if necessary loan agreement (Heim, 2015a). Different types of cooperation models are examined, in particular with regard to the requirements of corporate and municipal law: cooperation models of municipalities with their own municipal utilities but without their own electricity or gas grid, cooperation models of municipalities without their own municipal utilities and cooperation models of more than one municipality without their own municipal utilities. In this context, cooperation models in the form of grid owner companies are also part of his work. He describes the establishment of a grid owner company as follows: The grid owner company purchases the grid from the former concessionaire and leases the grid to the private energy company. The private energy company operates the grid, levies the use-of-system charges, and pays the concession levy to the municipality as well as the lease fee to the grid owner company (Heim, 2015a). Heim (2015a) points out that grid owner companies are the preferred alternative of all available cooperation models. First, the management model is subject to procurement law and requires a European-wide tender process. Second, the grid

owner company is advantageous for municipalities as the risk of profitability is often transferred to the distribution network operator by contract (Heim, 2015a).

As the focus of Heim's thesis is on legal aspects, several legal characteristics of grid owner companies are analysed. From the legal perspective, the establishment of a grid owner company is combined with a series of contractual arrangements.

At first, the consortium agreement is discussed. The consortium agreement is the fundamental basis of the cooperation between the private energy company and the municipality. In general, the municipality and the private energy company intend to work together in the field of energy and to guarantee a safe, inexpensive, consumer-friendly, efficient and ecologically harmless public supply of electricity and gas according to section 1 of the German Energy Industry Act. In most cases, the consortium agreement contains assignments, duties and additional services of the parties. They must mutually assent to the proposed objectives and make all efforts to achieve them. The influence of the municipality on the grid owner company is ensured by the right to determine the members of the shareholders' meeting and the supervisory board (Heim, 2015a). Moreover, the following objectives are prevalent in consortium agreements of German grid owner companies (Heim, 2015a):

- profitability of the grid owner company and the highest possible concession levy
- security of energy supply
- support of clean technologies
- tax-optimised and legally compliant company structures

With regard to the cooperation of different municipalities that intend to work together in the field of energy, the establishment of a municipal holding company is presented. To cooperate with the municipal holding company, the private energy company as a cooperation partner often sets up a grid owner company. In the consortium agreement, the private energy company usually offers call options: a call option with the possibility to purchase 51 percent of the shareholders' equity of the grid owner company. In most cases, the call option is temporarily restricted, for example five years (Heim, 2015a).

Financial structures could also be part of the consortium agreement. Normally, the grid owner company purchases the grid from the former concessionaire. The grid owner company enters into an agreement with the municipality and has the exclusive right to purchase the grid from the former concession holder according to section 46 (2) of the German Energy Industry Act. The purchase of the grid is often financed by 40 percent of equity and 60 percent of debt as the German regulatory system permits an equity ratio of a maximum 40 percent (section 6 Electricity and Gas Network Charges Ordinances). In most cases, the municipality and the private energy company commit to a capital increase according to their share of equity. In addition, the consortium agreement often contains a fixed guaranteed or a minimum guaranteed rate of return on the equity for the municipality. In case the net income of the grid owner company is not sufficient to pay the return, the private energy company is forced to pay it from its own capital (Heim, 2015a).

Second, the company agreement of a grid owner company is discussed. In general, it contains the nature and purpose of a grid owner company, namely the acquisition, development, installation, extension, renewal, operation and use of grids and other facilities to store and distribute energy. According to municipal law, a public purpose must be fulfilled. Furthermore, the grid owner company is authorised to participate in other companies. The amount of share capital is variable. The disposal of shares needs approval at the shareholders' meeting. Payments of the shareholders that exceed the company's share capital become part of the company's reserves. In most cases, the number of members of the shareholders' meeting, responsible for the fundamental decisions of the grid owner company, is unequal and depends on the share of equity. The mayor is often a designated member of the shareholders' meeting. The municipal members of the shareholders' meeting have to pursue interests of the municipality (Heim, 2015a).

Depending on the legal structure of a grid owner company, a mandatory or voluntary supervisory board is installed. The terms of the members of the supervisory board often correspond to the terms of the members of the municipal council. In most cases, the number of members of the supervisory board is often unequal and determined by the share of ownership. By virtue of his office, the mayor is usually a member of the supervisory board. The supervisory board is

responsible for issues of fundamental significance for a grid owner company, for example:

- Defining and changing the rules of order for the board of management and the supervisory board
- Supervising and advising the board of management
- Approval of the annual company planning
- Reviewing the annual financial statements
- Election of the auditor of the financial statements
- Proposal for the shareholders' meeting concerning the appropriation of net income

A synchronisation of the consortium agreement and the company agreement is required. This means that the sale of company shares to a third party is not possible without obliging the buyer to become party of the consortium agreement (Heim, 2015a).

Third, the payment for use of the grid is subject to a lease contract between the private energy company as distribution network operator and the grid owner company. The lease of the grid to the private energy company at a rent based on the cost of capital transfers the risk of decreasing use-of-system charges and high repairs and maintenance expenses to the private energy company. With the lease of the grid at a rent based on the cost of capital to the private energy and a regulatory optimised equity structure, the grid owner company has a stable and predictable profit situation. Moreover, the maintenance obligation is transferred by the lease contract to the private energy company as the lessee (Heim, 2015a).
In general, in a grid owner company the business and technical management of the grids are performed by the private energy company. As a management contract is subject to a European call for tenders, a lease contract between the private energy company and the grid owner company has become the preferred option. Furthermore, a lease contract is often less risky than a management contract, because the parties often agree upon lease payments that do not depend on use-of-system charges, but rather on the value of the grid (Heim, 2015a).

Concerning the research questions, Heim (2015a) presents two remarkable statements.

First, preferred legal forms for cooperation models comprising grid owner companies are limited liability companies or limited commercial partnerships with limited liability companies as general partners and a municipal majority shareholding with a cooperation partner as a minority shareholder (Heim, 2015a). As Heim's thesis belongs to the field of legal studies, no empirical evidence is given. It rather seems to be a statement in view of his professional practice. He also emphasises that the liability of municipalities in the case of public corporations cannot be restricted and that the legal form of a public limited company is not chosen due to high foundation expenses (Heim, 2015a). According to Heim (2015a), cooperation models generally consist of more than one shareholder or partner, the municipality and a private energy company as a strategic cooperation partner. Compared to the operation model, a grid owner company, designed as a typical lease model, is the preferred cooperation model by municipalities and private energy companies. In contrast to the operation model, a grid owner company is not subject to a Europe-wide tendering-process. Moreover, the grid owner company is more advantageous for municipalities as the risk of profitability of network operation and the maintenance costs are shifted to the private energy company. The private energy company as the official distribution network operator receives the use-of-system charges from the customers, but the lease payment is often based on the value of the grid (Heim, 2015a).

Second, Heim (2015a) also comes to the conclusion that the establishment of individual grid owner companies all over Germany leads to higher network charges due to the fixed costs of the individual grid owner companies. As section 1 of the German Energy Industry Act seeks to ensure the reasonably-priced public supply of electricity and gas, Heim (2015a) concludes that a minimum size of local grids is required and can be achieved by large grid owner companies consisting of the local grids of several municipalities.

With their practice-oriented manual, the German Association of Towns and Municipalities supports municipalities that are faced with the decision of how they

should deal with the expiration of their rights-of-way contracts (DStGB, 2017). As rights-of-way contracts in Germany have long durations, the concession award process is of high importance for municipalities. The authors point out that municipalities have the opportunity either to conduct a conventional concession-granting process or to establish a cooperation model in order to remunicipalise local grids. They emphasise that the establishment of a cooperation model between the municipality and a private energy company is often the basis for a successful cooperation and the cooperation model itself becomes part of the concession award process. In general, the joint venture could be either established by the municipality and the private energy company together or one partner sets up the company alone and then the other partner joins the company (DStGB, 2017).

After the cooperation company takes over the energy grid, the mode of operation of the grid, if applicable together with a private energy company, has to be determined. In their booklet, the German Association of Towns and Municipalities distinguishes and analyses four basic concepts of energy grid operation in Germany. Among other aspects, the focus of the analysis is on the distribution of control and risks of the models (DStGB, 2017):

- Large distribution network operator model: The basis for this model is a cooperation company that is established by the municipality and a private energy company. After having concluded a contract with the municipality, the cooperation company purchases the local grid and hires personnel to operate it. As the cooperation company becomes distribution network operator, it is exposed to the risks of incentive regulation. In contrast to other cooperation models, there is no supply and service relationship with the private energy company that is only party of the consortium agreement.

- Management model: The management model is based on the large distribution network operator model. In contrast to that model, the cooperation company enters into an operating agreement with a third party. In most cases, the operating agreement is concluded with the cooperation partner, i.e. a private energy company that takes over the management and decision-making power of the cooperation company. In general, the

operating agreement comprises business and technical services. For example, accounting and tax services as well as planning, construction and operation of grid assets. The operator operates the grid on behalf of the cooperation company, which remains distribution network operator and exposed to the risk of incentive regulation. In order to operate the grid, the cooperation company hires personnel that are left to the operator or the operator's own employees are used.

- Service model: Again, the service model is based on a cooperation company that is established by a municipality and a private energy company. After having concluded a contract with the municipality, the cooperation company purchases the local grid, but usually hires no personnel to operate it. On the contrary, services concerning the technical network operations and metering as well as administrative and financial functions are carried out by the private energy company based on service agreements. The cooperation company becomes distribution network operator and exposed to the risk of incentive regulation. In contrast to the management model, the private energy company is not responsible for the achievement of the company's objectives. Depending on the volume of the service agreement, it is subject to procurement law and to a tender process.

- Lease model: The basis for this model is also a cooperation company that is established by a municipality and a private energy company. After having concluded a concession contract with the municipality, the cooperation company purchases the local grid and leases it to the private energy company or a third party. The concession is awarded to the grid owner company. The private energy company is both leaseholder and distribution network operator. Different types of the lease model can be distinguished, especially the pure lease model and the lease model with special services.

- Pure lease model: The pure lease model is a synonym for a classical grid owner company. The cooperation company without any of their own personnel leases the grid to the private energy company that is the distribution network operator at the same time. By the lease contract, the cooperation company transfers the rights and obligations of the rights-of-

way contract and of the grid to the leaseholder. In return for the transfer, the cooperation company receives a lease payment that reflects the underlying risk distribution and represents the turnover. The lease agreement is not subject to procurement law.

- Lease model with special services: The lease model with special services is a combination of the pure lease model and the service model. In contrast to the pure lease model, the municipality and the cooperation company are more involved in the operation of the grid. The private energy company becomes distribution network operator, but the cooperation company also provides services. Over time, the employees of the cooperation company get trained and acquire more and more know-how in order to operate the grid.

The German Association of Towns and Municipalities systematically distinguishes and describes the different cooperation models with their characteristics. However, the advantages and disadvantages of the cooperation models, especially of grid owner companies, are not part of their analyses (DStGB, 2017). For example, advantages of lease models consist of safe and steady revenues that result from lease payments without bearing the economic risks of the network operation (Schäfer, 2017).

Concerning the influence of the municipality on local infrastructure, the authors recommend a cooperation model wherein the municipality gains the majority of shares. Furthermore, the option of the municipality to increase its participation quota gradually during the duration of the rights-of-way contract is presented. According to the German Association of Towns and Municipalities, the option offers the advantage of observing the development of the cooperation company before the decision on participation (DStGB, 2017).

Moreover, the authors also point out that all private legal forms that are permitted by German municipal law could be suitable for a cooperation company. In particular, it is mentioned that the limited partnership with a limited liability company as general partner would be preferred by the founders (DStGB, 2017). However, no explanation for this statement, i.e. why the limited partnership with a

limited liability company as general partner seems to be the most preferred legal form, is given. Overall, the statements of the authors are in the form of narratives and no financial analyses on grid owner companies, especially with regard to the relationship between firm size, ownership structure, legal forms and firm performance, are carried out.

Although the focus of the relevant part in the legal commentary of Theobald and Templin (2018) is on the legitimacy of payments and also on the risks and chances of participation, they describe the necessary contracts with regard to cooperation models of grid owner companies. First, a consortium agreement is needed as a basis for the cooperation between the local government and the private partner. Second, a company agreement is required to found the company. And third, a lease contract between the grid owner company and the private partner is common. According to Theobald and Templin (2018), the whole contract design depends on the results of the negotiation between the local government and the private partner.

Table 2: Summary of analysed literature on grid owner companies

Authors	Aim	Data Gathering	Method	Region	Outcome
Menges & Müller-Kirchen-bauer (2012)	Economic analysis of remunici-palisation activities	No empirical data	Narrative	Germany	Remunici-palisation depends on the cost of operation and tariff regulation
Arnold (2012)	Legal aspects of cooperation models	No empirical data	Narrative	Germany	All activities have to be in accordance with the arm's length principle
Rosenberger (2012)	Tax aspects of rights-of-way contracts	No empirical data	Narrative	Germany	Individual choice, depending on the tax effects
Chen (2012)	Legal analysis of organisatio-nal structures of energy companies	No empirical data	Narrative	Germany	Compli-ance with legal require-ments is necessary
Kunze (2012)	Analysis of fundamental options for municipalities when faced with the phase out of rights-of-way contracts	No empirical data	Narrative	Germany	A thorough analysis of risks and chances for municipalities is needed
Meyer-Gohde et al. (2013)	Analysis of financial conse-quences of remunici-palisation measures in the German electricity sector	Two examples of remunici-palisation activities	Narrative	Germany	Incorrect price determination means long-term financial burden to local govern-ment
Hall et al. (2013)	Analysis of the remunicipali-sation of energy operations in Germany and water	Data of new and remunici-palised energy utilities in Germany,	Quantita-tive	France/ Germany	Existence of a strong trend in France and Germany towards remunici-palisation of

	operations in France	2007-2012			water and energy services
Berlo & Wagner (2013a)	Taking stock of the new foundation of public utilities in Germany during 2005-2012; evaluation of the aims of foundation	Secon-dary data; different sources	Quanti-tative	Germany	72 new public utilities have been established; diverse recom-mendations
Berlo & Wagner (2013b)	Strategies of private energy companies when they are faced with expiring concession contracts	No empirical data	Narrative	Germany	Several avoiding strategies were identified
Michaels & Kohler (2013)	Commentary on the judgment of the provincial high court of Düsseldorf	No empirical data	Narrative	Germany	The foundation of a grid owner company is not affected by public procurement law
DStGB et al. (2013)	Supporting municipalities faced with the financing of grids in the context of remu-nicipalisation	No empirical data	Narrative	Germany	Several financing options discussed
Kinkel (2014)	To analyse the process of remunici-palisation of energy supply in North-Hesse and charac-terise the involved challenges for municipalities	12 expert interviews; applica-tion of grounded theory	Qualitati-ve	Germany	Thorough analysis of risks and chances of remunici-palisation
Tugendreich (2014)	Legal analysis of different cooperation models	No empirical data	Narrative	Germany	Compliance with legal requirements is necessary

Busshardt (2014)	Analysis of remunicipalisation activities	No empirical data	Narrative	Countries of the Organisation for Economic Co-operation and Development	Construction of an analytically reduced property space of the dimensions “cause” and “actor”
Meier (2014)	Legally compliant valuation of energy grids	Empirical data	Stage model (social research)	Germany	Deviations from the objectified capitalised earnings value
Heim (2015a)	Legal analysis of different cooperation models with regard to the requirements according to municipal, corporate and energy law as well as the legislation on prices	No empirical data	Narrative	Germany	Minimum size of local grids recommended due to fixed costs; preferred legal forms are limited liability companies or limited liability partnerships with limited liability companies as general partners and a municipal majority shareholding
DStGB (2017)	Supporting municipalities in their concession award decision	No empirical data	Narrative	Germany /Europe	Presentation of different cooperation models with their characteristics
Theobald & Templin (2018)	Description of the necessary contracts with regard to cooperation models	No empirical data	Narrative	Germany /Europe	Contract design depends on the results of the negotiation between parties

2.4 Critical drivers of firm performance

2.4.1 Firm performance

In general, the literature on firm performance is very wide-ranging. As firm performance is a concept, several proxies or measures are found in the literature. In this thesis, the terms “firm performance” and “firm profitability” are used synonymously. In most cases, firm performance is measured by the financial ratio Return on Assets (ROA) with slightly different denominators and numerators (Asimakopoulos, Samitas, & Papadogonas, 2009; Goddard, Tavakoli, & Wilson, 2005; Lazăr, 2016b; Nunes & Serrasqueiro, 2015; Yazdanfar, 2013). Moreover, other measures of firm performance are used. For example, share value (Makhija, 2003), gross profits-to-sales ratio (Brown & Brown, 2001), net income plus advertising expenses to total assets ratio (Lee, 2009), ratio of pre-tax profit plus interest paid to total assets (Goddard et al., 2005) or net income over total assets (Gschwandtner, 2005).

Although there is a large body of literature on firm performance, the literature on the critical drivers or determinants of firm performance is even larger. From the theoretical perspective, three main categories of critical drivers of firm performance can be distinguished: firm-specific characteristics, industry variables and market-related variables. Depending on the emphasis of these categories, the following theoretical approaches on firm performance have been established: structure-conduct-performance (SCP), market-based view (MBV), strategy-structure-performance (SSP), organisation-environment-structure-performance (OESP) and resource-based view (RBV) (Yazdanfar, 2013). First, the market-based view refers to a firm’s external environment and market characteristics, i.e. external variables. Geroski and Masson (1987), Grinstein (2008) and Porter (1979) are known representatives of this theoretical perspective. Second, there is the resource-based view that focuses on firm-specific resources, i.e. internal variables, and their influence on firm performance. Barney (1991), Day (2011) and Peteraf (1993) are important authors of the resource-based approach of firm performance (Lazăr, 2016b; Yazdanfar, 2013). Resources of the firm can be classified into three categories, namely physical capital resources (tangible and intangible assets, etc.), human capital resources (information, knowledge, qualification, etc.) and

organisational capital resources (processes, etc.) in order to improve their performance in terms of efficiency and effectiveness. By accessing and organising a range of resources, firms can gain competitive advantages and higher profitability (Barney, 1991; Daft, 1983; Lazăr, 2016b; Wernerfelt, 1984; Yazdanfar, 2013).

In the literature, a variety of critical drivers and their influence on firm performance have been identified and investigated in empirical studies concerning diverse industry sectors, countries and periods. Two major streams of studies can be distinguished. On the one hand, there are empirical studies that focus on internal determinants, for example critical drivers that are determined by management decisions. On the other hand, there are empirical studies that focus on external determinants, for example the market and economic environment of the firm (Yazdanfar, 2013). Typical examples of critical drivers of firm performance are firm size, leverage, sales growth, investments and current assets (Asimakopoulos et al., 2009), liquidity, tangibility, growth (Nunes, Serrasqueiro, & Sequeira, 2009), market share, capital intensity, advertising and research and development intensities, bad debt ratio, inventory (Lee, 2009), age, productivity and industry affiliation (Yazdanfar, 2013), net working capital, assets mix and firm location (Crespo & Clark, 2012). Overall, the impacts of these determinants on firm performance are ambiguous (Lazăr, 2016b) and do not clearly indicate which critical drivers are most significant with regard to firm performance (Pratheepan, 2014). For empirical research, cross-sectional and times-series oriented studies on firm performance can be distinguished (Lee, 2009).

As the scope of any study is limited by the objective, theoretical framework, and data availability (Yazdanfar, 2013), the literature review should focus on recent and relevant empirical studies that deal with the relationships between firm size, ownership structure, legal form and firm performance. These are possible critical drivers of firm performance of German grid owner companies for which public data should be available. Furthermore, as there is no market for grid owner companies as a natural monopoly, the focus of the research will be on the resource-based approach of firm performance. Despite the importance of grid owner companies in Germany, to the knowledge of the researcher, no study has dealt with the firm performance of German grid owner companies.

As only phenomena confirmed by the senses can be warranted as knowledge (principle of phenomenalism), concepts have to be translated into measures (Bryman & Bell, 2011). According to Bryman and Bell (2011, p. 153) “concepts are the building blocks of theory and represent the points around which business research is conducted”. Once they are measured, concepts can be in the form of independent and dependent variables, i.e. concepts may provide an explanation of certain aspects of the social world (Bryman & Bell, 2011).

The performance of grid owner companies in Germany represents a concept. As firm performance is not directly quantifiable, an indicator is needed in order to provide a measure of the concept (Bryman & Bell, 2011). The key figures used in research on measurement of performance impacts are Tobin’s Q and return figures like ROA or ROE (Asimakopoulos et al., 2009; Fessler, 2013; Goddard et al., 2005; Yazdanfar, 2013); moreover, profit-cost-margin (McDonald, 1999) or net income plus advertising expenses to assets ratio (Lee, 2009).

Demsetz and Villalonga (2001) point out that accounting performance is an appropriate indicator for firm performance, because the results of accounting performance reflect management actions. Market performance, however, depends much on investor expectations. Tobin’s Q is a well-known proxy to measure firm or market performance and takes into account the future development of the firm (Boonyawat, 2013). It is calculated as the ratio of the market value of the firm to the replacement value of assets (Tobin, 1978). As grid owner companies in Germany are not listed, Tobin’s Q is not an appropriate proxy to measure their market performance. Furthermore, the information used to calculate accounting performance seems to be more reliable, because it is normally governed by accounting standards (Demsetz & Villalonga, 2001).

The abbreviation ROA stands for Return on Assets. The ratio is one of the most important financial figures, often forming the starting point for profitability analyses, and it measures the return on total capital, i.e. debt and equity. It is an indicator about how profitable or successful a company is relative to its total assets and how efficient a company’s management is at using its assets or invested capital to generate earnings or rather allocating its resources (Wöltje, 2016). As the ROA reflects the efficiency of the ways in which assets are allocated and managed, it is

often used as a proxy for profitability and in particular accounting performance (Boonyawat, 2013; Demsetz & Villalonga, 2001). Compared to the ROE, i.e. return on equity, that only refers to the performance with regard to the equity, the ROA is independent of the capital structure of a company as it refers to the return on total assets. In contrast to the ROA, the ROE neglects financial leverage (Fessler, 2013). However, the ROE is not a suitable measure for firm performance of German grid owner companies. In general, the optimal equity ratio of a grid owner company is 40 percent as the German Electricity and Gas Network Charges Ordinances limit the application of the return on equity rates to a maximum of 40 percent of the operating assets. Hence, all German grid owner companies aim at an equity ratio of 40 percent and the performance of different grid owner companies might not be distinguished. Grid owner companies are defined by their grids that are assets. Hence, the ROA as a proxy for firm performance is also applicable to grid owner companies that are capital intensive companies.

In literature and professional practice, there are several versions for how the ROA is calculated. First, according to the definition of Compustat, the annual ROA is calculated as net income divided by the book value of total assets at the balance sheet date (Standard & Poor's Global Market Intelligence, 2018). Second, ROA is also calculated as earnings before interests and taxes, divided by the book value of total assets at the balance sheet date (Boonyawat, 2013). Third, in some calculations of this ratio, the borrowing costs are added to the net income in order to use operating returns. The higher the ROA, the better the performance, because the company is earning more money on less investment. A company's total assets are the sum of its total liabilities and shareholders' equity, i.e. the assets are either funded by debt or equity (Wöltje, 2016).

Overall, the ROA is the preferred measure for the firm performance of grid owner companies in this research.

2.4.2 Firm size

According to Lazăr (2016a), firm size as a concept can be measured by using several proxies. However, Dang, Li, & Yang (2018) argue that every firm size

measure has its advantages and disadvantages, and no measure can capture all characteristics of firm size.

Typical proxies for firm size are total assets, sales, natural logarithm of book value of sales and number of employees (Lazăr, 2016a). This corresponds to the company size categories according to section 267 of the German Commercial Code: balance sheet total, annual net turnover and annual average headcount.

According to section 277 of the German Commercial Code, turnover comprises the proceeds from the sale, rental or leasing of products and services, net of sales deductions and value added tax. In general, turnover is recorded when goods have been delivered or services have been rendered. The turnover is the output value of the profit and loss account and an important absolute or relative key figure (Schmidt & Peun, 2018).

In general, the annual turnover of a grid owner company consists of the lease payments paid by the private energy company. The basis for the lease payments is often the regulation on charges for access to electricity or gas supply networks, the so-called Electricity or Gas Grid Network Charges Ordinances. Thus, the calculation formula is as follows (section 4 Electricity or Gas Network Charges Ordinances):

(1)	calculated depreciation
(2)	+ calculated return on equity
(3)	+ calculated taxes
(4)	+ real estate taxes
(5)	+ interest expenses
(6)	-/+ gains/losses from derecognition of assets
(7)	- income from the reversal of construction costs by customers
(8)	- interest income
(9)	+ administrative expenses
=	Lease payment

In case the lease payment is based on the Electricity or Gas Network Charges Ordinances and does not refer to the German Incentive Regulation Ordinance, grid owner companies profit from the advantages of the regulatory environment without bearing the revenue reduction risks of the German Incentive Regulation Ordinance.

In the case of a grid owner company, turnover encompasses not only the turnover from the lease of grids, but also contributions in aid of construction and building connections that are generally amortised over the useful life of the corresponding asset or simply over 20 years. In Germany, distribution network operators are obliged to connect the customers to the grid and to keep the grid in good condition for a secure energy supply. The customers pay an upfront-payment for the connection that is transferred from the distribution network operators to the grid owners (section 17 German Energy Industry Act).

However, there is a mechanical correlation between annual turnover and ROA. Annual turnover is part of the net income as the numerator of the dependent variable. As annual turnover is implied in the measurement of firm performance, it is not a suitable proxy for firm size in this thesis. According to Dang et al. (2018), the researcher should use total assets if the size refers to the total resources from which the company can generate profits. Nonetheless, there is also a mechanical correlation with the balance sheet total or total assets as this represents the denominator of the ROA. As German grid owner companies regularly do not have any employees, with the exception of the members of the management board, the number of employees is not a suitable proxy for size of German grid owner companies.

Furthermore, variables like management fees, audit fees or contributions in aid of construction and building connections are also implied in the measurement of firm performance. Whereas management fees and audit fees are part of the net income as the numerator of the dependent variable, contributions in aid of construction and building connections belong to the total assets as the denominator of the ROA. Moreover, according to Kitterer (1989) management fees or administrative expenses themselves depend on the size of a company. Thus, they are not suitable proxies for firm size in this research.

With regard to the choice of a suitable firm size measure in practice, Hart and Oulton (1996) claim that choosing which measure to use depends on data availability.

According to section 27 (2) of the German Electricity or Gas Network Charges Ordinances, German distribution network operators are obliged to disclose the following structural features of their grids on their websites by 1st April each year:

1) the circuit length of each of the cable and overhead lines in the low-voltage, medium-voltage, high-voltage and extra-high voltage levels as at 31st December of the previous year,

2) the installed capacity of the transmission levels as at 31st December of the previous year,

3) the annual work in kilowatt hours per network and transmission level taken in the previous year,

4) the number of supply points for all network and transmission levels,

5) the population in the network area of operators of low-voltage electricity supply networks as at 31st December of the previous year,

6) the area supplied by the distribution service operator as at 31st December of the previous year,

7) the geographical area of the grid as at 31st December of the previous year.

If a municipality is supplied by several network operators, only the corresponding parts of the area must be taken into account and specified.

In contrast to a German distribution network operator, German grid owner companies are not obliged to disclose data on their grid structures. Moreover, German distribution network operators often operate more than one grid (section 23a German Energy Industry Act). Thus, it is not possible to draw conclusions from the published data of the distribution network operator on the structural grid

data of the respective grid owner company. Furthermore, distribution network operators are obliged to prepare and submit separate data entry forms for each grid owner company that they lease a grid from to the German Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways (section 4 (5) German Electricity or Gas Network Charges Ordinances). However, the data entry forms are subject to trade and business secrets and are not publicly available.

Although German grid owner companies are not obliged to disclose specific data on population or area like distribution service operators, publicly available data on population and area could be gathered and used as proxies of firm size of grid owner companies.

Comparable to the number of employees of a company (Glancey, 1998; Lazăr, 2016a), the population reflects the number of inhabitants living in the supply area of a grid owner company. As German grid owner companies normally do not have any employees with the exception of the management, the population seems an appropriate proxy for the size of a German grid owner company. In general, a grid owner company has at least one municipal shareholder (Heim, 2015a). For the analysis, the inhabitants of the municipality serve as a measure for firm size. As many grid owner companies own grids that are located in several municipalities, the population of each municipality has to be added up in order to determine the population of a grid owner company. The more people supplied by a grid owner company, the larger its own infrastructure or facilities should be.

The area of a grid owner company represents an alternative proxy for firm size that is not implied in the measurement of firm performance. In the agricultural literature, area is often used as a proxy for firm size (Graskemper, Feil, & Quiring, 2019). Comparable to the area of an agricultural enterprise as a measure of size (Graskemper et al., 2019), area as an independent variable serves as a measure of size of German grid owner companies.

The area specified for every municipality is basically the district area (cadastral area according to the German surveying authorities) measured in square kilometres. As many grid owner companies own grids that are located in several municipalities, the areas of each municipality have to be added up in order to

determine the area of a grid owner company. In general, the larger the area of a municipality and ultimately of a grid owner company, the more grid facilities like distribution lines or local network stations are installed and owned by the grid owner company. The relationship is supported by the fact that in a closed urban area, the energy distribution is easier and fewer grid facilities are necessary to supply energy to the customers than in a rural area. Basically, in rural areas longer distances have to be covered by additional distribution lines (Bundesnetzagentur & Bundeskartellamt (2017). However, it may be that the area of one or more municipalities is large, but the grid owner company owns only a few grid facilities. This can occur if an area is governed by more than one rights-of-way contract, so that there is more than one distribution network operator and thus more than one grid owner. In essence, though, the larger the area, the higher the level of firm performance of a grid owner company.

Overall, population and area as proxies for the firm size variable seem to be suitable figures for measuring the firm size of German grid owner companies.

2.4.3 Firm size and firm performance

Key words: “firm performance” and “firm size”
Time: no restriction
Results: 2,850,000 citations (Google Scholar), 1,525 citations (SSRN), 5,900 (Business Source Ultimate)

The role of firm size in determining firm performance, i.e. whether larger firms are more profitable than smaller firms, is the topic of a large amount of literature in the fields of business organisation and industrial economics.

The literature on firm size and its effects on firm performance is enormous (Lazăr, 2016a). Baumol’s theoretical thesis that larger companies have a higher performance than smaller ones due to higher credit volumes and lower borrowing costs (Baumol, 1967) is the starting point of many empirical studies dealing with the research question of the relationship between firm size and firm performance. According to him, the firm size-dependent amount of borrowing costs is a decisive factor why larger companies have a higher performance than smaller ones (Baumol, 1967). Corresponding to the variety of literature on firm size and its effects on profitability that originated in the United States in the 1960s and 1970s, there is a variety of ambiguous empirical findings, ranging from a positive to a negative relationship as well no relationship at all between firm size and firm performance (Nunes & Serrasqueiro, 2015; Lazăr, 2016a; Schmidt, 1995). Early empirical studies, like Hall and Weiss (1967) and Scherer (1973), find a positive relationship between firm size and firm performance. They explain the positive effect primarily through economies of scale (Lazăr, 2016a). For example, Nanda and Panda (2018) explain the occurrence of economies of scale from various dimensions. First, there are financial aspects in terms of lower interest rates or better discount rates for large companies due to large quantities. Second, a large scope of specialisation and division of labour in the context of organisational structures of large companies contributes to economies of scale. Third, economies of scale could appear for technical reasons, i.e. high fixed costs are distributed over a large number of units (Nanda & Panda, 2018). In contrast, Shepherd (1972) figures a negative relationship between firm size and firm performance. He attributes the negative effect to X-inefficiency. This means a failure to keep costs

under control depending on the status of competition (Lazăr, 2016a; Shepherd, 1972).

The following empirical studies focus on the impact of firm size on firm performance and find a positive and significant relationship:

Lee (2009) examines the determinants of firm performance and, in particular, the role that firm size plays in profitability. He uses a fixed-effects dynamic panel data model for over 7,000 US publicly-held firms during the years 1987-2006 and discovers a positive non-linear correlation between firm size, measured by the log value of total assets, and firm performance, defined by net income plus advertising expenses to total assets ratio. This suggests that profitability decreases once the firm size grows too much (Lee, 2009).

In their article “Firm-specific and economy wide determinants of firm profitability: Greek evidence using panel data”, Asimakopoulos et al. (2009) examine the determinants of profitability for a sample of 191 Greek non-financial firms listed on the less developed Athens Stock Exchange for the period 1995-2003 using panel data estimation techniques. Apart from other firm-specific and economy wide factors that determine firm performance, they find that firm size, measured by the natural logarithm of sales, positively affects firm performance. Firm performance is measured by the ROA that is calculated as pre-tax profit divided by total assets (Asimakopoulos et al., 2009).

In his article “Profitability determinants among micro firms: evidence from Swedish data”, Yazdanfar (2013) investigates various variables affecting firm performance by applying a seemingly unrelated regression method to a large sample of approximately 87,000 observations covering 12,530 non-financial micro firms in Sweden operating in four industry sectors, from 2006 to 2007. The empirical study considers profitability determinants at the firm as well as industry affiliation levels in examining hypotheses developed from resource-based approaches. Among other findings, Yazdanfar (2013) points out that firm size as an internal determinant, measured by the natural logarithm of the firm’s book value of sales, positively influences firm performance, measured by the ROA. In his study, the ROA is defined as the firm’s book value of net profit after tax divided by total

assets. Overall, he concludes that firm performance is mainly determined by internal rather than external variables (Yazdanfar, 2013).

In his study “A panel data analysis of profitability determinants: empirical results from Sri Lankan manufacturing companies“, Pratheepan (2014) uses a balanced panel data set of 55 Sri Lankan listed manufacturing companies with 550 observations over the period of 2003-2012 in order to examine the determinants of profitability of manufacturing companies by applying static panel models. The ROA as the ratio between profit and total assets measures profitability and represents the dependent variable whereas firm size is one of the independent variables. According to Pratheepan’s findings, firm size is statistically significant and positively related to the profitability of selected listed manufacturing companies in Sri Lanka (Pratheepan, 2014).

Zaid, Ibrahim and Zulqernain (2014) investigate the determinants of public based construction companies' profitability in Malaysia from 2000-2012. They use the ROE to measure firm performance and the natural logarithm of total sales to measure firm size. Overall, the findings show that firm size has a significant positive relationship with firm performance.

Nunes and Serrasqueiro (2015) study profitability determinants of knowledge-intensive business services by considering a sample of 187 Portuguese knowledge-intensive business services for the period 2002 to 2009 using panel data models. Among other findings, the results indicate that firm size, represented by the logarithm of sales, has a positive influence on firm performance, measured by the ratio between earnings before tax and interest and total assets, of Portuguese knowledge-intensive business services. Thus, the authors make the suggestion for policymakers and for the owners and managers of Portuguese knowledge-intensive business services to support services that are profitable, but small in size, aiming to help them diversify their activities and in this way preventing their limited size from contributing to diminished profitability (Nunes & Serrasqueiro, 2015).

Nanda and Panda (2018) provide new evidence about firm-specific (internal) and macroeconomic (external) determinants of profitability of 173 Indian manufacturing firms listed in S&P BSE Industrials Index in the period from 2000 to 2015 by using advanced panel data regression analysis techniques (random effects design). Among the variety of firm-specific parameters, firm size, measured in terms of total assets, positively and significantly influences firm performance. The ROA and the net profit margin are used as proxies for firm performance. Thus, the empirical study confirms the relative importance of size on firm performance (Nanda & Panda, 2018).

However, Goddard et al. (2005) find a negative relationship between firm size and firm performance. They research the determinants of profitability for manufacturing and service sector firms in Belgium, France, Italy and the UK, for the period 1993-2001. Panel data in the form of pooled cross-sectional and time series data are used. Firm size is measured by the natural logarithm of total assets and profitability by the ROA. They come to the conclusion that a negative and statistically significant relationship between firm size and firm performance exists (Goddard et al., 2005).

Using all non-financial companies listed on the Bucharest Stock Exchange for a twelve year period from 2000 to 2011 with 668 observations, Lazăr (2016a) investigates whether firm size has any influence on firm performance. He uses a fixed effects panel data model. The proxies for firm size are total assets, sales and number of employees. Firm performance is measured by the ROA, calculated as the ratio of net income to total assets. Overall, he finds a negative effect of firm size on corporate performance when size is expressed in total assets and sales and no effect at all when the number of employees is used as a proxy for size. However, due to the application of the fixed effects model being conditional on the sample, the results cannot be extrapolated, particularly not to privately-held companies (Lazăr, 2016a). Lazăr (2016a) attributes his findings to the fact that Romanian listed companies possess a large amount of real-estate assets that are not directly involved in producing goods and thus in generating profits (Lazăr, 2016a).

Furthermore, Glancey (1998) analyses the relationship between company characteristics, in particular firm size, and firm performance on the basis of accounts data for a sample of 38 small manufacturing firms in a small region in Scotland during the period 1988-1990. He applies regression analysis techniques, in particular ordinary and two-stage least squares, and uses the employee numbers as a suitable measure of firm size in the entrepreneurship context. According to Glancey (1998), firm characteristics are of limited value in explaining profitability. Thus, no significant relationship between firm size and firm performance has been found.

German grid owner companies are not listed companies. They are not subject to market economy rules. Moreover, they are subject to regulation. Furthermore, they are large in terms of population, area, etc. However, there has been no empirical research on the relationship between firm size and firm performance of German grid owner companies.

2.4.4 Ownership structure

Another aspect to be investigated is the ownership structure of newly established grid owner companies in Germany. Depending on the percentage of participation of municipalities and private energy companies in the registered capital of the company, a distinction is made between different types. For example, a minority interest in the company refers to a situation when a private energy company owns less than 50 percent of the shares. In order to determine the private participation quota of a grid owner company, the shareholders are assigned to types of shareholders, i.e. either private or municipal. When two or more private energy companies participate in a grid owner company, their quotas are added together. The magnitude of the private participation quota of grid owner companies reflects the fact that private energy companies often seek to secure their position on the energy market as minority shareholders (Wagner & Berlo, 2017).

2.4.5 Ownership structure and firm performance

Key words: “firm performance” and “ownership structure”
Time: no restriction

Results: 2,600,000 citations (Google Scholar), 543 citations (SSRN), 1,238 (Business Source Ultimate)

The literature on the impact of ownership structure, more precisely state versus private ownership, on firm performance is also extensive. In particular, welfare economics and property rights theory have produced a large number of theoretical contributions to the literature. The spectrum of potential effects of state ownership on firm performance is very broad. A popular postulation is that privately-owned companies are more efficient and more profitable than state-owned companies or in turn state ownership may adversely affect firm performance (Chan, Chen, & Wong, 2018; Megginson & Netter, 2001). Whereas ordinary shareholders usually strive for profit and wealth maximisation, a high degree of state ownership could lead to pursuing competing goals, for example social or political objectives, suffering from high agency cost or lacking private property rights to facilitate efficient resource allocation (Alfaraih, Alanezi & Almujamed, 2012; Boardman & Vining, 1989; Capobianco & Christiansen, 2011; Chan et al., 2018; Martin & Parker, 1997; Phung & Mishra, 2016; Shleifer, 1998; Shleifer & Vishny, 1997; Villalonga, 2000). The supporters of the property rights theory claim that property rights are more clearly defined in the private sector than in the public sector. Hence, the incentive for maximising profits of private shareholders leads to more effective monitoring of management performance (Alchian, 1965; Chan et al., 2018; McCormick & Meiners, 1988). However, there are theoretical studies that identified circumstances in which state ownership might be superior to private ownership. For example, Shapiro and Willig (1990) conclude that public ownership addresses informational asymmetry issues. Hart, Shleifer and Vishny (1997) assume that state ownership is superior when output is less specifiable like quality of service.

With regard to the relationships between mixed ownership and firm performance, in their fundamental empirical study Boardman and Vining (1989), applying OLS regression analyses, point out that mixed companies have a slightly higher performance than publicly owned companies. Moreover, they argue that private companies are the most efficient.

Demsetz and Villalonga (2001) find no statistically significant relationship between ownership structure and firm performance of companies in the US. According to their empirical study applying ordinary and two-stage least squares regressions, ownership structures differ across firms due to differences in their circumstances. For example, scale of economies, regulations and environment stability (Fauzi & Locke, 2012).

The results of recent empirical studies on the relationship between state ownership and firm performance are also mixed (Alfaraih et al., 2012).

Hess, Gunasekarage and Hovey (2010) investigate the relationship between ownership structure and performance for a sample of Chinese listed firms over the period from 2000 to 2004 (balanced panel data). The focus is on the impact of dominance of state, measured by the proportion of shares held by the various levels of the state, and private blockholders on firm performance, measured by Tobin's Q. By applying ordinary least squares and two-stage least squares analysis, they find a U-shape of the state ownership-performance relationship. As states put more effort into state companies, a higher level of state ownership improves firm performance (Hess et al., 2010).

Based on multiple regression analysis over the period of 2001-2006, Najid and Rahman (2011) discover a positive and significant influence of government ownership on the performance of Malaysian enterprises. The study compares financial and market performance measures like ROE or ROA of 47 government-linked companies with 47 non-government-linked companies. The authors suppose that government-linked companies will be supported by the government in times of trouble (Najid & Rahman, 2011).

Le and Buck (2011) analyse more than 1,000 Chinese listed firms over the period 2003-2005 by using multiple regression analysis. They find a positive association between state ownership in terms of the percentage of ownership by the state, and firm performance. This demonstrates that companies with higher state ownership generally have higher firm performance. The independent variable firm performance is measured by the ROA, calculated as net income divided by average total assets. Among other explanations, Le and Buck (2011) attribute the

findings to governmental support and the lower cost of capital for state-owned companies.

Alfaraih et al. (2012) empirically explore the effects of institutional and state ownership on the performance of firms listed on the Kuwait Stock Exchange. They used Tobin's Q and ROA to measure firm performance of a sample of 134 listed companies in the year 2010 by applying regression analysis. Whereas the analysis shows a positive relationship between institutional ownership and firm performance, a negative relationship between government ownership and firm performance is detected (Alfaraih et al., 2012).

Yu (2013) applies in her study "State ownership and firm performance: Empirical evidence from Chinese listed companies" panel data regression techniques to 10,639 firm-year observations on non-financial Chinese publicly listed firms over the period 2003-2010. Yu (2013) shows that state ownership, measured by the percentage of state ownership, has a U-shaped relationship with firm performance, calculated by ROA, ROE and Tobin's Q. Overall, the study demonstrates that a higher level of state ownership positively influences firm performance. Moreover, the findings reveal that a higher level of state ownership is preferred to dispersed ownership structures due to governmental support and political connections (Yu, 2013).

In their article "Ownership and Performance in a Lightly Regulated Environment", Bradbury and Hooks (2015) analyse the relationship between ownership and performance, measured by the ROA as earnings before interest and tax divided by total assets, for New Zealand electricity lines firms over the period 1998 to 2006. The focus is on local distribution or line businesses, i.e. regulated companies being natural monopolies that are responsible for the design, development and maintenance of the electricity line network that delivers power to the customers. In Germany, distribution network operators in contrast to grid owner companies are responsible for the maintenance of the electricity networks. Overall, their hypothesis that private ownership results in higher performance than forms of public ownership, e.g. council ownership, is not supported by the regression analyses (Bradbury & Hooks, 2015).

Phung and Mishra (2016) examine the effect of ownership structure on firm performance for firms listed on Vietnamese stock exchanges. By using panel data of 2,744 firm-year observations from 2007 to 2012, they find a convex relationship between state ownership and firm performance, i.e. firm performance increases beyond a 28.67 percent level of state ownership. The findings suggest that at first, state ownership does not contribute to high firm performance due to the adherence to social or political goals. With an increase of state ownership, the state increases its influence on managers and forces them to pursue social and political goals (Phung & Mishra, 2016).

Szarzec & Nowara (2017) investigate the impact of state ownership on firm performance in the largest non-financial enterprises operating in 13 post-socialist Central and Eastern European countries over the period 2007-2013. Applying descriptive statistics and financial analysis indicators, they identify 69 enterprises out of 500 as state-owned enterprises, holding a dominant position in energy supply, the oil and gas sector and transport. On average, the performance of the largest state-owned companies, measured by profit margin and ROE as profitability ratios, is similar to the performance of the analysed private companies (Szarzec & Nowara, 2017).

In their empirical study, Chan et al. (2018) analyse the effects of state ownership on the performance of state-owned enterprises in New Zealand by applying cross-sectional (years 1990, 1995, 2000, 2005 and 2010) and time-series approaches (state-owned enterprises privatised between 1988 and 2010). They come to the conclusion that state ownership, measured by an indicator variable, unlike private ownership is negatively and significant associated with firm performance. In the study, firm performance is measured in several ways, for example ROA, defined as earnings before interest and tax divided by average operating net assets and ROR, measured by earnings before interest and tax divided by net revenue.

In his empirical study, Eforis (2018) explores the influence of state ownership on the firm performance of state-owned enterprises, i.e. business entities that are wholly or primarily owned by the state, in Indonesia listed on the Indonesia Stock Exchange between 2011 and 2015. He comes to the conclusion that state ownership has a positive influence on firm performance, measured by ROA.

Overall, there is a huge amount of literature that focuses on the relationship between ownership structure and firm performance. However, the relationship between ownership structure and firm performance of grid owner companies in Germany has not been analysed yet.

2.4.6 Legal form

2.4.6.1 Introduction

To operate local grids, municipalities in Germany can choose between all forms of private and public law (Wagner & Berlo, 2017). On the one hand, there could be owner-operated municipal enterprises, so-called “Eigen- oder Regiebetriebe” and on the other hand companies according to public and private law are available, so-called “Eigengesellschaften”. In most cases, third parties can take a share in those companies according to public and private law (Lormes, 2016). In general, owner-operated municipal enterprises or companies can operate the grids themselves or assign the task to a third party by means of a management or a lease contract. As municipalities’ liability has to be restricted to the share in the company they have paid by German municipal law (for example section 122 (1) Hessian Municipal Code), only limited liability companies, public limited companies, limited partnerships or limited partnerships with a limited liability company as general partner are permitted legal forms for grid owner companies in Germany (Heim, 2015a). Moreover, a municipality shall only establish, take over, substantially expand or participate in a public limited company if the public purpose of the enterprise cannot be fulfilled equally well in another legal form (section 122 (3) Hessian Municipal Code). Thus, only limited liability companies or limited partnerships with a limited liability company as general partner are available legal forms for grid owner companies in Germany (Heim, 2015a). Due to the legal restriction, municipalities are not allowed to become general partner (Rosenberger, 2012). Overall, with regard to the chosen models since the mid-2000s, the preferred legal structures belong to the private law and they distinguish themselves by a limitation of liability. Whereas limited liability companies and limited partnerships are predominant, public limited companies are not chosen as they require a lot of effort to establish (Heim, 2015a). Grid owner companies by public law are not chosen by the municipalities, because neither liability nor

financial risks can be limited (Heim, 2015a). Furthermore, section 122 (1) no. 3 of the Hessian Municipal Code requires that the municipality has an appropriate influence on the company, in particular on the supervisory board or a corresponding body.

The choice of a company's legal form is a long-term, but not irreversible decision and needs revision from time to time if key framework conditions change (Rosenberger, 2012). The most important criteria in the choice of legal form might be the following (Rosenberger, 2012):

- Liability
- Control and voting rights
- Distribution of profits, losses and assets
- Financing options
- Tax burden
- Disclosure requirements

In order to substantiate the research on German grid owner companies, the characteristics of public limited companies, limited liability companies, limited commercial partnerships with a limited liability company as general partner and limited commercial partnerships with a public limited company as general partner as permitted legal forms of grid owner companies are discussed in the following sections. The focus is on company-specific features, company organs, liability, shareholders' agreement, share contributions and profit participation, accounting, auditing and disclosure as well as taxation. As grid owner companies with the legal form of public limited companies are not chosen due to their great effort to establish (Heim, 2015a), the public limited company is only presented with its essential features.

2.4.6.2 Public limited company

The public limited company is a publicly held company. It was intended as the appropriate form for entities owned by a large number of shareholders and under the control of employed managers (PwC, 2018). The German Stock Corporation Act ("Aktiengesetz") governs the bodies, structures and organisation of this legal

form. The shares of a public limited company may be publicly traded on a stock exchange (PwC, 2018). The minimum share capital is 50,000 euros divided into ordinary shares of equal nominal value of at least 1 euro (sections 7 and 8 German Stock Corporation Act). The public limited company may issue shares of different classes, for example preference shares with no voting rights but with a preferential dividend entitlement (section 140 German Stock Corporation Act; PwC, 2018). The directors of a public limited company meet as a board (section 76 German Stock Corporation Act) and a supervisory board of at least three members has to be appointed (section 95 German Stock Corporation Act). Compared to a limited liability company, the formation of a public limited company and shareholders' meeting procedures are more cumbersome (PwC, 2018).

2.4.6.3 Limited liability company

2.4.6.3.1 Company-specific features

The limited liability company is a popular type of private business organisation in Germany. In contrast to the public limited company, the limited liability company was designed to suit the circumstances of an owner-managed business with its own legal personality (PwC, 2018). The legal basis for the limited liability company in Germany as a trading company is the Limited Liability Companies Act ("GmbH-Gesetz"). According to section 1 of the Limited Liability Companies Act, the limited liability company as a capital company can be established for any admissible purpose and it is an independent legal entity. The entry into the Register of Commerce is constitutive (section 11 (1) Limited Liability Companies Act) and requires the following information: corporate name, registered office, business purpose, amount of share capital, list of shareholders, shareholders' agreement in a notarial form and managing director(s) (section 8 Limited Liability Companies Act)

As the shareholders' agreement provides a high degree of individuality (section 3 Limited Liability Companies Act), this legal form is famous for its flexibility and scalability to lots of enterprises. Compared to a public limited company (section 23 (5) German Stock Corporation Act), the limited liability company is subject to less strict directives. In contrast to a partnership, the limited liability company is a trade

company with its own legal personality and is liable to creditors for corporate debts (section 13 Limited Liability Companies Act). It has a share capital determined by the shareholders' agreement; the minimum share capital amounts to 25,000 euros (section 5 Limited Liability Companies Act). According to section 4 of the Limited Liability Companies Act, the company name must always contain the designation "company with limited liability" or an appropriate abbreviation.

In the context of remunicipalisation, limited liability companies are recognised as flexible and adaptive to changing market situations by local decision-makers. In contrast to public sector organisations, limited liability companies offer the possibility to affiliate third parties as strategic partners and are separated from municipal assets. Whereas municipalities with a public legal form are fully liable for their financial obligations, the liability of municipalities as shareholders of a limited liability company towards their creditors is limited to the company's capital stock. With regard to the ownership transfer of grids, e.g. disputes with the former concessionaire over the purchase price, etc., the limitation of liability seems to be an advantage (Wagner & Berlo, 2017).

2.4.6.3.2 Company organs

The limited liability company has at least two independent executive organs: the managing director(s), recorded in the German Register of Commerce, (section 6 Limited Liability Companies Act) and the shareholders' meeting (section 48 Limited Liability Companies Act). One or more managing directors are appointed by the shareholders' agreement or by a resolution of the shareholders' meeting (section 6 Limited Liability Companies Act). The managing directors have to carry out the resolutions of the shareholders, to manage the business of the limited liability company and to represent it to the outside (section 35 Limited Liability Companies Act). By law, the representation power of the managing director towards third parties cannot be limited (section 37 (2) Limited Liability Companies Act). Thus, they are subject to various liability risks. For example, the managing director is responsible for a proper accounting and drawing up of the financial statements.

A breach of duties leads to personal liability of the managing director towards the company and the creditors as well as criminal punishment (section 69 German Fiscal Code, section 331 German Commercial Code). The shareholders' rights and obligations are primarily determined by the shareholders' agreement (section 45 Limited Liability Companies Act). They normally pass their resolutions at the shareholders' meeting where one euro grants one vote (section 48 (1) Limited Liability Companies Act).

Typical responsibilities of the shareholders' meeting are as follows (section 46 Limited Liability Companies Act):

- approval of the annual financial statements
- allocation of the profits
- appointment, recall and approval of the managing directors
- approval of the supervisory board
- measures for auditing and monitoring of the management
- change of company agreement

Normally, a supervisory board is not mandatory, except for enterprises with worker participation (section 1 One-Third Participation Act). In such cases, the provisions of the German Stock Corporation Act apply accordingly to the supervisory board (section 52 Limited Liability Companies Act). The supervisory board is responsible for monitoring and advising the management, auditing the annual financial statements and the proposal for the allocation of the profits. In addition, the shareholders' agreement can make certain transactions dependent on the approval by the supervisory board. Usually, the supervisory board is directly involved in all fundamental decisions of the company (section 52 Limited Liability Companies Act, section 111 (4) German Stock Corporation Act).

2.4.6.3.3 Liability

According to the term "limited liability", the shareholders' liability towards creditors is limited to the company's share capital as far as the share contribution has been paid in (Ryan & Collett, 2017; section 13 (2) Limited Liability Companies Act). However, acting before entry into the Register of Commerce could lead to a

personal liability of the shareholders. In some cases, for example financial difficulties of the enterprise, claims of the shareholders could be satisfied by ranking below the other claims of insolvency creditors (section 39 Insolvency Statute).

2.4.6.3.4 Shareholders' agreement

Notarial certification of the shareholders' agreement is mandatory (section 2 Limited Liability Companies Act). According to section 3 of the Limited Liability Companies Act, the following items have to be part of the contract: company name, registered office, business purpose, amount of share capital and share contribution. Moreover, the following items are often found in a shareholders' agreement: distribution of votes, preparation of annual financial statements, allocation of profits and terms of termination. Finally, the formal directives with regard to the shareholders' meeting are simpler than those for a public limited company (Heim, 2015a).

2.4.6.3.5 Share contributions and profit participation

A share contribution must amount to at least one euro (section 5 Limited Liability Companies Act). The share contributions can be provided either in cash or in kind. According to section 7 of the Limited Liability Companies Act, the entry in the German Register of Commerce can only be made if at least one quarter of each share contribution to be provided in cash is paid in and the payments together amount to 12,500 euros. In the case of a contribution in kind, the contribution has to be at the free disposal of the management at the time of application (section 7 (3) Limited Liability Companies Act) and must be proven in a valuation report (section 5 (4) Limited Liability Companies Act). Furthermore, every change in share capital requires notarial certification and is to be declared to the German Register of Commerce (section 53 (2) Limited Liability Companies Act).

According to section 46 no. 1 of the Limited Liability Companies Act, the distribution of profits requires a shareholder resolution and is based on the proportion of shares, unless the shareholders' agreement governs a different allocation formula (section 29 (3) Limited Liability Companies Act).

2.4.6.3.6 Accounting, auditing and disclosure

As a trading company, the limited liability company is subject to the German Commercial Code by virtue of its legal form (section 13 (3) Limited Liability Companies Act). It is obliged to keep accounting records and to draw up annual financial statements comprising balance sheet, profit and loss account and notes in the German language (section 242 German Commercial Code). The annual financial statements must present fairly the financial position and financial performance of an entity (section 264 German Commercial Code) and they must be drawn up under the assumption of a going concern (section 252 German Commercial Code). Depending on the size of a limited liability company or on the requirements of municipal law, the annual report also includes the management report. Small capital companies are those that do not exceed at least two of the three following features: 6,000,000 euros balance sheet total; 12,000,000 euros annual net turnover, and with an annual average of 50 employees. Medium-sized companies exceed at least two of the three features mentioned, but not at least two of the following three concerning large companies: 20,000,000 euros balance sheet total; 40,000,000 euros annual net turnover, and an annual average of 250 employees (section 267 German Commercial Code).

The management report contains the business situation, the major risks and opportunities as well as the future outlook and development of the company (section 289 German Commercial Code). The fiscal year is generally a twelve month period. However, the first fiscal year may be shortened (section 240 (2) German Commercial Code). According to section 316 of the German Commercial Code, auditing of the annual financial statements is mandatory for large and medium-sized limited liability companies. Through the audit, the limited liability company receives an audit report by the auditor certifying the correspondence of the accountancy with the German Commercial Code and the statutory directives (section 321 German Commercial Code). The disclosure of annual financial statements is also prescribed within twelve months of the balance sheet date in the Federal Gazette (section 325 German Commercial Code).

2.4.6.3.7 Taxation

In Germany, all limited liability companies are subject to two taxes, namely trade tax and corporate income tax (PwC, 2018). Concerning trade tax, under national rules each local authority charges its share of the overall basis at its own local rate within the range of 7 and 20 percent (PwC, 2018). A company's profit is also subject to corporation tax that is levied at 15 percent (section 23 German Corporate Income Tax Act). The basis of the tax computation is the business income, i.e. the net result for the year as shown in the Commercial Code financial statements, adjusted by specific expenses and tax-free income (section 7 German Corporate Income Tax Act). Moreover, the corporate income tax is subject to a solidarity surcharge of 5.5 percent of the amount due (section 4 Solidarity Surcharge Act).

Furthermore, corporation and trade tax arrangements between a parent company and a grid owner company as a subsidiary company are possible (Rosenberger, 2012). By the corporation and trade tax arrangement, the grid owner company is obliged to transfer all its profits to the parent company and the parent company is obliged to offset all the losses of the grid owner company. From the tax perspective, the outcomes of both companies can be offset (Rosenberger, 2012).

2.4.6.4 Limited partnership with a limited liability company

2.4.6.4.1 Company-specific features

Whereas general rules on partnerships are found in sections 705 to 740 of the German Civil Code, mercantile partnerships are governed by the German Commercial Code. The limited commercial partnership with a limited liability company as general partner (GmbH & Co. KG) is a special form of the limited commercial partnership. A suffix notifying this specific formation must always be part of the company name (section 19 (2) German Commercial Code). Instead of a natural entity, a limited liability company is the personally liable partner in the business partnership. It combines the advantages of a capital company, e.g. limitation of liability, with those of a partnership of people, e.g. no minimum share capital. According to section 161 of the German Commercial Code, the typical

purpose of business of a limited commercial partnership is to operate a trading business. However, all other legitimate business purposes can be pursued (IHK, 2019).

A limited commercial partnership distinguishes itself by at least one partner who is liable without limitations, whereas the liability of the other partner towards the corporate creditors is limited to the amount of a certain asset contribution (section 161 (1) German Commercial Code). Whereas each personally liable partner has the authorisation to represent the company alone, the limited partners have no representation power to the outside (section 170 German Commercial Code). As a legal entity, the limited commercial partnership can sue and be sued before a court of law, acquire rights and enter into liabilities and acquire possession (sections 124 and 161 German Commercial Code). The legal basis for all forms of limited commercial partnerships are sections 161-177 of the German Commercial Code. Thus, the law of limited commercial partnerships is to be applied to a limited commercial partnership with a limited liability company as general partner (IHK, 2019).

2.4.6.4.2 Company organs

To establish a limited commercial partnership with a limited liability company as general partner, at least two partners are necessary. On the one hand, the so-called general partner, a limited liability company, that is liable without limitation. On the other hand, the limited partner whose liability is limited to their contribution (section 171 German Commercial Code). Apart from the partners, no specific executive organs exercising management exist (IHK, 2019). The limited liability company as general partner, represented by the managing director of the limited liability company who does not need to be a partner, manages and represents the company alone (sections 125, 161 and 164 German Commercial Code). In general, the limited partner has been excluded from management and has no power of representation (section 164 German Commercial Code). However, deviating regulation can be part of the partnership agreement. In contrast to the general partners that have comprehensive information and inspection rights, limited partners only have limited control rights (sections 118 and 161 German Commercial Code).

2.4.6.4.3 Liability

In general, a limited commercial partnership is liable for corporate debts with its corporate assets. In addition, the general partners are personally liable. A limitation of the general partners' liability to the corporate assets is not possible. In contrast, a limited partner is only liable to corporate debtors with their contribution as long as it has not been paid (section 171 German Commercial Code). However, the limitation of liability of the limited partner depends on the entry into the Register of Commerce. If the company has already started business and the creditor is not aware of the capacity as limited partner, they are liable without limitation (section 176 (1) German Commercial Code). As the limited liability company is only liable with its own assets (section 13 (2) Limited Liability Companies Act), the liability of the limited commercial partnership with a limited liability company as general partner is limited.

2.4.6.4.4 Partnership agreement

The limited commercial partnership with a limited liability company as general partner is established with the conclusion of the partnership agreement between the general partner, a limited liability company, and the limited partner. Moreover, it is to be notified to the Register of Commerce. The designation of the limited partners and the amount of contribution are to be stated (sections 106 and 162 German Commercial Code). In general, the entries in the Register of Commerce are made known by publication (IHK, 2019). Compared to a limited liability company, changes of the partnership agreement are subject to notification to the Register of Commerce, but not subject to notarial certification (section 162 German Commercial Code).

An existing limited liability company is required. In contrast to the shareholders' agreement of the limited liability company, the partnership agreement of a limited commercial partnership with a limited liability company as general partner neither requires notarial certification nor any form. Nevertheless, a comprehensive written partnership agreement is recommendable in order to avoid disputes between the partners. The following items are usually part of the agreement: object, corporate name, nature and scope of the partners' contributions, amount of limited liability of

each limited partner, management and representation power, allocation of profits and losses and termination of the company. Normally, a change of partners is only possible with the consent of all partners unless the partnership agreement provides otherwise (IHK, 2019).

2.4.6.4.5 Partnership contribution and profit participation

The contributions of each partner can comprise cash, contributions in kind or the rendering of services. The modalities of payment can be freely agreed. In general, the corporate assets jointly accrue to all partners, including the limited partners. The specific amount of money of each partner can be seen from the balance sheet (IHK, 2019).

According to sections 121 and 168 of the German Commercial Code, each partner has the right to claim annual profit amounting to four percent of its contribution. More profit has to be distributed according to the number of partners. Furthermore, the partnership agreement can stipulate a different profit distribution (section 121 German Commercial Code). In practice, partnership agreements often contain different profit distribution clauses. For example, results of tax balance sheets that are caused by one partner often justify different profit distribution (Rosenberger, 2012).

Where the limited partners are also shareholders of the limited liability company with the same participation quota, the limited liability company often has no participation quota and no voting rights. Therefore, the limited commercial partnership with a limited liability company as a general partner has to compensate the expenses of the limited liability company (section 670 German Civil Code). However, the general partner with unlimited liability is not obliged to make capital contributions at all (Heim, 2015a).

2.4.6.4.6 Accounting, auditing and disclosure

As a trading company, the limited commercial partnership with a limited liability company as general partner is required to keep accounting records and to draw up annual financial statements in the German language (section 252 German

Commercial Code), extended by notes with explanations (section 264 German Commercial Code). The annual financial statements of large and medium-sized limited commercial partnerships with a limited liability company as general partner have to be audited by an auditor (section 316 German Commercial Code). The limited liability company as general partner has to draw up separate annual financial statements. Furthermore, the annual financial statements and further documents of the limited commercial partnership with a limited liability company as general partner and of the limited liability company have to be disclosed within twelve months of the balance sheet date in the Federal Gazette (section 325 German Commercial Code). Whereas small limited commercial partnerships with a limited liability company as general partner are obliged to disclose summarised balance sheets with notes, medium-sized and large companies have to disclose a balance sheet, a profit and loss account, notes, a management report, the audit certificate and the report by the supervisory board (sections 326 and 327 German Commercial Code). According to section 326 of the German Commercial Code, certain small companies can also fulfill their disclosure obligations by submitting the balance sheet in electronic form for permanent deposit with the operator of the Federal Gazette. Small companies that do not exceed at least two of the following three characteristics are called the smallest companies (section 267a German Commercial Code): Balance sheet total of 350,000 euros, sales in the twelve months preceding the balance sheet date of 700,000 euros and an annual average of ten employees.

As the limited commercial partnership with a limited liability company as general partner consists of two companies, the costs of operating two companies are higher compared to a limited liability company.

2.4.6.4.7 Taxation

Concerning the taxation of the limited commercial partnership with a limited liability company as general partner, it is necessary to distinguish between the taxation of the limited commercial partnership, the limited liability company and the partners. As a partnership, the limited commercial partnership with a limited liability company as general partner is not subject to income or corporation tax. Moreover, the taxable profit is directly attributed to the partners and, depending on their legal

form, it is subject to income or corporation tax. However, the limited commercial partnership with a limited liability company as general partner is obliged to pay trade tax. The basis of the taxation is the company profit, adjusted by special amounts and a tax allowance of 24,500 euros (sections 1-11 German Trade Tax Act). Then, each local authority charges its share of the overall basis at its own local rate within the range of 7-20 percent (PwC, 2018). Furthermore, the limited commercial partnership with a limited liability company as general partner is subject to German value added tax (section 1 German Value Added Tax Act). With regard to the taxation of the limited liability company as general partner, reference is made to paragraph 2.4.6.3.7. Where the limited liability company is solely limited partner of a limited commercial partnership, it does not have to pay trade tax (IHK, 2019). The main advantage of a limited commercial partnership is that assets can be transferred to the company in a neutral way with regard to taxation (section 6 German Income Tax Act). Moreover, partners of a limited commercial partnership with a limited liability company as general partner could treat their refinancing costs of equity contributions and shareholder loans as special business expenses and thus reduce their tax burden (section 15 German Income Tax Act). Compared to a limited liability company, this advantage makes the limited commercial partnership with a limited liability company as general partner more attractive for municipalities.

2.4.6.5 Unified limited partnership

The unified limited commercial partnership with a limited liability company as general partner is a special type of the limited commercial partnership with a limited liability company as general partner. In the so-called unified limited commercial partnership with a limited liability company as general partner, the limited commercial partnership is the only shareholder of the limited liability company. In turn, the limited liability company is the general partner of the limited commercial partnership. However, the limited partners are not shareholders of the limited liability company. The corporate form facilitates the change of partners as the limited partners are indirectly shareholders of the limited liability company (Heim, 2015a).

2.4.6.6 Limited partnership with a public limited company

2.4.6.6.1 Company-specific features

The limited commercial partnership with a public limited company as general partner is a combination of a limited commercial partnership and a public limited company. The public limited company as the only general partner with its management represents the limited commercial partnership with a public limited company as general partner. With regard to the legal and economic design, the limited commercial partnership with a public limited company as general partner corresponds more to a limited commercial partnership with a limited liability company as general partner than an original public limited company. There are only a few limited commercial partnerships with a public limited company as general partner in Germany, approximately between 500 and 1,000. Tax advantages and the independence of the management board of the public limited company from the influence of the shareholders are reasons for choosing this legal form (Werner, 2008).

2.4.6.6.2 Taxation

From the perspective of corporate taxation, the limited commercial partnership with a public limited company as general partner does not exist and municipalities as limited partners do not have to pay any taxes on the income from the grid owner company. In turn, the public limited company has to pay all income taxes. However, it requires that the municipalities only receive fixed returns on their equity contribution, do not carry any risks and do not participate in hidden reserves or hidden charges. Compared to a limited commercial partnership with a limited liability company as general partner, the participation and co-determination rights of the municipalities do not differ. The position of the municipality as a limited partner is comparable to a lender. According to the German Federal Fiscal Court, municipalities that do not participate in current or total profits of a partnership are not partners from the tax perspective (Bundesfinanzhof, 1993). The possibility of losing the capital contribution is not harmful. In return for the tax-free profits, municipalities are not allowed to deduct borrowing costs for capital contributions (Rosenberger, 2012).

Where the municipality and a private energy company as the former concessionaire establish a grid owner company, the financial risk is lower as the purchasing price of the grid is moderate compared to the sale to a third party or the grid being transferred to the grid owner company in exchange for shareholders' equity. Moreover, the former revenue cap remains unchanged (Heim, 2015a). According to municipal law, for example section 122 of the Hessian Municipal Code, limited liability and limited participation in financial risks as well as securing influence on a grid owner company are required when choosing a private legal structure.

2.4.7 Legal form and firm performance

Key words: "firm performance" and "legal form"
Time: no restriction
Results: 2,330,000 citations (Google Scholar), 34 citations (SSRN), 317 (Business Source Ultimate)

Research on the relationship between legal form as the independent variable and firm performance as the dependent variable is very rare. With the exception of three publications, the researcher has not identified any relevant contributions to the literature.

First, in his journal article "Market Success and Factors of Success of Cooperatives and Investor-Owned Firms: An Interfirm Comparison of German Dairies on the Basis of Key Performance Indicators", Zieseniß (2014) analyses the business performance of the German dairy industry based on the annual account data of the years from 2005 to 2007. The empirical work examines critical factors for the financial security and for the potential yield of the dairy industry. One research question focuses on the influence of the legal form as the independent variable on the firm performance of dairy companies as the dependent variable. The interfirm comparison of dairy-cooperatives and investor-owned dairies shows significant differences between the performances of the two groups. Among other tests, Mann-Whitney-U-tests are applied and the dependent variable is also measured by the ROA. According to the author, cooperatives have a higher

performance with regard to stability ratios and a lower performance with regard to earnings ratios (Zieseniß, 2014).

Second, Ruester & Zschille (2010) investigate the impact of governance structure on firm performance, measured by retail prices, using a database of 765 German water suppliers. The authors use different econometric techniques to assess the impact of governance choice on firm performance, especially a simple OLS regression and a switching regression model. However, the explanatory power of the governance choice model has been very low.

Third, Pudil, Pirozek, Somol & Komarkova (2016) examine the influence of legal form on firm performance, assessed by ROA. They gathered data from 222 companies with various legal forms over the period 2011-2013 and applied a non-linear regression model. Overall, the authors come to the conclusion that the independent variable legal form, with the characteristics of joint-stock companies, limited liability companies or other, has no significant influence on firm performance as the dependent variable.

2.5 Conclusions and derivation of research hypotheses

2.5.1 Conclusions on the literature review

As a result of the systematic literature review, in this section the research gaps in the existing literature are identified with regard to the research questions formulated at the beginning of the thesis. They also form the basis for the derivation of the research hypotheses.

Concerning research question 1 “*What is the population of German grid owner companies?”*, the systematic literature review on academic and practitioner literature from 2010 to 2019 on the new phenomenon known as grid owner companies shows that grid owner companies in Germany are already the subject of research by academics and practitioners, but from a narrative or qualitative perspective and with regard to the advantages and disadvantages of the process of remunicipalisation of public services. As with any new phenomenon, the first phase of research is often descriptive and seeking to categorise in some way.

Berlo and Wagner (2013b) state that public services in Germany are well researched. However, nobody has systematically taken stock of the grid owner companies already founded in Germany.
Whereas for example Arnold (2012), Chen (2012), Kunze (2012), Rosenberger (2012), Tugendreich (2014) and Heim (2015a) have already discussed cooperation models or joint ventures theoretically, they do not refer to empirical cooperation models or joint ventures. Especially Kinkel (2014) investigates selected examples of newly established public utilities in the sense of a descriptive case study, but she does not refer to the population of German grid owner companies and especially their legal and financial characteristics.

Overall, the systematic literature review shows that only a few authors have identified individual grid owner companies in Germany, but no one has determined the population of German grid owner companies yet. Prior studies mainly examine the advantages and disadvantages of remunicipalisation in combination with a general discussion of available cooperation models, including grid owner companies. In order to conduct further empirical research with the use of sampling, the total population of German grid owner companies has to be determined. In this context, the population of German grid owner companies as a concept comprises all elements of established grid owner companies in Germany. The research aims at identifying all grid owner companies (statistical units) at a specific date (temporal identification) in Germany (local identification). A partial investigation or an investigation on a random basis by means of descriptive statistics is out of the question. Thus, the fact that the population of German grid owner companies has not been determined yet constitutes the first identified research gap. To the researcher's best knowledge, this is the first study that aims at determining the population of German grid owner companies. Simply, the researcher intends to fill this research gap by determining the population of German grid owner companies.

With regard to research question 2 "*How do firm size, ownership structure and legal form affect the firm performance of German grid owner companies?"* the systematic literature review comes to the conclusion that neither the financial performance nor the relationships between firm size, ownership structure, legal form and firm performance of German grid owner companies have been

empirically researched yet. Whereas for example Arnold (2012), Chen (2012), Kunze (2012), Rosenberger (2012), Tugendreich (2014) and Heim (2015a) theoretically examine legal and ownership structures of cooperation models, they do not refer to empirical cooperation models or joint ventures, especially grid owner companies. Although Menges and Müller-Kirchenbauer (2012) maintain that the question of ownership structure is not a decisive factor with regard to the success of remunicipalisation, the structure of ownership could be very important for net income and other financial outcomes of municipalities and energy companies as shareholders or partners of a grid owner company. In general, the percentage of ownership of municipalities or energy companies determines their influence on the relevant decisions in the grid owner company. The relevant decisions are decisions on the budget, the investment in the grids and the capital structure of the grid owner company. In particular, Heim (2015a) examines aspects of firm size, ownership structure and legal form with regard to grid owner companies. He concludes that a minimum size of local grids is required and can be achieved by large grid owner companies consisting of the local grids of several municipalities. According to him, preferred legal forms for cooperation models comprising grid owner companies are limited liability companies or limited liability partnerships with limited liability companies as general partners and a municipal majority shareholding with a cooperation partner as a minority shareholder (Heim, 2015a). However, as Heim's thesis belongs to the field of legal studies, no empirical evidence is given. The authors of the literature found mainly apply a narrative style to deal with the problems. Empirical data is rarely used. This could be the basis for further research, also to support the narrative arguments. Financial data from the Federal Gazette in Germany, official statistical data provided by the Statistical Offices of the German States in cooperation with the Federal Statistical Office or other sources could be used to analyse the phenomenon known as grid owner companies in Germany.

Apart from the literature on grid owner companies, the research on critical drivers determining firm performance provides an extensive body of knowledge. In particular, the impacts of firm size, ownership structure and legal form on firm performance have been examined theoretically and empirically in numerous studies. However, there is no consensus on the effects as they are complex and empirically ambiguous: positive linear, negative linear, curvilinear or no relation at

all. With regard to the chosen research methods, most often quantitative empirical studies with regression methods were applied to measure the relationships between lots of different critical drivers and firm performance, especially panel data regression.

Overall, the systematic literature review shows that the relationships between firm size, ownership structure, legal form and firm performance of German grid owner companies have yet to be examined. Therefore, the empirical analysis of the relationships between firm size, ownership structure, legal form and firm performance constitutes the second identified research gap. The researcher intends to fill this research gap by conducting empirical analyses on the relationships between firm size, ownership structure, legal form and firm performance of German grid owner companies.

As a result of the preceding research gaps and research questions, a practical recommendation would enrich the research on German owner companies. However, with regard to research question 3 *"What is the optimal design for profitable grid owner companies in Germany?"* the relevant literature is rather limited. To the researcher's best knowledge, nobody has addressed the question of the optimal design of German grid owner companies in order to achieve a high level of firm performance yet. Heim (2015a) is the only author who refers to the firm size, ownership structure and legal forms of grid owner companies. First, he argues that a minimum size of local grids is required and can be achieved by large grid owner companies comprising the local grids of several municipalities. Second, he claims that preferred legal forms for cooperation models consisting of grid owner companies are limited liability companies or limited partnerships with limited liability companies as general partners and a municipal majority shareholding with a cooperation partner as a minority shareholder (Heim, 2015a). However, due to the legal background of the thesis neither an empirical analysis is conducted nor a recommendation with regard to the level of firm performance made.

Thus, the research gap is that there is no literature that focuses on the optimal design of profitable grid owner companies in Germany with regard to the level of firm performance. This is astonishing for three reasons. First, German municipal law, for example in Hesse, requires adherence to the economic principle when

operating an enterprise (sections 121 and 122 of the Hessian Municipal Code). Second, due to the fact that in the future further rights-of-way contracts will phase out and local as well as private energy companies have to make a decision to renew rights-of-way contracts or to establish grid owner companies, a quantitative aid to decision-making is needed. Third, many recently renewed rights-of-way contracts between municipalities and private energy companies contain options to establish grid owner companies (Tugendreich, 2014).

To sum up, the determination of the optimal design for profitable grid owner companies in Germany represents a research gap. The researcher intends to close the research gap by conducting an empirical analysis on the relationships between firm size, ownership structure, legal form and firm performance of German grid owner companies. At the end, a recommendation on the optimal design of German grid owner companies from a financial perspective will be made.

2.5.2 Derivation of research hypotheses

2.5.2.1 General remarks

According to Bryman and Bell (2011, p. 715), a research hypothesis is “an informed speculation, which is set up to be tested, about the possible relationship between two or more variables”. Kerlinger (1968, p. 27) goes even further and points out that “hypothesis is the most powerful tool man has invented to achieve dependable knowledge”. In contrast to a normal speculation, a hypothesis must be amenable to being confirmed or disconfirmed through gathering and analysing empirical data (Nenty, 2009). Based on the theoretical background, especially the systematic literature review, the expected influence of firm size, private participation quota and legal form on firm performance of German grid owner companies is derived in the following section. In other words, the expected relationships between firm size, ownership structure, legal form as independent variables and firm performance of German grid owner companies as the dependent variable are developed. Moreover, the relevant hypotheses are formulated.

2.5.2.2 Firm size and firm performance

The results of the systematic literature review form the basis of the expectation about the relationship between firm size and firm performance of German grid owner companies. In general, the literature on firm size and its effects on firm performance is enormous (Lazăr, 2016a). The theoretical work of Baumol (1967) represents the starting point of the research on the relationship between firm size and firm performance. According to him, the firm size-dependent amount of borrowing costs is a decisive factor why larger companies have a higher performance than smaller ones (Baumol, 1967). As a result, numerous empirical studies have been carried out, ranging from no relationship at all to a negative relationship as well as a positive relationship between firm size and firm performance (Nunes & Serrasqueiro, 2015; Lazăr, 2016a; Schmidt, 1995).

First, according to the empirical study of Glancey (1998), situated in the entrepreneurship context, there is no significant relationship between firm size and firm performance. Glancey (1998) uses employee numbers as a measure of firm size. In another empirical study concerning the relationship between firm size and firm performance, Lazăr (2016a) also finds no effect at all when the number of employees is used as a proxy for firm size. As German grid owner companies normally do not have any employees with the exception of the management, the results of both empirical studies could not be applied to German grid owner companies. Hence, it is not expected that there is no relationship between firm size and firm performance of German grid owner companies.

Second, in their empirical study Goddard et al. (2005) come to the conclusion that a negative and statistically significant relationship between firm size and firm performance exists. Thereby, firm size is measured by the natural logarithm of total assets and profitability by the ROA (Goddard et al., 2005). Lazăr (2016a) also finds a negative effect of firm size on corporate performance when size is expressed in total assets and sales. However, due to the application of the fixed effects model being conditional on the sample, the results cannot be extrapolated, certainly not to privately-held companies (Lazăr, 2016a). On the one hand, German grid owner companies are not listed companies and belong to privately-held companies. They are not subject to market economy rules. Moreover, they

are subject to regulation. On the other hand, they are large in terms of population, area or annual turnover. To measure firm size by the natural logarithm of total assets in combination with the measurement of firm performance by the ROA seems to be a circular argument as total assets are the denominator of the ROA. Hence, it is not expected that there is a significant negative relationship between firm size and firm performance of German grid owner companies.

Third, the systematic literature review shows that several empirical studies, in particular the research of Asimakopoulos et al. (2009), Lee (2009), Nanda and Panda (2018), Nunes and Serrasqueiro (2015), Pratheepan (2014), Yazdanfar (2013) and Zaid et al. (2014), discover a positive and significant relationship between firm size and firm performance by applying regression analyses. Thereby, the natural logarithm of sales as the independent variable and the ROA as the dependent variable are often applied. Thus, a positive relationship between firm size and firm performance of grid owner companies is expected. In fact, there is no empirical research on the relationship between firm size and firm performance of German grid owner companies yet. In the context of grid owner companies, only one author comments on their size. Heim (2015a) comes to the conclusion that the establishment of individual grid owner companies all over Germany leads to higher network charges due to the fixed costs of the individual grid owner companies. As section 1 of the German Energy Industry Act seeks to ensure the reasonably-priced public supply of electricity and gas, Heim (2015a) concludes that a minimum size of local grids is required and can be achieved by large grid owner companies consisting of the local grids of several municipalities. Based on the argumentation, a positive relationship between firm size and firm performance of German grid owner companies is expected. This leads to the following hypothesis that shall be verified by the empirical evidence of this thesis:

Hypothesis 1: There is a positive relationship between firm size and firm performance of grid owner companies.

2.5.2.3 Ownership structure and firm performance

The literature on the impact of ownership structure, more precisely municipal or state versus private ownership, on firm performance is also extensive. The results

of the impact of ownership on firm performance are diverse. A popular postulation is that privately-owned companies are more efficient and more profitable than state-owned companies or in turn state ownership may adversely affect firm performance (Chan et al., 2018; Megginson & Netter, 2001). Whereas ordinary shareholders usually strive for profit and wealth maximisation, a high degree of state ownership could lead to pursuing competing goals, for example social or political objectives, suffering from high agency cost or lacking private property rights to facilitate efficient resource allocation (Alfaraih et al., 2012; Boardman & Vining, 1989; Capobianco & Christiansen, 2011; Chan et al., 2018; Martin & Parker, 1997; Phung & Mishra, 2016; Shleifer, 1998; Shleifer & Vishny, 1997; Villalonga, 2000). Based on the findings in the literature, a positive influence of private ownership on firm performance of German grid owner companies is expected. An interesting aspect is introduced by Heim (2015a). He argues that an important requirement for the profitability of a grid owner company is the expertise to operate a grid and the economic power of the private energy company. In general, municipalities have neither capital nor know-how or experience to operate a grid (Heim, 2015a). Consequently, the participation and contribution of the private energy company in a grid owner company seems to generate value and firm performance. Therefore, the ownership structure should be analysed in terms of private ownership percentage. As a consequence, the research hypothesis is as follows:

Hypothesis 2: The higher the percentage of private ownership, the higher the level of firm performance of German grid owner companies.

2.5.2.4 Legal form and firm performance

Research on the relationship between legal form and firm performance is very rare. With the exception of three publications, the researcher has not found any relevant empirical contribution to literature.

Zieseniß (2014) focuses on the influence of the legal form (independent variable) on the firm performance of dairy companies (dependent variable). He argues that cooperatives have disadvantages in earnings indictors compared to other legal forms, particularly a lower level of ROA. First, as the focus of the study is on

cooperatives that are not the subject of the research on grid owner companies, the results are not applicable. Second, whereas the dairy industry has market-based structures, grid owner companies as part of the German energy sector belong to the regulated environment. Hence, the results of Zieseniß (2014) with regard to the relationship between legal form and firm performance cannot be applied to grid owner companies.

Although the German water distribution sector is more comparable to the energy sector, the results of Ruester & Zschille (2010) who investigate the impact of governance structures on firm performance do not help in indicating the possible relationship between legal form and firm performance of German grid owner companies as firm performance is measured by retail prices that grid owner companies do not have.

In their empirical study, Pudil et al. (2016) come to the conclusion that the independent variable legal form, with the characteristics of joint-stock companies, limited liability companies or other, has no significant influence on firm performance, assessed by the ROA as the dependent variable. Actually, the assumption should be that legal form has no significant influence on firm performance of German grid owner companies. However, Pudil et al. (2016) do not refer to grid owner companies at all.

Heim (2015a) points out that preferred legal forms for grid owner companies are limited liability companies or limited partnerships with limited liability companies as general partners and a municipal majority shareholding with a cooperation partner as a minority shareholder (Heim, 2015a). As Heim's thesis belongs to the field of legal studies, no empirical evidence is given. It rather seems to be a statement in view of his professional practice. Moreover, the publication of the German Association of Towns and Municipalities points out that all private legal forms that are permitted by German municipal law could be suitable for a cooperation company. In particular, it is mentioned that the limited partnership with a limited liability company as general partner would be preferred by the founders (DStGB, 2017). However, no explanation for this statement, i.e. why the limited partnership with a limited liability company as general partner seems to be the most preferred legal form, is given.

Although there is no evident theoretical or empirical basis for the relationship between legal form and firm performance of German grid owner companies in the literature, the statement of the German Association of Towns and Municipalities indicates that the limited partnership with a limited liability company as general partner would be preferred by the founders (DStGB, 2017). Furthermore, it should be noted that limited partnerships with a limited liability company as general partner have a lower overall tax burden than limited liability companies (sections 2.4.6.3.7 and 2.4.6.4.7). This could be the starting point for the following research hypothesis:

Hypothesis 3: Grid owner companies in Germany that are limited partnerships have a higher firm performance than grid owner companies that are limited liability companies.

3. Methodology

3.1 Introduction

The methodology chapter of this thesis addresses two important aspects. On the one hand, the research philosophy or research paradigm as a basic belief system or worldview that guides the researcher (Guba & Lincoln, 1994) is presented (methodology part). The researcher examines how adopting realist, constructionist, interventionist and positivist research approaches might affect the understanding of the research questions and shape the creation of a research design to address these questions. Therefore, the four research approaches and their adaptations are discussed. The discussion is mainly focused on the differences between the four approaches, the role of the researcher's values for different approaches and the required skills needed for different approaches. This also comprises a critical evaluation and adaptation of the most suitable approach with regard to the selected research topic and the specific research questions. On the other hand, the procedures of gathering, analysing and presenting data on grid owner companies in Germany are outlined (methods part). The total population of grid owner companies in Germany as well as the relevant characteristics and variables are determined with regard to the research questions. The procedures for obtaining the data and the obtainable types of data are presented, including the relevant methods. In this step, the researcher is concerned with using a number of techniques of quantitative data analysis to reduce the amount of data gathered, to test for relationships between variables and to develop ways of presenting the results of the analysis (Bryman & Bell, 2011). It also involves looking at the data graphically to identify general trends (Field, 2013). Moreover, analysing data means fitting statistical models to the data and seeing whether or not it supports the hypotheses that are defined in statistical formulas. It is important to be fully aware of what techniques will be applied at an early stage, because one cannot apply any technique to any variable and the size and the nature of a sample could impose limitations on the techniques that can be used (Bryman & Bell, 2011).

3.2 Research designs and research philosophies

3.2.1 Definitions

In order to achieve the research objectives, the researcher has to make decisions about how research should be conducted or how research activities have to be organised. The so-called research designs also include the gathering of data. In short, it is making choices about what will be observed and how it will be observed (Easterby-Smith, Thorpe, & Jackson, 2012). The choices of research objectives and methods are often determined by philosophical views on the world. This means that the approach chosen by the researcher depends on their perspective on and underlying assumptions about the world. According to Moses and Knutsen (2012), any given research design and choice of methods is underpinned by a researcher's understanding of the nature of the world. Ryan, Scapens & Theobald (2002) point out that our values determine the way we conduct research. This understanding is typically expressed in the terms "ontology" and "epistemology" (Davies & Hughes, 2014). Ontology is a theory of the nature of social entities and deals with the nature of reality and existence (Bryman & Bell, 2011); this means "the study of being" (Moses & Knutsen, 2012, p. 4). The relevant questions are how the researcher views and perceives the social world, its rules and its structures (Davies & Hughes, 2014). Thus, "the world can be perceived in different and contrasting ways" (Moses & Knutsen, 2012, p. 6). The philosophical concept of epistemology denotes a theory of knowledge or the philosophical study of knowledge (Moses & Knutsen, 2012). It is a stance on what should be seen as acceptable knowledge (Bryman & Bell, 2011) and refers to assumptions about the best ways of inquiring into the nature of the physical and social worlds (Easterby-Smith et al., 2012). The relevant questions are what constitutes knowledge and how knowledge can be developed (Davies & Hughes, 2014). Finally, a methodology in the sense of a framework has to be chosen, namely research techniques and methods are grouped together to provide a coherent research picture (Easterby-Smith et al., 2012). In fact, the two terms "methods" and "methodology" are not synonyms. While the term method denotes research techniques, the term methodology refers to concepts, theories and principles of reasoning on a subject (Moses & Knutsen, 2012). Moses and

Knutsen (2012) recommend thinking of methods as tools and methodologies as toolboxes.

Furthermore, it is important to understand the difference between qualitative and quantitative research methods. On the one hand, quantitative research methods can be fast and economical. On the other, they seem to be inflexible and artificial. Moreover, they are not very effective in understanding processes or the significance that people attach to actions. They make it hard for policymakers to infer what changes and actions should take place in the future. In contrast, data gathered can be used to support the covert goals of decision-makers (Easterby-Smith et al., 2012).

Thus, in the following section, four common philosophical positions are discussed and their application to this research is challenged.

3.2.2 Realist perspectives on the research problem

Realism is a philosophical stance that originates from the traditions of the natural sciences (Davies & Hughes, 2014). The underlying assumption is that the physical and social worlds exist independently of any observations or perceptions made about them by the researcher (Easterby-Smith et al., 2012; Saunders, Lewis & Thornhill, 2011). In short, there is a reality with objects that is independent of the human mind and is influenced by the context (Saunders et al., 2011).

In contrast to realism, relativism assumes that scientific laws are created by people (Easterby-Smith et al., 2012). Several manifestations of realism can be distinguished, in particular traditional realism, transcendental realism, critical realism, empirical realism or internal realism (Bryman & Bell, 2011; Easterby-Smith et al., 2012). The supporters of traditional realism assume that the world is material and external and observations have a direct linkage to the real phenomena being examined (Easterby-Smith et al., 2012). A further modification of realism is transcendental realism. According to this philosophical position, research refers to real objects in the natural or social worlds that act quite independently of the researcher (Bhaskar, 1989; Bryman & Bell, 2011). Combining elements of naturalism and constructionism, Moses and Knutsen (2012) point out

that critical (or scientific) realism is a response to the critique that social phenomena cannot be approached in the same manner as phenomena in natural sciences. Critical realism deals with the identification of structures that generate the social world being studied. In other words, it focuses on providing an explanation for organisational events by examining the underlying causes and mechanisms (Saunders et al., 2011). In general, the supporters of critical realism aim at identifying structures and changing them in order to overcome inequalities and injustices. Whereas positivism is empiricist, critical realism is not, because structures identified may not be amenable to the senses as they are internal representations of the external world (Bryman & Bell, 2011). According to Saunders et al. (2011, p. 136) critical realists argue that "our knowledge of reality is a result of social conditioning and cannot be understood independently of the social actors involved in the knowledge derivation process". This means that researchers will only be able to understand the social world if they understand the social structures of the relevant phenomena; there is a bigger picture. To experience the world, two steps are needed. First, there is an object of the real world that we perceive and second, there is a mental processing afterwards (Saunders et al., 2011).

Easterby-Smith et al. (2012, p. 29) describe that critical realism "recognises social conditions (such as class or wealth) as having real consequences whether or not they are observed and then incorporates a relativist thread, which recognises that social life is both generated by the actions of individuals, and also has an external impact on them". Moreover, the structure of critical realism is characterised by three levels. First, the empirical domain that refers to the experiences and perceptions that people have. Second, the actual denotes events and actions that take place whether or not they are observed. Third, the real represents mechanisms that cannot be detected directly, but which have real consequences for people and society (Easterby-Smith et al., 2012). As supporters of critical realism argue that social facts are social constructions agreed on by people rather than existing independently, critical realist notions of causality cannot be reduced to statistical correlations and quantitative methods (Saunders et al., 2011). Moreover, critical realism corresponds with a range of research methods; nevertheless, specific choices of research methods should depend on the object of study (Moses & Knutsen, 2012).

Another development of realism is empirical realism. The underlying assumption of empirical realism (Easterby-Smith et al., 2012) is that reality can be understood through the use of appropriate methods (Bryman & Bell, 2011). Bhaskar (1989) criticises that empirical realism seems to be superficial, because it does not recognise that there are enduring structures and generative mechanisms underlying what can be observed. The representatives of internal realism point out that reality is independent of the observer, but that scientists can only access that reality indirectly by gathering evidence in fundamental physical processes. In short, it is impossible to gain objective information about an object, because the experiment itself determines the state of the object being studied. However, the representatives of internal realism accept that scientific laws once discovered are independent of further observations (Easterby-Smith et al., 2012; Putnam, 1988). Qualitative methods such as case studies and convergent interviews are often applied in realism research (Bryman & Bell, 2011).

Applied to the research topic of German grid owner companies, a qualitative based realist approach to research provides the opportunity to investigate causal relationships in a case study without the need to control for variables as they are less appropriate for explaining the social structures that underlie such patterns (Roberts, 2014). The authors featuring in the systematic literature review, for example Arnold (2012), Kunze (2012), Rosenberger (2012) and Heim (2015a), mainly apply a narrative approach to deal with the topic. Words rather than quantification in the gathering and analysis of data are emphasised by qualitative researchers (Bryman & Bell, 2011). This way of conducting research is compatible with the idea of (critical) realism. The research with regard to grid owner companies as well as critical realism deal with the identification of structures. The skill of the researcher could be demonstrated by exploring new relationships and patterns within a single grid owner company (Easterby-Smith et al., 2012). The supporters of critical realism aim at identifying structures and changing them in order to overcome inequalities and injustices (Bryman & Bell, 2011). The advantage of research on grid owner companies from a critical realist perspective could be that structural and cultural conditions could be seen as having an existence independent of social interaction. The structures or conditions of a grid owner company and the accounting practices exist, but they are not wholly determined by management, supervisory board members or shareholders of a grid

owner company. In general, critical realists claim that an entity could exist independently of our knowledge of it (Bryman & Bell, 2011). The researcher remains detached from the object to be investigated and is able to look for patterns or causal relations which are not directly accessible (Easterby-Smith et al., 2012).

However, as the researcher is interested in determining the population of German grid owner companies and analysing the relationships between firm size, ownership structure and legal form as critical drivers of firm performance of grid owner companies in Germany, the realist paradigm is less suitable. Overall, after having determined the population of German grid owner companies and analysed the relationships between firm size, ownership structure, legal form and firm performance, further research might focus on the social structures that underline the patterns with regard to German grid owner companies. Furthermore, as the phenomenon of German grid owner companies is relatively new and much of critical realist research takes the form of in-depth historical analysis of social and organisational structures, and how they change over time (Saunders et al., 2011), the researcher does not choose the realist paradigm.

3.2.3 Constructionist perspectives on the research problem

As defined by Bryman and Bell (2011, p. 713), constructionism is an ontological position that states that “social phenomena and their meanings are continually being accomplished by social actors”, i.e. social phenomena are social constructions. Constructionism is an interpretive approach (Easterby-Smith et al., 2012). In contrast to the views of positivism and realism, representatives of constructionism believe that reality is socially constructed or determined and given meaning by people. The assumption is that there is no absolute truth, and that truth becomes constructed (Easterby-Smith et al., 2012). Famous authors of (social) constructionism are Berger and Luckman (1966), Shotter (1993) or Watzlawick (1984). They focus on the ways that people make sense of the social world, particularly by sharing their experiences with others via language (Easterby-Smith et al., 2012). The patterns of interest are constructed by the observer and society (Moses & Knutsen, 2012). Nevertheless, representatives of constructionism argue that social phenomena are not only produced through

interaction, but that they are in a constant state of revision. This is important, because social interactions between actors are a continual process. Therefore, it is necessary to study the details of a situation in order to understand the action (Saunders et al., 2011). Knowledge is regarded as indeterminate, because the researcher always presents a specific version of social reality (Bryman & Bell, 2011). Driven by the idea that reality is not external, but determined by social actions of people, researchers should not gather facts and measure how often certain patterns occur. They should rather appreciate the different constructions and meanings that people place upon their experience. The focus of research is on people's feelings and thinking and the ways of communication with each other. In this context, the medium of language plays an important role (Easterby-Smith et al., 2012). People's behaviour is not explained by external causes or fundamental laws, but rather by the sense that people make of different situations. Constructionists try to understand the meaning of a social action for a social agent (Moses & Knutsen, 2012). The observer is part of what is being researched and aims to understand the relevant situation (Easterby-Smith et al., 2012). Because of the assumption that there may be many different realities, as understood by people, the researcher has to focus on multiple perspectives by a mixture of qualitative and quantitative methods (Easterby-Smith et al., 2012). Easterby-Smith et al. (2012) distinguish between "normal" constructionism and "strong" constructionism. Whereas normal constructionism allows a difference between individual and social knowledge, strong constructionism does not. Often described as "triangulation", normal constructionists gather different views and experiences of different people through a mixture of qualitative and quantitative methods. In contrast, strong constructionists aim at understanding how people invent structures to help them make sense of what is going on around them, focusing on the use of language and conversations between people (Easterby-Smith et al., 2012). Concerning the strengths and weaknesses of constructionism, Easterby-Smith et al. (2012) emphasise the ability to examine change processes over time, to understand people's meanings, to adjust to new issues and to develop new theories (Easterby-Smith et al., 2012). Furthermore, the gathering of data will be more natural (Easterby-Smith et al., 2012), for example by analysing language. In contrast, a thorough gathering and interpretation of qualitative data is very time-consuming and suffers from low credibility from policymakers due to a vast amount of subjective opinions (Easterby-Smith et al., 2012).

A possible research design for constructionists is archival research. In general, archival research consists of the “collection and analysis of public documents relating mainly to organisational or governmental strategies” by a detached researcher (Easterby-Smith et al., 2012, p. 339). Its focus is primarily on textual information and its analysis (Easterby-Smith et al., 2012). Smith (2014) applies a broad approach to the term archival. According to him, archival research refers to research based on historical documents, texts, journal articles, corporate annual reports or company disclosures. He distinguishes between primary and secondary sources or data. Primary data denotes original research results published for the first time and secondary data refers to aggregated information or information which has been reworked in databases (Smith, 2014). Preferred sources of archival data in business and management research are the annual reports from companies that contain statements from management with achievements from the past year and plans for the next year (Easterby-Smith et al., 2012).

Another constructionist process is ethnography. Bryman and Bell (2011, p. 714) define ethnography as “a research method in which the researcher immerses him- or herself in a social setting for an extended period of time, observing behaviour, listening to what is said in conversations both between others and with the fieldworker, and asking questions”. This strong form of constructionism aims at understanding the meanings and behaviour of a group of people under study (Easterby-Smith et al., 2012). Furthermore, ethnographers can also use narrative methods. Narrative methods concentrate on collecting stories told among organisational members. By collecting organisational stories, the researcher will gain insights into organisational life. On the one hand, the researcher could become part of the process of constructing stories and on the other, the researcher could ask people for stories they have heard. Depending on the role of the researcher, narrative research could be seen as more detached or more involved. For example, if the researcher encourages people to invent new stories, the research design is more involved (Easterby-Smith et al., 2012). Concerning the weaknesses of narrative methods, the critics argue that they do not provide additional value compared to usual qualitative research. Strengths can be seen in a holistic perspective towards organisational behaviour, in the development of social histories of identity and in the examination of relationships between individuals and the wider organisation (Easterby-Smith et al., 2012).

Applied to the research of grid owner companies, a constructionist would take the view that a grid owner company is not objective, but is socially constructed and governed by people. In short, a grid owner company can be seen as a social phenomenon. The manner in which assets are used and other decisions are made in a grid owner company can also be seen as having a constructed meaning that depends on the people involved. The different structures of a grid owner company, for example the different board structures, depend on the social actors, i.e. the board members. All relationships inside and outside the company are determined by the social interaction of the people involved. The focus of research is on the social actors and their interaction. From a constructionist perspective, different motives and experiences of the people involved, could contribute to the variety of structures of grid owner companies. Thus, different structures of grid owner companies and even different accounting practices are the result of the different social interactions of people.

In contrast to the philosophical view of realism, the focus of research is not primarily on the legal structures and accounting figures, but on the people's feelings, thinking and the ways of communication (Easterby-Smith et al., 2012). In a grid owner company, management, supervisory board and shareholders' meeting are typical boards. The members of these committees communicate with each other. So, the medium of language plays an important role in grid owner companies, too (Easterby-Smith et al., 2012). Taking the constructionist research philosophy to investigate the phenomenon of German grid owner companies from a constructionist perspective would require detailed investigations of the behaviours, views, motivations and experiences of the social actors in a grid owner company. On the one hand, the reasons why shareholders of a grid owner company, i.e. representatives of local government and of private energy companies, decide to establish a grid owner company could be investigated. On the other, the behaviours of social actors in different situations of a grid owner company's daily business could be emphasised. This approach is underpinned by the statement of Easterby-Smith et al. (2012) that the constructionist researcher is interested in the reasons for decision-making situations and not how often certain patterns occur.

Another important aspect could be the social context of a grid owner company. Even the market requirements of private energy companies, the guidelines of local government as well as the requirements of the German Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways that are important for grid owner companies are social constructions. Due to the fact that social phenomena are in a constant state of revision (Bryman & Bell, 2011), different developments of grid owner companies over time could be investigated. The specific research questions could be examined by interviews with the board members of a grid owner company. Furthermore, annual reports of grid owner companies in Germany that were founded in recent years could be examined. Especially the annual reports of grid owner companies which have to be published in the Federal Gazette in Germany could be analysed. They contain verbal management statements of information, for example financial and legal structures, the course of business, the composition of boards, and the development of annual net income. So, the relationship between the structure of ownership and the firm performance of a grid owner company could be examined by narrative methods. Due to the fact that qualitative methods are more effective in understanding the significance that people attach to action, in this case management, archival research seems to be a suitable approach to address the research topic. Besides, a single case study could be used to look in depth at one grid owner company. Case method could be defined as a research design that focuses on one, or a small number of, organisations, events or individuals, over time (Easterby-Smith et al., 2012). In general, case study methods are recommendable when a contemporary phenomenon should be analysed, the researcher has little control over events and questions like “how” or “why” are being examined (Yin, 2003).

In contrast to realism, the research quality of constructionist designs and the generalisation of outcomes are often questioned (Easterby-Smith et al., 2012). Easterby-Smith et al. (2012) point out that the results of constructionist research should be believable and they should be reached through transparent methods. In this context, the explanations of the researcher and how he or she gained access to an organisation, how data was created and how data was analysed are emphasised (Easterby-Smith et al., 2012). Although the research on several board members of specific grid owner companies and their feelings could produce useful insights into the nature of social interactions, the researcher of this thesis is

interested in the relationships between firm size, ownership structure, legal form and firm performance of grid owner companies in Germany. In short, due to the accounting background of the researcher, he focuses on financial and accounting figures, independent of the social actors' feelings. The generalisation of characteristics of grid owner companies, their typologies and their financial outcomes are more interesting than the feelings and experiences of the social actors of grid owner companies. As financial and accounting figures exist independently of social interaction, the constructionist approach will not be applied by the researcher. Maybe in future research, social actors with their feelings and communication in individual grid owner companies could be examined. Nevertheless, in order to support quantitative research on grid owner companies, archival research referring to statements of management could contribute to the bigger picture. Thus, it could contribute to practitioner knowledge. However, the population of German grid owner companies has to be determined in general before the involved people become subjects of research.

3.2.4 Interventionist (active) perspectives on the research problem

In contrast to the research perspectives discussed above, the supporters of interventionism or active research, especially Lewin (1947), assume that social phenomena are continually changing, and are not static. Action research works through a cyclical four-step process: planning, taking action, evaluating that action, leading to further planning then repeat (Rock & Levin, 2002). Theory building is incremental, moving through a cycle of developing theory, to action, to reflection, to developing theory, gradually from the particular to the general (Eden & Huxham, 2007). The researcher is no longer objective and independent from the object of study. Action research is participative and demands an integral involvement by the researcher (Eden & Huxham, 2007). The researcher becomes part of the research process itself, because the best way of learning about an organisation or social system is through attempting to change it. This should be an objective of the action researcher. According to Coughlan and Coghlan (2002), action research aims at taking action and creating knowledge and theory about that action. It is an approach to research that seeks understanding by attempting to change the situation under investigation (Easterby-Smith et al., 2012). Action research is primarily a qualitative approach, although Davies and Hughes (2014) point out that

the action researcher can use both, quantitative and qualitative approaches. Moreover, it is intended to lead to the solution of specific problems. This means that the action researcher and the client collaborate in the diagnosis of a problem and in finding a solution based on the diagnosis. The researcher is part of the organisation that requires the solution and generates a list of actions to solve a problem (Bryman & Bell, 2011). The output of combining action with research results from “involvement with members of an organisation” (Eden & Huxham, 1996, p. 75). Therefore, it is an approach that links researchers and practitioners and it is useful in researching and solving problems in organisations such as learning and change (Bryman & Bell, 2011). Writing about research outcomes of an action research project represents an important aspect of theory exploration and development (Eden & Huxham, 2007). Similar approaches are feminism as well as collaborative and participative forms of enquiry (Bryman & Bell, 2011). From a historical view, the idea of action research reached its peak with the community development movement and feminist activism in the second half of the twentieth century. Radical campaigners built research elements into their programmes, with the aim of achieving interaction between the accumulation of evidence and the implementation of funded projects. The central idea is that once researchers have identified areas of need, change will be more easily achievable (Davies & Hughes, 2014). The reflection and data gathering process as well as the emergent theories are most valuably focused on the aspects that cannot be captured by other approaches (Eden & Huxham, 2007).

According to the definition of Argyris, Putnam, and Smith (1985), action research can be defined as follows (Bryman & Bell, 2011, p. 413):

- “Experiments are on real problems within an organization and are designed to assist in their solution.
- This involves an iterative process of problem identification, planning, action, and evaluation.
- Action research leads eventually to re-education, changing patterns of thinking, and action. This depends on the participation of research subjects (who are often referred to in action research as clients) in identifying new courses of action.

- It is intended to contribute both to academic theory and practical action."

With regard to the strengths and weaknesses of action research in the context of qualitative methods, Bryman and Bell (2011) emphasise that in most cases action researchers are already part of the organisations and have a thorough understanding of the setting in order to conduct their research. In general, they have insights and are used to the object that is being examined (Bryman & Bell, 2011). However, the close relationship between the researcher and the members of an organisation or a project could have a negative impact on the research outcomes, too. Critics of action research often consider it as a mere consultancy project (Coughlan & Coghlan, 2002). Furthermore, action research can be criticised for its lack of repeatability and lack of rigour. Each action research project is situational and more or less unique. Therefore, it is difficult to generalise the results and to describe how to carry out such projects (Adams, Hoque, & McNicholas, 2006). It is important for action research to resist making assumptions before the action begins, because alternative interpretations are possible if pre-understanding is suppressed (Eden & Huxham, 1996). The combination of action and research could lead to difficulties of project control and it could be very time-consuming, because all participants of the project have to be involved substantially (Adams et al., 2006).

Because action research is a variant of applied research (Bryman & Bell, 2011), it could be a potential research approach to examine research questions concerning the new phenomenon known as grid owner companies in Germany. The researcher could be involved in a process of setting up a grid owner company in Germany, because he is an employee of a company which often founds grid owner companies together with local municipalities. While setting up a new grid owner company, the author could examine and influence a variety of decisions. For example, the author could be involved in the decision on the legal structures of a grid owner company, the composition of its boards, the structure of ownership and other relevant characteristics that could have an influence on the performance or net income of a grid owner company. By this, the author becomes an integral member of a team commissioned to bring about some new development, a change in policy or a challenge to existing practice. However, the philosophy of action research stems from the idea that knowledge is power. So, problems

sometimes can arise if the researcher's findings do not coincide with the ideas of the employer. Although action research is suitable while making changes within an organisation or its parts in order to understand the dynamic forces within (Bryman & Bell, 2011), the employment of the researcher could be prejudicial to the outcome. Furthermore, municipalities as potential owners are often skeptical about research activities while setting up a grid owner company. A process began ten years ago to phase out more than 20,000 rights-of-way contracts for electricity and gas grids throughout Germany. So, the idea of establishing cooperation models, for example grid owner companies, is relatively new. As the process of setting up grid owner companies in Germany is still going on, "an approach to research that seeks understanding through attempting to change the situation under investigation" (Easterby-Smith et al., 2012, p. 339) is not suitable. Maybe in future, when a steady state of grid owner companies has been reached, action research could be applied to change existing situations. Yet, the act of setting up a grid owner company could be a possible situation for applying action research design. However, whereas in action research qualitative research methods are used, the objectives of this research are more compatible with quantitative research methods. On the one hand, the determination of the population of German grid owner companies as well as the analysis of relationships between firm size, ownership structure, legal form and firm performance of grid owner companies in Germany from a financial perspective require quantitative approaches. On the other hand, the recommendation on the optimal design for profitable German grid owner companies will be based on the quantitative findings.

3.2.5 Positivist perspectives on the research problem

Based on the ideas of Comte (1853), the key idea of positivism as an epistemological position is that the social world exists externally, and that objective methods are required to measure its properties. Bryman and Bell (2011) specify the objective methods by asserting that positivism comprises the application of the methods of the natural sciences to the study of the social reality and beyond. Thereby, epistemology refers to views about the most appropriate ways of enquiring about the nature of the world (Easterby-Smith et al., 2012). Referring to the philosophical stance of the natural scientist, positivists gather data about observable objects and try to find patterns in the data in order to produce law-like

generalisations. This comprises the application of scientific empiricist methods designed to yield pure data and facts uninfluenced by human interpretation or bias and accessible to replication. However, there are also positivist researchers that seek to quantify qualitative data by applying hypothesis testing to data gathered in in-depth interviews (Saunders et al., 2011). In general, positivism is difficult to outline as it is used in a number of ways by different authors, ranging from a descriptive category to a superficial data gathering. With regard to the question of what is regarded as acceptable knowledge in a discipline, positivism postulates that only phenomena and knowledge confirmed by the senses can be warranted as knowledge. Knowledge is generated by the gathering of facts that provide the basis for laws. Science can be conducted in an objective way that is also value free (Bryman & Bell, 2011). Pugh (1983) emphasises the distinction between facts and values and made systematic comparisons across entities that would enable generalisations about the relationship between size, technology and structure. The role of research or theory is to generate hypotheses that can be tested and that will thereby allow explanations of laws to be assessed and to be developed (Bryman & Bell, 2011). Either the positivist researcher starts with hypotheses and then seeks data to confirm or disconfirm it, or the researcher develops several hypotheses and uses data to select the correct one (Easterby-Smith et al., 2012). However, it does not mean that the positivist researcher necessarily has to start with existing theory (Saunders et al., 2011).

The main philosophical assumptions of positivism are as follows (Easterby-Smith et al., 2012):

- The observer has to be independent from what is being observed.
- Objective criteria rather than human beliefs and interests determine the manner of the study.
- Identifying causal explanations and fundamental laws.
- Hypothesising fundamental laws and then accepting or falsifying hypotheses.
- Facts have to be measured quantitatively.

- Reduction of problems into the simplest possible elements.
- Generalisation by selecting random samples from which inferences can be drawn about the population.
- Making comparisons of variations across samples.

As the researcher aims to gather quantitative data on the financial performance of grid owner companies in Germany and search for patterns or causal relationships in the data to create law-like generalisations like those produced by natural scientists (Saunders et al., 2011), the philosophical stance of positivism is most appropriate for the research. At first, the population of German grid owner companies has to be determined or quantified. Then the relationships between firm size, ownership structure, legal form and firm performance of German grid owner companies have to be analysed by statistical or empirical methods. Finally, based on the findings, an optimal design for profitable German grid owner companies could be recommended. Furthermore, the academic and practical background strongly corresponds to the paradigm of positivism. Having studied Business Administration, Economics and Corporate Law and worked for more than 14 years in the accounting and auditing sectors, the devotion to quantitative data and its analysis is obvious. The researcher is used to applying statistical methods to produce primary quantitative data and analysing secondary quantitative data. Thus, addressing the research questions from the philosophical stance of positivism is preferred.

3.2.6 Results

In the context of the research topic, it has been examined how adopting realist, constructionist, interventionist and positivist perspectives might affect the understanding of the research and shape the creation of a research design to address the research questions. The differences between realist, constructionist, interventionist and positivist approaches to the research problem and research design, the role of researcher values for different approaches and the research skills needed have been discussed.

First, the discussion shows that the authors in the systematic literature review mainly apply a narrative approach belonging to research philosophies that rely on qualitative research.

Second, the researcher does not choose the (critical) realist paradigm as the phenomenon of German grid owner companies is relatively new and much of critical realist research takes the form of in-depth historical analysis of social and organisational structures, and how they change over time (Saunders et al., 2011).

Third, whereas constructionism mainly focuses on social actors with their feelings and communication, the researcher prefers a quantitative research design with regard to German grid owner companies.

Fourth, although action research is a variant of applied research and it could be a potential research approach to examine research questions concerning the new phenomenon known as grid owner companies in Germany, the novelty of the phenomenon is conflicting. When a steady state of grid owner companies has been reached, action research could be applied to change existing situations.

Finally, as the researcher aims to gather quantitative data on the financial performance of grid owner companies in Germany and search for patterns or causal relationships in the data to create law-like generalisations like those produced by natural scientists (Saunders et al., 2011), the philosophical stance of positivism is most appropriate for the research. At first, the population of German grid owner companies has to be determined or quantified. Then the relationships between firm size, ownership structure, legal form and firm performance of German grid owner companies have to be analysed by statistical or empirical methods. Finally, based on the findings, an optimal design for profitable German grid owner companies could be recommended. Furthermore, the academic and practical background strongly corresponds to the paradigm of positivism. Having studied Business Administration, Economics and Corporate Law and worked for more than 14 years in the accounting and auditing sectors, the devotion to quantitative data and its analysis is obvious. The researcher is used to applying statistical methods to produce primary quantitative data and to analyse secondary

quantitative data. Overall, positivism fits best with the researcher's own beliefs and is chosen to address the research questions.

3.3 Methods

3.3.1 Definitions and types of data

According to Bryman and Bell (2011), a research method is simply a technique for gathering data. The process of data gathering comprises the decisions on what to measure and how to measure it, i.e. how data are gathered (Field, 2013). In other words, data gathering refers to the methods used to gather information and the identification of variables to be measured (Easterby-Smith et al., 2012).

In contrast to qualitative data, quantitative data refers to the gathering of numerical data. Objective measurements and the statistical, mathematical, or numerical analysis of data gathered through questionnaires, and surveys, or by manipulating statistical data using computational techniques are employed (Bryman & Bell, 2011). Quantitative data are usually associated with positivism (Davies & Hughes, 2014). The underlying assumption of positivist methods is that the job of the researcher is either to start with a hypothesis of the nature of the world, and then seek data to confirm or reject it, or pose several hypotheses and seek data to select the correct one (Easterby-Smith et al., 2012). A hypothesis is an informed speculation about the possible relationship between two or more variables. A variable is an attribute on which cases vary (Bryman & Bell, 2011). To test hypotheses, variables have to be measured (Easterby-Smith et al., 2012). There are a lot of different forms and levels of variables. In general, variables can be categorical or continuous. Furthermore, they can have different levels of measurement (Field, 2013). An interval variable is defined as "data measured on a scale along the whole of which intervals are equal" (Field, 2013, p. 877). A ratio variable is "an interval variable with the additional property that ratios are meaningful" (Field, 2013, p. 882).

Most hypotheses can be expressed in terms of two variables, namely a proposed cause and a proposed outcome. One main goal of research is to determine the relationship or association between an independent variable and another variable

within a population. A variable that is a cause is known as an independent or predictor variable, because its value does not depend on any other variables. A variable that represents an effect is called a dependent or outcome variable, because its value depends on the cause (independent variable) (Field, 2013).

Given the research questions and the chosen research paradigm, gathering data through surveys or using secondary data sources are the principle methods of obtaining data that are available to the researcher. Both of them look for patterns and causal relations. For this research, interval or ratio variables are appropriate. These are variables where the distances between the categories are identical across the range of categories (Bryman & Bell, 2011).

In general, survey research denotes a cross-sectional design in relation to which data are gathered by self-completion questionnaires or by structured interviews on more than one case and at a single point in time. Quantitative data in connection with two or more variables are gathered in order to examine patterns in the relationship (Bryman & Bell, 2011).

First, survey data of grid owner companies can be gathered either through self-completion questionnaires where respondents record their own answers, or administered by interviewers face-to-face or over the telephone (Easterby-Smith et al., 2012). On the one hand, postal questionnaire surveys are cheaper than any other method that requires face-to-face contact with individuals. On the other hand, response rates can be very low, because there is no personal contact with the respondents. Web-based surveys, located on a website, can be customised for individual respondents more easily than postal surveys (Easterby-Smith et al., 2012). Where postal addresses or other contact details are not available, structured interview surveys may be the most effective way to gather survey data. A structured interview is defined as “a research interview in which all respondents are asked exactly the same questions in the same order with the aid of a formal interview schedule” (Bryman & Bell, 2011, p. 719). But they are more expensive than self-completion questionnaires as an interviewer has to be present. Finally, telephone interview surveys are cheaper than postal surveys and they also facilitate interactivity (Easterby-Smith et al., 2012).

Second, to address the research questions, it could be useful to undertake some secondary analysis of data (Davies & Hughes, 2014). In general, secondary data are research information or data that already exist in the form of publications or other electronic media and that were gathered by other people (Easterby-Smith et al., 2012). Archival sources of secondary data, such as financial or statistical data, could be used to gather data on legal forms, ownership structure, firm size and firm performance of grid owner companies in Germany. Typical archival sources are annual financial statements including balance sheets or profit and loss accounts, particularly from the Federal Gazette in Germany or other databases, e.g. Bloomberg, Thomson Reuters, etc. Furthermore, statistical data provided by the Statistical Offices of the German States in cooperation with the Federal Statistical Office are a frequently used archival source.

According to Easterby-Smith et al. (2012), the most important factor affecting the quality of what can be done with secondary data is the design of the database. Davies and Hughes (2014) point out that the advantage of these databases can be seen in their size, because they include a large volume of cases. Economics and finance usually rely more on secondary data such as public or corporate financial data and statistics, because quantitative methods can be fast and economical (Easterby-Smith et al., 2012). Moreover, geographical variations or change over time could be analysed by combining datasets (Davies & Hughes, 2014). In Germany, almost every company is forced to disclose its financial data in the German Federal Gazette and in the German register of companies, depending on its size. The German Federal Gazette provides annual and quarterly income statements, balance sheets and supplementary data items for German companies (Bundesanzeiger, 2019). Thus, it is possible to compare absolute or relative figures from the annual financial statements. Furthermore, information about the legal form or the ownership structure of grid owner companies can be taken from the German register of companies. Being aware of the fact that balance sheets and profit and loss accounts are influenced by earnings management and do not always show the “real picture of the world”, it is important to appreciate qualitative data in the annual reports. For example, the notes and the management reports have to be analysed with regard to the use of accounting discretion. Furthermore, the background of grid owner companies and the reasons of municipalities and

energy companies for founding grid owner companies have to be considered while analysing financial data.

3.3.2 Choice and justification of method

From the researcher's point of view, using secondary data is the most suitable research method on German grid owner companies, although structured interviews and self-completion questionnaires have their specific advantages.

First, secondary analysis offers the prospect of having access to high-quality data (Bryman & Bell, 2011) such as from the German Federal Gazette, the German register of companies or the GV-ISys. Depending on their size, ownership structure or legal form, the financial data of grid owner companies in Germany must be audited by an external auditor prior to disclosure and they are forced to disclose at least their balance sheet in the German Federal Gazette. GV-ISys contains official statistics that have been compiled in a neutral and professionally independent manner on every politically independent municipality in Germany (Statistische Ämter des Bundes und der Länder, 2019). The clear advantage of these databases is their size as they include a large volume of cases. Moreover, geographical variations or change over time could be analysed (Davies & Hughes, 2014).

Second, using secondary data offers the opportunity to have more time for data analysis. As data gathering is very time-consuming, it is possible to spend more time on analysing and interpreting data. It is fast and economical (Bryman & Bell, 2011).

Third, often the response rates of self-completion questionnaires can be very low, because there is no personal contact with the respondent (Easterby-Smith et al., 2012).

Fourth, according to the positivist paradigm, science must be conducted in a way that is value free, i.e. objective (Bryman & Bell, 2011). As gathering data by self-questionnaires and interviews with people could be influenced by subjective

human aspects, using secondary analysis of data rather corresponds to the principle of objectivity.

Finally, people are often very reluctant to reveal confidential and sensitive information in questionnaires or surveys, so that even the most skilled interviewer cannot gather relevant data of grid owner companies (Easterby-Smith et al., 2012).

However, the use of secondary data is contested in academia. For example, the researcher often does not have control over data quality. Therefore, the quality of data should never be taken for granted (Bryman & Bell, 2011).

To sum up, given the research questions to be addressed and the positivist research paradigm, using secondary data is the most suitable research method on grid owner companies in Germany.

3.3.3 Ethical considerations

The research will be undertaken in accordance with the requirements of “The University of Gloucestershire’s Handbook of Research Ethics”. The researcher has read and understood the underlying principles of research ethics. In general, secondary data from publicly available databases like the German Federal Gazette or the German register of companies will be used. As the researcher generates data in his accountant’s job by preparing financial statements of grid owner companies, primary data could also be taken. With regard to ethical issues, the possible use of primary data of grid owner companies by the researcher has to be approved by the general managers of the grid owner companies in advance. However, as long as no primary data of grid owner companies is used by the researcher, an approval is not necessary.

3.3.4 Data gathering

3.3.4.1 Total population

One of the greatest challenges of this research is the determination of the population of German grid owner companies as a basis for the sampling frame, i.e. the listing of all units in the population from which a sample of grid owner companies will be selected (Bryman & Bell, 2011). According to Field (2013), in statistical terms the expression population usually refers to the gathering of units to which researchers want to generalise a set of findings or a statistical model. In general, scientists are interested in finding results that apply to an entire population of entities. All individuals or objects within a certain population usually have a common characteristic or trait (Easterby-Smith et al., 2012). In this research, the population is essentially the universe of grid owner companies in Germany about which the researcher wishes to draw conclusions.

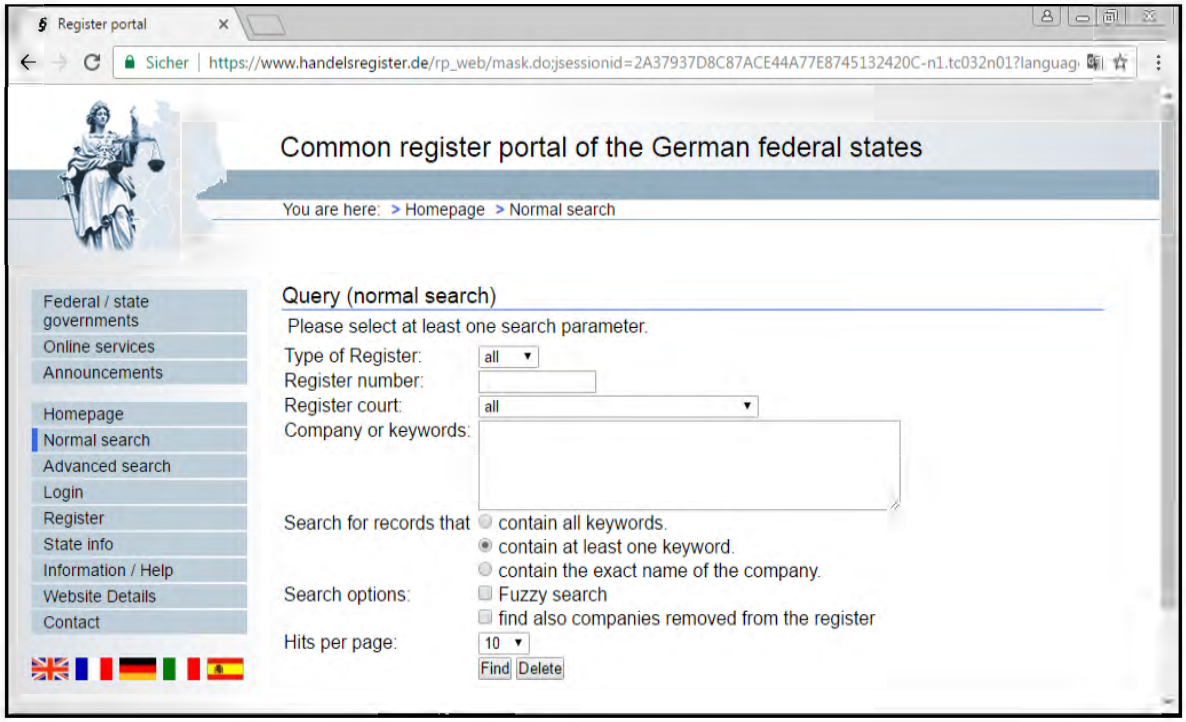
As the phenomenon of grid owner companies is relatively new and all grid owner companies in Germany are forced to disclose their financial statements, it is possible to gather data from the whole population of grid owner companies in Germany. For example, data from the financial statements for the years ending 31st December 2010 to 2015 can be gathered.

As grid owner companies in Germany are not obliged by law to provide information to the Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways like network operators or suppliers of energy, the determination of the population is not an easy task. Typical examples of financial databases like Bloomberg, Compustat or Thomson Reuters cannot be applied because of their design. Whereas they provide financial data on publicly listed companies, grid owner companies in Germany are usually not listed. As every German company, partnership and association must be officially registered in the Commercial Register according to the German Commercial Code, the Commercial Register is a suitable source of information to determine the population of grid owner companies in Germany. According to section 29 of the German Commercial Code, every business person is required to register its company, the place and domestic business address of its commercial establishment with the court in whose district

the place of business is located, for entry in the commercial register. The purpose of the companies' registers, which are kept locally by the respective district courts, is to disclose the details on the legal status of companies. Thus, it serves to improve security in business transactions for business people. The publicly accessible registers contain information on the company, type of legal entity, subjects of its business activity, registered office, individuals with representative power as well as their personal details and if applicable registered capital of the company. Moreover, they are maintained in an electronic format, contain copies of the company statutes and are open to public inspection (Common Register Portal of the German Federal States, 2018; PwC, 2018). Therefore, information about the legal form or the ownership structure of grid owner companies can be taken from the German register of companies.

Since 2007, German justice authorities through the Common Register Portal of the German Federal States offer the possibility to find an entry into the Commercial Register of any German state by using the website www.handelsregister.de. The Company Registry is divided into two sections. Section A (HRA) comprises entries of retail salesmen, the general partnership, the limited partnership and the European Economic Interest Grouping. Section B (HRB) contains entries of the following organisations: the public limited company, the association limited by shares, the limited liability company, the European public company, the Insurance Society and the Pension Fund Society. Furthermore, data from the Cooperative and Partnership Registries and from some of the Registry of Associations is offered, too (Common Register Portal of the German Federal States, 2018).

Figure 3: Website of the Common Register Portal of the German Federal States



The searches on the Common Register Portal of the States in Germany to determine the population of German grid owner companies were conducted between 1st May 2016 and 4th August 2017. Six key words comprising the nature of grid owner companies were applied. As a result, 1,385 entries have been found. All findings that did not refer to German electricity or gas grid owner companies were excluded.

Table 3: Search results

Key words	**Entries**
“Energiegesellschaft”	57
“Energieversorgung”	251
“Gasnetz”	27
“Netz”	870
“Netzgesellschaft”	143
“Stromnetz”	37

Furthermore, the consolidated financial statements for the years ending 31st December 2015 and 31st December 2016 of the four largest energy companies in Germany, E.ON, RWE, EnBW and Vattenfall, were reviewed for whether they contain grid owner companies in the list of shareholdings as part of the notes.

In all cases, the findings were mirrored against comprehensive lists of the German electricity and gas network operators by the Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways. They contain the name and the address of the network operator and the state in which the network operator is based. As the focus of the research is solely on grid owner companies and not on network operators, grid owner companies that are also network operators were excluded from the total population.

Through the process of gathering data to determine the total population of German grid owner companies, 170 different German grid owner companies have been identified. The population of grid owner companies consists of 140 limited partnerships with limited liability companies as general partners, 27 limited liability companies and 3 limited partnerships with public limited companies as general partners. Thus, the most popular legal form is the limited partnership with a limited liability company as general partner at 82 percent and the limited liability company follows at 16 percent. The findings correspond to the reviewed literature and confirm the qualitative statements. In particular, Heim (2015a) points out that preferred legal forms for grid owner companies are limited liability companies or limited commercial partnerships with limited liability companies as general partners.

Figure 4: Population: List of grid owner companies (extract)

Company Name	Legal Form	Federal State	Registered Office	Register Court
Abens-Donau Netz	GmbH & Co. KG	Bayern	Mainburg	Amtsgericht Regensburg
Bingen Netz	GmbH & Co. KG	Rheinland-Pfalz	Bingen am Rhein	Amtsgericht Mainz
Brüggen.E-Netz	GmbH & Co. KG	Nordrhein-Westfalen	Brüggen	Amtsgericht Krefeld
Cremlinger Energie	GmbH	Niedersachsen	Cremlingen	Amtsgericht Braunschweig
Dorsten Netz	GmbH & Co. KG	Nordrhein-Westfalen	Dorsten	Amtsgericht Gelsenkirchen
Elektrizitätsnetzgesellschaft Grünwald	GmbH & Co. KG	Bayern	Grünwald	Amtsgericht München
EMB Netz	GmbH & Co. KG	Hessen	Marburg	Amtsgericht Marburg
Energie Dannstadter Höhe	GmbH & Co. KG	Rheinland-Pfalz	Dannstadt-Schauernheim	Amtsgericht Ludwigshafen a. Rhein
Energie Kirchheim unter Teck	GmbH & Co. KG	Baden-Württemberg	Kirchheim unter Teck	Amtsgericht Stuttgart
Energie Mechernich	GmbH & Co. KG	Nordrhein-Westfalen	Mechernich	Amtsgericht Bonn
Energie Region Kassel	GmbH & Co. KG	Hessen	Vellmar	Amtsgericht Kassel
Energiegesellschaft Leimen	GmbH & Co. KG	Baden-Württemberg	Leimen	Amtsgericht Mannheim
Energienetz Neufahrn/Eching	GmbH & Co. KG	Bayern	Neufahrn b. Freising	Amtsgericht München
EnergieRegion Taunus - Goldener Grund -	GmbH & Co. KG	Hessen	Bad Camberg	Amtsgericht Limburg
Energieversorgung Denzlingen	GmbH & Co. KG	Baden-Württemberg	Denzlingen	Amtsgericht Freiburg
Energieversorgung Horstmar/Laer	GmbH & Co. KG	Nordrhein-Westfalen	Horstmar	Amtsgericht Steinfurt
Energieversorgung Immenstaad	GmbH & Co. KG	Baden-Württemberg	Immenstaad am Bodensee	Amtsgericht Ulm
Energieversorgung Kranenburg Netze	GmbH & Co. KG	Nordrhein-Westfalen	Kranenburg	Amtsgericht Kleve
Energieversorgung Niederkassel	GmbH & Co. KG	Nordrhein-Westfalen	Niederkassel	Amtsgericht Siegburg
Energieversorgung Strohgäu	GmbH & Co. KG	Baden-Württemberg	Gerlingen	Amtsgericht Stuttgart
Energieversorgung Timmendorfer Strand	GmbH & Co. KG	Schleswig-Holstein	Timmendorfer Strand	Amtsgericht Lübeck
Energieversorgung Vechelde	GmbH & Co. KG	Niedersachsen	Vechelde	Amtsgericht Braunschweig
EVB Gasnetz	GmbH & Co. KG	Bayern	Bobingen	Amtsgericht Augsburg
EVB Stromnetz	GmbH & Co. KG	Bayern	Bobingen	Amtsgericht Augsburg
Gasnetz Bad Oeynhausen	GmbH & Co. KG	Nordrhein-Westfalen	Bad Oeynhausen	Amtsgericht Bad Oeynhausen
Gasnetz Bornheim	GmbH & Co. KG	Nordrhein-Westfalen	Bornheim	Amtsgericht Bonn
Gasnetz Dillingen Lauingen	GmbH & Co. KG	Bayern	Dillingen a. d. Donau	Amtsgericht Augsburg
Gasnetz Ebersbach	GmbH & Co. KG	Baden-Württemberg	Ebersbach an der Fils	Amtsgericht Ulm
Gasnetz Günzburg	GmbH & Co. KG	Bayern	Günzburg	Amtsgericht Memmingen

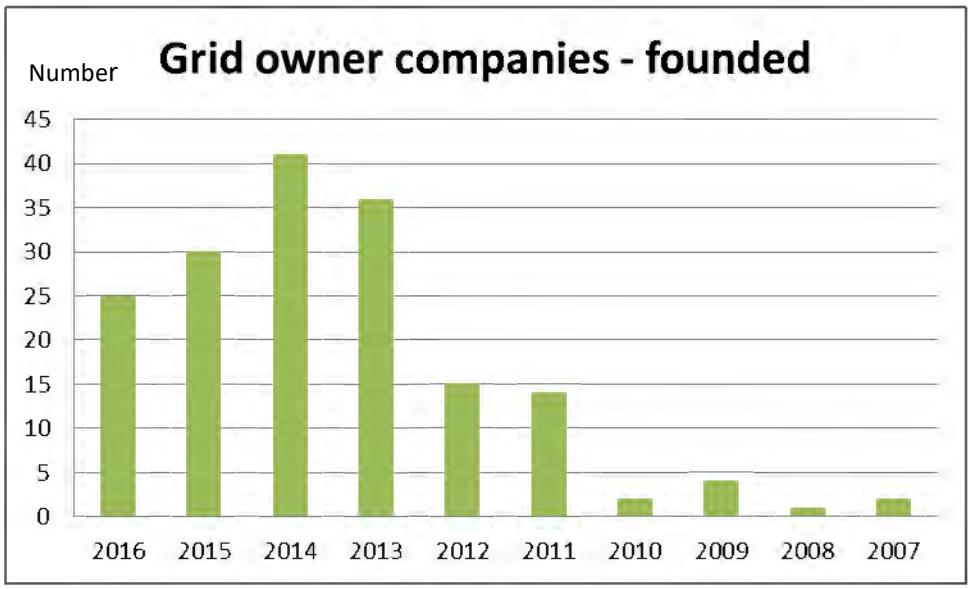
With regard to the geographical distribution over Germany, the registered offices of grid owner companies can be found in 11 of the 16 German Federal States. It is remarkable that most of the German grid owner companies are located in the Federal state of Baden-Württemberg, followed by North Rhine-Westphalia and Lower Saxony. Concerning the regional concentration of established grid owner companies, most are located in the western part of Germany, although during the reunification in the 1990s large numbers of new rights-of-way contracts with a duration of 20 years were negotiated, too. To sum up, more than 94 percent of the German grid owner companies are located in former Western Germany. So a decline from west to east is apparent.

Table 4: Geographical distribution of grid owner companies

State	Region	Number of companies
Baden-Württemberg	West	60
Bayern (Bavaria)	West	13
Brandenburg	East	6
Hessen (Hesse)	West	9
Niedersachsen (Lower Saxony)	West	25
Nordrhein-Westfalen (North Rhine-Westphalia)	West	44
Rheinland-Pfalz (Rhineland-Palatinate)	West	7
Sachsen (Saxony)	East	2
Sachsen-Anhalt (Saxony-Anhalt)	East	1
Schleswig-Holstein	West	2
Thüringen (Thuringia)	East	1

Referring to the time frame, the German grid owner companies, forming the total population, were founded between the years 2007 and 2016. Most of the grid owner companies in Germany were established in 2014. The entry of the date of incorporation in the Commercial Register is decisive for the year of foundation unless further information indicates an earlier date. For example, a grid owner company was founded in the year 2016, but the entry in the Commercial Register took place at the beginning of 2017.

Figure 5: Year of foundation



3.3.4.2 Characteristics

After having determined the population of grid owner companies in Germany and found some interesting characteristics, data on ownership structures, legal forms and size of grid owner companies in Germany have to be gathered to address the research questions.

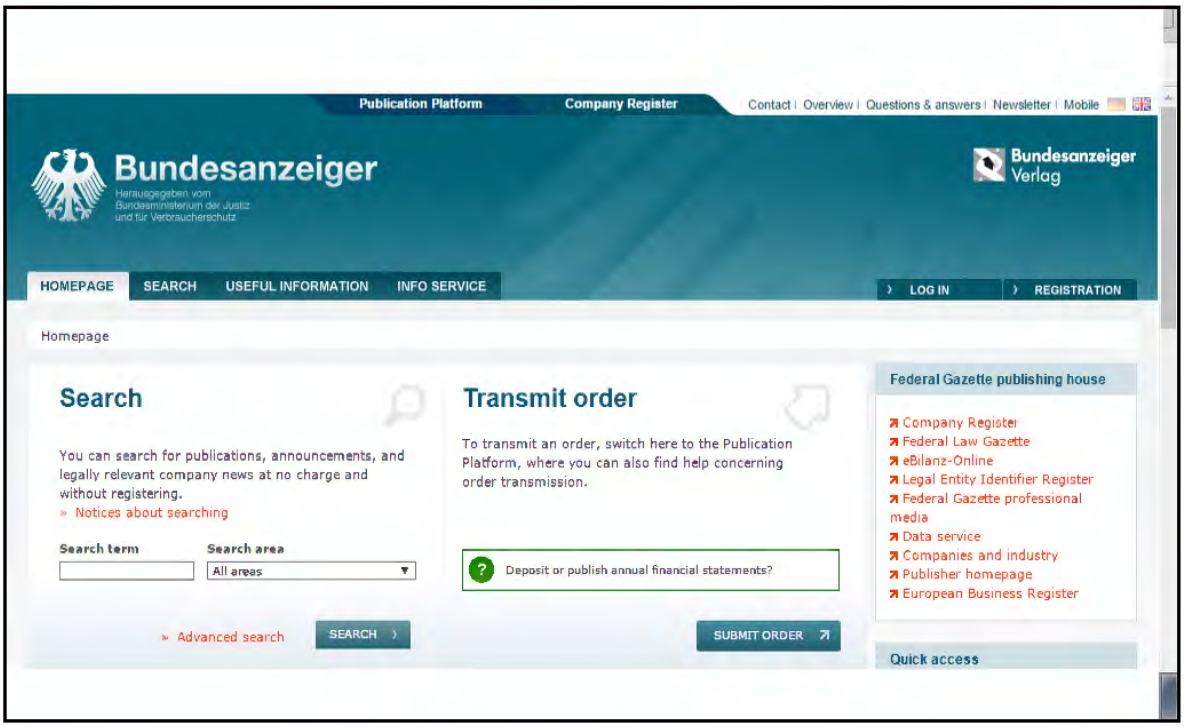
As companies in Germany are required by the German Commercial Code to disclose their annual financial statements in the German Federal Gazette, it provides a comprehensive source of data. The German Federal Gazette is the central platform for pronouncements and announcements, as well as for legally relevant company news. It provides annual and quarterly income statements, balance sheets and supplementary data items for German companies (Bundesanzeiger, 2019). Furthermore, it offers a fulltext search database but it is not possible to perform a fulltext search on the content of disclosed annual financial statements and publications pursuant to sections 264 (3) and 264b of the German Commercial Code. However, the relevant information can be retrieved from the comprehensive Company Register on the website http://www.unternehmensregister.de. The Company Register is the central platform for legally relevant company data. All important information required to be disclosed about companies is available and made electronically retrievable for the public.

Over the Company Register, the following information is provided (Unternehmensregister, 2019):

- commercial, cooperative and partnership register with the documents submitted
- publications from the German Federal Gazette
- balance sheets deposited with the Federal Gazette
- company-relevant messages from securities issuers
- disclosures of the bankruptcy courts

To sum up, in Germany almost every company is forced to disclose its financial data in the German Federal Gazette and in the German Register of Companies, depending on its size. Thus, it is possible to compare absolute or relative figures from the annual financial statements.

Figure 6: Website of the Federal Gazette



The data on population (inhabitants) and area as proxies for firm size of German grid owner companies are taken from the German Community Directory Information System (GV-ISys). It is a database provided by the Statistical Offices of the German States in cooperation with the Federal Statistical Office and contains official statistics that have been compiled in a neutral and professionally independent manner on every politically independent municipality in Germany. Among other key figures, the GV-ISys provides the following characteristics (Statistische Ämter des Bundes und der Länder, 2019):

- Official Regional Code
- Official Municipal Code
- Official name of municipality
- Postal Code of municipality
- Address of municipality
- Area in square kilometres
- Population (total, male, female)

The data on area as well as on population (inhabitants) is provided as quarterly or annual output in Excel format or as GV100 in ASCII format with fixed sentence structure and corresponding data record description (Statistische Ämter des Bundes und der Länder, 2019).

In the course of the determination of the population of German grid owner companies and the gathering of data from the German Federal Gazette, the German Company Register and GV-ISys, the following data on grid owner companies were gathered:

- company/commercial business name: According to sections 17 and 18 of the German Commercial Code, the business name of a trading company is the name under which it carries out its business and can sue as well as be sued. It shall be suited to designate the company and shall have a distinctive character. Moreover, the business name shall not contain any

information which is apt to be misleading with respect to business circumstances that are of material relevance for the market groups concerned.

- legal form: Reference to section 2.4.6.
- federal state: Germany as a federal republic consists of 16 states with each having its own federal constitution and measure of sovereignty. Whereas Berlin, Hamburg and Bremen are city states, the other 13 federal states (see section 3.3.4.1) belong to the category of area states.
- registered office: According to section 11 of the German Fiscal Code, corporations, associations of persons or conglomerations of assets shall have their registered office at a place which is determined by law, articles of partnership, statutes, acts of foundation or similar provisions.
- register court: According to section 8 of the German Commercial Code, the commercial register is maintained in electronic form by the courts in Germany.
- register number: The comprehensive commercial register number consists of the register court, the type of register and the individual number. The commercial register comprises two sections. Whereas limited liability companies and corporates are entered in section B, business partnerships can be found in section A (section 3 of the German Commercial Register Ordinance).
- date of foundation: The date of incorporation in the Commercial Register.
- divisions: In general, a grid owner company could have three different divisions, i.e. electricity, gas or water.
- shareholders and shareholding (in percent): The shareholders of the grid owner company and their shareholdings are identified. The ownership data provided in the German Register of Companies include the names of the shareholders and the percentage of shares owned. In this research, the focus is on the percentage of shares owned by local government, which is often the largest shareholder in a grid owner company due to municipal law in Germany. As the ownership structure could change during the year

(Boonyawat, 2013), the ownership structure at the balance sheet date, 31st December, has to be chosen.

- private participation quota: Based on the information on shareholding, the shareholdings of private shareholders are summarised. The focus is on the participation quota of private energy companies.

- group affiliation: If a grid owner company is an affiliated company and included in consolidated financial statements, the group parent company is determined.

- balance sheet and profit and loss account items: As the research focuses on German grid owner companies, the balance sheet and profit and loss account items are presented according to the accounting principles of the German Commercial Code. Companies with a profit-and-loss transfer agreement that account for compensation payments to minority shareholders and profit and loss transfers are treated as if they account for net income

- population: The data on the population or inhabitants, categorised by total, male and female, of each municipality are results of the population update as of 31st December 2010, 2011, 2012, 2013, 2014 and 2015, currently updated on the basis of the results of the last census (2011 census on the reference date 9th May 2011) or previous censuses (for example, 1987 census).

- area: The area specified for every municipality is basically the district area (cadastral area according to the German surveying authorities) measured in square kilometres as of 31st December 2010, 2011, 2012, 2013, 2014 and 2015.

The data on German grid owner companies were gathered in a Microsoft Excel spreadsheet. It serves as a simple database. In Excel the data are organised into tables using rows and columns of a worksheet. The grid owner companies can be found in rows and their characteristics or variables in columns. This corresponds to a rectangular layout for the data, i.e. a spreadsheet as a single rectangle with rows corresponding to subjects and columns corresponding to variables. The first row contains the names of the variables. Thus, the data could be analysed and

visualised in a separate programme. It reduces the risk of contaminating the raw data in the spreadsheet (Broman & Woo, 2018).

3.3.4.3 Limitations and sampling

The required data on grid owner companies does not exist for the total population of grid owner companies. Thus, data have to be gathered from a small subset of the population known as a sample and to be used to infer information about the whole population (Field, 2013). In order to use a sample with the highest possible validity, the total population is adjusted.

Inferential statistics are applied to make inferences or judgements about a larger population based on the gathered data from a sample (Davies & Hughes, 2014). When sampling is applied, hypothesis testing is used to make inferences about the population of grid owner companies based upon data drawn from the samples (Easterby-Smith et al., 2012). In general, researchers are interested in finding results that apply to an entire population of entities (Field, 2013). Patterns in that sample data have to be identified and the conclusions drawn from those patterns are used to make claims that go beyond the sample itself (Easterby-Smith et al., 2012). Then, statistical tests are used to determine how likely it is that the pattern observed would occur if the hypothesis was not true (Davies & Hughes, 2014). The researcher has to make a decision about the sampling unit and on what basis sampling is to be undertaken. The random sample is the most basic form of sampling, i.e. random number tables are used to select sample units (Bryman & Bell, 2011). The bigger the sample, the more representative it is likely to be, regardless of the size of the population from which it is drawn (Bryman & Bell, 2011).

Before 2010 only a few rights-of-way contracts were phased out and only a few grid owner companies were established. As the annual financial statements of German companies have to be submitted to the Federal Gazette within twelve months of the balance sheet date, the effective disclosure is often made several months later. The researcher finished the data gathering in August 2017 and it comprises the annual financial statements of the years ending 31st December 2010 to 2015. Moreover, firms with accounting periods that do not end on 31st

December will be excluded from the research. The reasons for these exclusions are that the data of grid owner companies with a short fiscal year will not be comparable to the data of the other grid owner companies with a full fiscal year. Thus, bias is avoided.

In case the data could not been taken from the annual financial statements disclosed in the German Federal Gazette, the German Register of Companies or the German Community Directory Information System (GV-ISys), the following alternative sources were used, if applicable

- consolidated financial statements of the parent company,
- website of the company,
- protocols of the municipal council.

3.3.5 Data analysis procedures

3.3.5.1 General remarks

Based on a positivist approach, statistical techniques are used to understand causal relationships (Field, 2013), i.e. testing hypotheses involves building statistical models with regard to grid owner companies. Referring to the research questions, the appropriate data analysis methods, i.e. the methodical basis for the test of hypotheses, are presented in the following sections. Thus, the presentation comprises the definition of the statistical model and the applied measures and variables. Finally, bivariate and multivariate statistical analyses are used to test the data.

3.3.5.2 Descriptive statistics

Analysing data also means that the general trends in the data are studied (Field, 2013). On the one hand the average of a distribution of values can be examined and on the other, the amount of variation (Field, 2013). With regard to the measures of central tendency, there are three different forms of average. First, the arithmetic mean represents the total of a distribution of values divided by the

number of values. Second, the median is the mid-point of a distribution of values. Third, the mode denotes the value that occurs most in a distribution of values (Bryman & Bell, 2011). To quantify the amount of variation in the data, measures of dispersion have to be applied (Field, 2013). The range is one way of measuring dispersion. It is “the value of the smallest score subtracted from the highest score” (Field, 2013, p. 882). Furthermore, the standard deviation is a common measure of dispersion. It is the average amount of variation around the mean (Bryman & Bell, 2011).

Tables, diagrams or charts are common methods of displaying quantitative data.

A frequency table presents the number or percentage of units in different categories of a variable in question. The categories have to be grouped when an interval or ratio variable is displayed. To analyse and display relationships, contingency tables seem to be very flexible. They are similar to frequency tables and allow for analysing two variables simultaneously. Thus, relationships or causalities between two variables can be examined. In general, users of contingency tables often present the presumed independent variable as the column variable and the presumed dependent variable as the row variable (Bryman & Bell, 2011).

According to Bryman and Bell (2011), diagrams are among the most frequently used methods of displaying quantitative data. They are rather easy to interpret and to understand. Scatter diagrams, also known as scatterplots, are useful to show relationships between pairs of interval or ratio variables. To display interval or ratio variables, a histogram (frequency distribution) is appropriate, too (Bryman & Bell, 2011). It is a graph that plots values of observations on the horizontal axis; the bar shows how many times each value occurs in the data (Field, 2013). In contrast to a bar chart, there is no space between the bars (Bryman & Bell, 2011).

Furthermore, the boxplot (box-whisker diagram) is another way to display the data (Field, 2013). A boxplot displays central tendency, dispersion and it also indicates any outliers (Bryman & Bell, 2011). Depending on the position of the median, they vary in their shape as the median is at the center of the plot (Field, 2013).

3.3.5.3 Regression analysis

As the researcher aims to analyse quantitative data on the firm performance of grid owner companies in Germany, and search for patterns or causal relationships in the data to create law-like generalisations (Saunders et al., 2011), regression analysis seems to be an appropriate analytical technique. In general, regression analysis is a set of statistical processes to estimate the relationships among variables; i.e. the focus of the analysis is on the relationships between one or more predictor variables and an outcome variable. Regression analysis means fitting a model to the data and using it to predict values of an outcome variable from one or more predictor variables (Davies & Hughes, 2014; Field, 2013). In other words, regression analysis is used to model the dependence of a variable on one or more explanatory independent variables (Davies & Hughes, 2014) Thus, the task is to find the mathematical formula that best describes the relationship between the relevant variables (Field, 2013). In contrast, correlation analysis as a method of statistical evaluation used to examine the strength of a relationship between two variables does not imply causality. In particular, correlation coefficients give no indication of the direction of causality. Hence, questions on the cause-effect-relationships of variables are usually addressed by the application of regression analysis (Field, 2013). Overall, bivariate and multivariate statistical analyses are appropriate to test the data. Whereas “bivariate analysis is concerned with the analysis of two variables at a time in order to uncover whether or not the two variables are related” (Bryman & Bell, 2011, p. 346), “multivariate analysis entails the simultaneous analysis of three or more variables” (Bryman & Bell, 2011, p. 350).

There are several regression techniques, in particular linear, logistic and multiple regressions. According to Davies and Hughes (2014), the selection of a particular regression technique depends on the type of variables. Whereas linear regression models are based upon a straight line with regard to interval or ratio variables, logistic regression is a version of multiple regression in which the outcome is a categorical variable (Field, 2013).

A simple regression is a linear model in which one variable or outcome is predicted from a single predictor variable. The formula is: $Y_i = (b_0 + b_1X_i) + \varepsilon_i$.

Y_i denotes the outcome variable, X_i the independent variable, b_1 is the regression coefficient, b_0 is the value of the dependent variable when the independent variable is zero and ε_i symbolises some error (Field, 2013). An extension of simple regression is multiple regression in which an outcome is predicted by a linear combination of two or more predictor variables (Field, 2013).

In research on corporate governance, a lot of critical drivers that determine firm performance were already identified. For example, firm size, industry affiliation and debt ratio have an influence on firm performance. However, these influences could not be identified in univariate analyses. Multivariate analyses offer the opportunity to isolate effects and to minimise bias (Fessler, 2013). Hence, regression analysis is also preferred and supplemented by tests of robustness.

The structure of the multiple linear model is as follows:

$$Y_i = (b_0 + b_1 * X_{1i} + b_2 * X_{2i} + \ldots + b_n * X_{ni}) + \varepsilon_i$$

Y represents the outcome (dependent variable), and each predictor (independent variable) is denoted as X. b_1 is the regression coefficient of the first predictor X_1, b_2 is the regression coefficient of the second predictor X_2, etc. In general, each predictor has a regression coefficient b associated with it that represents the gradient of the regression line in a simple regression model. The regression coefficients b estimate the relationship between predictors and the outcome, i.e. the value of b stands for the change in the outcome resulting from a unit change in the predictor (Field, 2013). b_0 as the intercept of the regression line is the value of the outcome when all predictors are zero. The error term of a regression model is symbolised by ε. It summarises all those factors that have an influence on the dependent variables beyond the independent variables (Kohler & Kreuter, 2016). To assess the error in a regression model, the sum of squared errors is used, the so-called residual sum of squares (Field, 2013). In all cases, the sub-script $_i$ denotes an individual item, for example a grid owner company.

Applied to the phenomenon of grid owner companies, the ROA as the outcome (dependent variable) is denoted as Y_i. X_1 stands for the population or area as proxies for firm size, X_2 symbolises the private participation quota and X_3 refers to

the legal form of a grid owner company. Hence, the multiple linear regression model is suitable for the analysis.

As the same German grid owner companies are observed over several years, i.e. from 2010 to 2015, the data have a temporal dimension and form a panel. Normally, panel data are analysed by panel data regression. However, the data on German grid owner companies from 2010 to 2015 are not enough to run a valid panel data regression. One main reason is that grid owner companies are a relatively new phenomenon and most of them were established in 2014. Thus, instead of panel data regression, multiple linear regression seems to be a suitable method.

In order to find the regression model or the regression coefficients that fit best with the data, the OLS method is applied. OLS stands for ”Ordinary least squares” and is a method of regression in which the parameters of the model are estimated using the method of least squares. It is a method of estimating parameters, here regression coefficients, that is based on minimising the sum of squared errors. The parameter estimate will be the value out of all possible values that has the smallest sum of squared errors. The aim of a multiple linear OLS regression model is to determine the influence of at least two independent variables on a dependent variable (Field, 2013; Kohler & Kreuter, 2016). As the underlying analysis aims at determining the influence of firm size, private participation quota and legal form on firm performance of German grid owner companies, a multiple OLS regression model is chosen.

To sum up, in the following regression analysis, the influences of population or area as proxies for firm size, private participation quota and legal form on ROA are investigated. Thus, a multiple linear regression is applied and an ordinary least squares estimation method is used.

The estimation of regression coefficients of a regression model with the OLS method is determined by the assumption that the expected value of error terms is zero, formally $E(\varepsilon) = 0$. It means that all influences on the dependent variable that are not part of the model cancel each other out on average.

In other words, these other influences are zero over a large number or repetitions (Kohler & Kreuter, 2016). To avoid biased estimations, it has to be checked whether the requirements are met (Kohler & Kreuter, 2016).

The assumption E (ε) = 0 is violated if

(1) the relationship between the dependent and one of the independent variables is non-linear,

(2) individual outliers excessively influence the regression outcomes and

(3) multicollinearity between the independent variables exists.

A violation of the requirements reduces the quality of the results. However, a full compliance of all assumptions is not possible in practice as this requires a pure linear relationship between the independent and dependent variables (Field, 2013; Kohler & Kreuter, 2016).

Concerning the methods of predictor selection, i.e. the way in which variables can be entered into the regression model, different methods have to be distinguished. In order to obtain a robust regression model, only those predictor variables that account for a large proportion of the outcome variable should be included in the model. In general, stepwise regressions like the forward and the backward method, hierarchical (blockwise entry) method and forced entry are common methods. Whereas stepwise techniques are often influenced by random variation in the data, forced entry as a method in which all predictors are forced into the model simultaneously is seen as the only appropriate method for theory testing (Field, 2013). Thus, forced entry is chosen in this thesis. As a rule of thumb, the number of observations should be about 20 times larger than the number of variables studied (Schneider, Hommel, & Blettner, 2010).

The general procedure for conducting regression analysis and fitting a regression model is as follows (Field, 2013):

(1) Producing scatterplots in order to check if the assumption of linearity is met, and also check for any outliers and obvious unusual cases.

(2) Running initial regression and fitting a model.

(3) Generalising the model beyond the sample by examining residuals to check for homoscedasticity, normality, independence and linearity.

3.3.5.4 Significance and accuracy of the model

In general, research has to be reliable and valid. On the one hand, reliability refers to the consistency of a measure of a concept. On the other hand, validity questions whether or not an indicator really measures a concept (Bryman & Bell, 2011).

In order to generalise the findings outside of the sample, the underlying assumptions of the linear model have to be met. The main assumptions of the linear model are as follows (Field, 2013; Gelman & Hill, 2007):

(1) Additivity and linearity: The model is valid if it can be described by the linear model. In addition, the dependent variable is an additive, noninteractive function of two or more independent variables.

(2) Independent errors: A lack of autocorrelation is aimed at, i.e. the residuals of two observations in a regression model are not correlated.

(3) Homoscedasticity: The residuals at each level of the predictor variables have similar variances; i.e. the spread of residuals should be fairly constant.

(4) Normally distributed errors: The residuals in the model are random and normally distributed variables with a mean of 0.

The validity of the results of a regression analysis requires that the assumptions of the linear model are met. Then, the estimated regression coefficients of the independent variables can be analysed. The null hypothesis assumes that the independent variables have no influence on the dependent variable: $b_i = 0$. If b_i is different from 0, the t-test is used to determine the significance of the influence. The t-statistic is the ratio of the departure of the estimated value of the regression coefficient from its hypothesised value to its standard error. A regression coefficient is significant at a level α if the probability of error in the case of a rejection of the null hypothesis is lower than α (Fessler, 2013; Field, 2013).

The assessment of the accuracy of a model across different samples is called cross-validation. One common method of cross-validation is the adjusted R^2. It is a measure of the loss of predictive power or shrinkage in regression. It measures how much variance in the outcome would be accounted for if the model has been derived from the population from which the sample was taken (Field, 2013). As the value of R^2 always increases with any additional independent variable, the adjusted R^2 considers the number of predictors, k, and the sample size, n (Kohler & Kreuter, 2016):

$$\text{adj. } R^2 = 1 - \frac{n-1}{n-k} * (1 - R^2)$$

Nevertheless, a high value of the adjusted R^2 might indicate multicollinearity. It describes a situation in which two or more variables are very closely linearly related, i.e. a strong correlation between two or more predictors exists. That makes it difficult to assess the individual importance of a predictor (Field, 2013). Multicollinearity with regard to the independent variables is tested by variance inflation factors (VIF) for each independent variable. The VIF indicates whether a predictor has a strong linear relationship with other predictors in an ordinary least squares regression analysis. The formula of the VIF is as follows:

$$VIF_k = \frac{1}{1 - {R_k}^2}$$

As a rule of thumb, a variable whose VIF values are greater than 10 needs further investigation. A tolerance value (1/VIF) lower than 0.1 is comparable to a VIF of 10 (Field, 2013).

In order to test the assumption that E (ε) = 0 in the regression model, the residual-vs.-fitted-plot is applied. It denotes a scatterplot of the residuals of a linear regression against the predicted values (Kohler & Kreuter, 2016).

3.3.5.5 Hypotheses

3.3.5.5.1 Testing

Being attracted to a positivist approach, statistical techniques are used to understand causal relationships (Field, 2013); i.e. testing hypotheses involves building statistical models with regard to grid owner companies. There are two types of hypotheses that are compared through statistical testing. The null hypothesis states that there is no relationship between the variables. It is needed as the hypothesis cannot be proved using statistics, but evidence can be gathered to reject the null hypothesis (Field, 2013). This is compared to the alternative hypothesis that states there is some kind of relationship. The null hypothesis can be tested and found to be false, which then implies there is a relationship between observed data. Falsification denotes the act of disproving a hypothesis or theory (Field, 2013). If the null hypothesis is supported, the alternative hypothesis is not upheld (Bryman & Bell, 2011). However, making decisions about whether to accept a hypothesis or not does nothing to explain why such a difference might occur (Easterby-Smith et al., 2012).

In order to perform the regression analysis, each of the hypotheses is restated in the null form.

3.3.5.5.2 Hypothesis 1

Hypothesis 1: There is a positive relationship between firm size and firm performance of grid owner companies.

Null hypothesis 1: There is no relationship between firm size and firm performance of grid owner companies.

3.3.5.5.3 Hypothesis 2

Hypothesis 2: The higher the percentage of private ownership, the higher the level of firm performance of grid owner companies.

Null hypothesis 2: There is no relationship between the percentage of private ownership and the level of firm performance of grid owner companies.

3.3.5.5.4 Hypothesis 3

Hypothesis 3: Grid owner companies in Germany that are limited partnerships have a higher firm performance than grid owner companies that are limited liability companies.

Null hypothesis 3: Grid owner companies in Germany that are limited partnerships do not have a higher firm performance than grid owner companies that are limited liability companies.

3.3.5.6 Applied statistical software

The process of analysing the data can be supported by analytical software. Therefore, the choice of appropriate statistical software, i.e. the computer programme for analysis in statistics, has to be made. There are several software tools that could be used to run the quantitative statistical analyses (Field, 2013). Applied to this research, IBM SPSS Statistics or Stata are selected for the shortlist as they constitute comprehensive statistics software packages. In both programmes, multiple regression analysis can be performed. IBM SPSS Statistics is known as “the Statistical Package for the Social Sciences”. It was launched in 1989 and has become one of the standard analytical tools for quantitative researchers (Davies & Hughes, 2014). Whereas SPSS prevails in the social sciences and psychological research, Stata is common in the finance and econometrics research community (Kohler & Kreuter, 2016). Moreover, the command structures of Stata are more flexible in documenting the results. Therefore, Stata in the standard version Stata 15/IC is used for the empirical research. The name is a syllabic abbreviation of the words statistics and data. It is

a complete, integrated general-purpose statistical software package and includes data management, statistical analysis, graphics, simulations, and regression. The dataset is always rectangular in format, i.e. all variables hold the same number of observations. The gathered data of grid owner companies are imported from an Excel spreadsheet. Stata uses user-written commands created in a do-file (Kohler & Kreuter, 2016).

3.3.6 Definition of variables

3.3.6.1 Introduction

This section covers the measures and variables applied in the statistical methods. It focuses on the dependent and independent variables that are used in the following statistical analyses. Whereas the ROA denotes the dependent variable, population and area as proxies for firm size, private participation quota and legal form represent the independent variables. In general, if a grid owner company has a missing value for any variable, then it is excluded from the whole analysis. The selection of the predictors is based on a sound theoretical rationale and well-conducted past research that has demonstrated their importance (Field, 2013).

3.3.6.2 Dependent variable

The dependent variable is a ratio whose size or variation should be explained with the regression model (Fessler, 2013). The return on assets ratio as the dependent variable in this thesis is defined as follows:

$$ROA = \frac{net\ income}{total\ assets}$$

The net income pursuant to section 275 (2) of the German Commercial Code is based on the operating result, i.e. operating income less operating expenses, less financial result and less taxes. According to section 266 (2) of the German Commercial Code, on the one hand total assets is the sum of the assets on the asset side of the balance sheet at the balance sheet date. Due to double-entry bookkeeping, total assets correspond to the sum of equity and debt capital on the

liabilities side of the balance sheet. With regard to the consistency of the ratio, the numerator should be represented by profit before interest and tax (Ryan & Collett, 2017). However, as grid owner companies are not obliged to disclose profit before interest and tax in their financial statements, net income is chosen. In Stata, the abbreviation “ROA“ is used for the variable.

3.3.6.3 Independent variables

3.3.6.3.1 Population

An important independent variable of interest in this thesis is firm size. According to section 2.4.2, a suitable proxy for the size of a grid owner company that is not implied in the measurement of firm performance is the population, i.e. the inhabitants. Not being implied in the measurement of firm performance means that the relevant variable or proxy is neither part of the numerator nor of the denominator of the dependent variable. In other words, the population is neither part of the net income nor of the total assets, so there is no mechanical correlation between population and ROA.

The data on the population, categorised as total, male and female, of each municipality are results of the population update as of 31st December 2010, 2011, 2012, 2013, 2014 and 2015, currently updated on the basis of the results of the last census (2011 census on the reference date 9th May 2011) or previous censuses (for example, 1987 census).

In Stata, the metric variable is denoted “einwohner“, the German translation for population.

3.3.6.3.2 Area

According to section 2.4.2, another suitable proxy for the size of a grid owner company is area. The area specified for every municipality is basically the district area (cadastral area according to the German surveying authorities) measured in square kilometres as of 31st December 2010, 2011, 2012, 2013, 2014 and 2015. As many grid owner companies own grids that are located in several

municipalities, the areas of each municipality have to be added up in order to determine the area of a grid owner company. In general, the larger the area of a municipality and ultimately of a grid owner company, the more grid facilities like house connections, distribution lines or local network stations are installed and owned by the grid owner company. The data on area are also taken from the German Community Directory Information System (GV-ISys).

In Stata, the metric variable is denoted “flaeche“, the German translation for area.

Furthermore, a logarithmic transformation (natural logarithm) shows a better approximation to the normal distribution. In case of right-skewed distributions, the natural logarithm of the relevant variable is often used. The underlying assumption is that a logarithmic relationship between the independent and the dependent variable exists. The higher the value of the independent variable, the smaller the variation of the dependent variable when the independent variable varies by one further unit (Field, 2013). In Stata, the abbreviation “ln(area)“ is used for the variable.

3.3.6.3.3 Private participation quota

The private participation quota denotes the percentage of participation of private companies in the registered capital of a grid owner company. If two or more private companies are shareholders or partners, their percentages are added up to determine the private participation quota. In this context, a private company is a company that is not owned by a municipality or municipal company. In Stata, the abbreviation “Beteiligung“ is used for the metric variable.

3.3.6.3.4 Legal form

The legal form of a grid owner company is not a financial figure. Rather, it is a string variable. As it is not possible to do calculations with strings, in particular in a regression model, they have to be converted into numerical variables. With the command “encode“ in Stata, numeric values for each string are generated and the text field itself is used as a value label. The command “encode“ assigns values in

alphabetical order, i.e. the value 1 for the first entry of the alphabetically sorted string variables (Kohler & Kreuter, 2016).

As the total population of German grid owner companies contains just three limited partnerships with a public limited company as general partner (AG & Co. KG), they are excluded from the analysis. Due to the non-representativeness of this legal form, only limited liability companies (GmbH) and limited commercial partnerships with a limited liability company as general partner (GmbH & Co. KG) are part of the analyses. In the regression analysis with Stata, limited partnerships with a public limited company as general partner (AG & Co. KG) are replaced with the relevant command: “replace Rechtsform = . if Rechtsform == 1“.

With regard to the regression analysis, the variable “Rechtsform“ is prefixed with i. to specify indicators for each level (category) of the variable. Stata generates virtual dummy variables in the background, chooses a reference category and finally estimates the model with these dummy variables (Kohler & Kreuter, 2016).

3.4 Conclusions

In the following section, the main conclusions drawn from the statements above are summarised.

- As the researcher aims to gather quantitative data on the financial performance of grid owner companies in Germany and search for patterns or causal relationships in the data to create law-like generalisations, the philosophical stance of positivism is most appropriate.
- Given the research questions and the chosen research paradigm, gathering data through surveys or using secondary data sources are possible methods of obtaining data that are available to the researcher.
- For several reasons, using secondary data is the most suitable research method on grid owner companies in Germany, although structured interviews and self-completion questionnaires have their specific advantages.

- Legal form, ownership structure and firm size are factors that drive firm performance of grid owner companies.
- The research task comprises the gathering of data upon which to base generalisable propositions that can be tested (Bryman & Bell, 2011).
- Regression analysis and the statistics software Stata will be applied to analyse the data.
- Better information of the cause and effects of grid owner companies is essential to private energy companies and local governments.
- Due to the fact that large numbers of rights-of-way contracts between municipalities and energy companies contain options to found grid owner companies in Germany, the influence of several criteria on the firm performance has to be analysed; a theoretical basis of decision-making is needed.
- To present the results of the analysis to others, tables, diagrams or charts are appropriate methods of displaying quantitative data on grid owner companies in Germany.

Table 5: Variables

Variables	**Measurement**
Dependent variable	
firm performance	ratio between net income and total assets at the balance sheet date
Independent variables	
firm size	population or natural logarithm of area
private participation quota	percentage of participation of private companies in the registered capital of a grid owner company
legal form	factor variable

4. Discussion and Analysis

4.1 Introduction

In accordance with the research questions concerning the firm performance of German grid owner companies, empirical analyses were carried out to test the relationships between the dependent variable and the independent variables. The data analyses include summary descriptive statistics to describe data on German grid owner companies and inferential statistical tests to make inferences about the population of German grid owner companies.

4.2 Descriptive statistics

First, descriptive statistics are used to describe the relevant variables of the regression analysis. The descriptive statistics provide measures that can be used to examine and describe individual samples (Field, 2013).

The statistical distributions of the metric variables ROA, population, area and private participation quota are presented together over all years and then separately for each year.

The ROA varies between -1.03 and 0.34 and amounts to an average of 0.03. The standard deviation amounts to 0.099. Furthermore, the maximum ROA value is reached in 2015 with the minimum value in 2011.

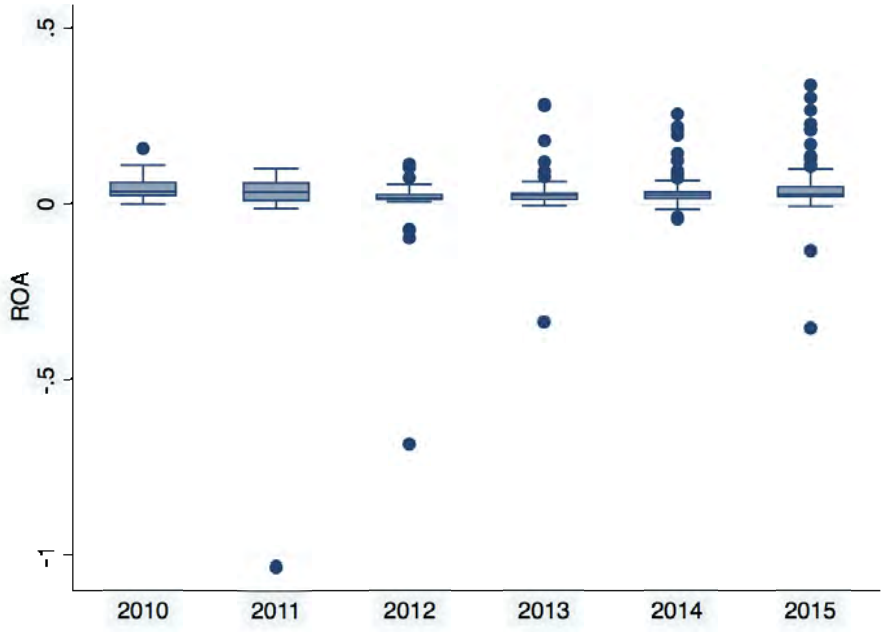
Table 6: Distribution of ROA

Variable	Freq.	Mean	Std. Dev.	Min	Max
ROA	302	0.032	0.099	-1.032	0.335

Table 7: Distribution of ROA per year

Year	Freq.	Mean	Std. Dev.	Min	Max
2010	9	0.051	0.050	-0.001	0.156
2011	12	-0.048	0.031	-1.032	0.099
2012	25	-0.010	0.148	-0.684	0.113
2013	48	0.027	0.073	-0.337	0.279
2014	85	0.039	0.051	-0.042	0.255
2015	123	0.043	0.079	-0.355	0.335

Figure 7: Boxplot ROA per year



The average population as a proxy for firm size is 33,160 with a standard deviation of 54,634.

Table 8: Distribution of population

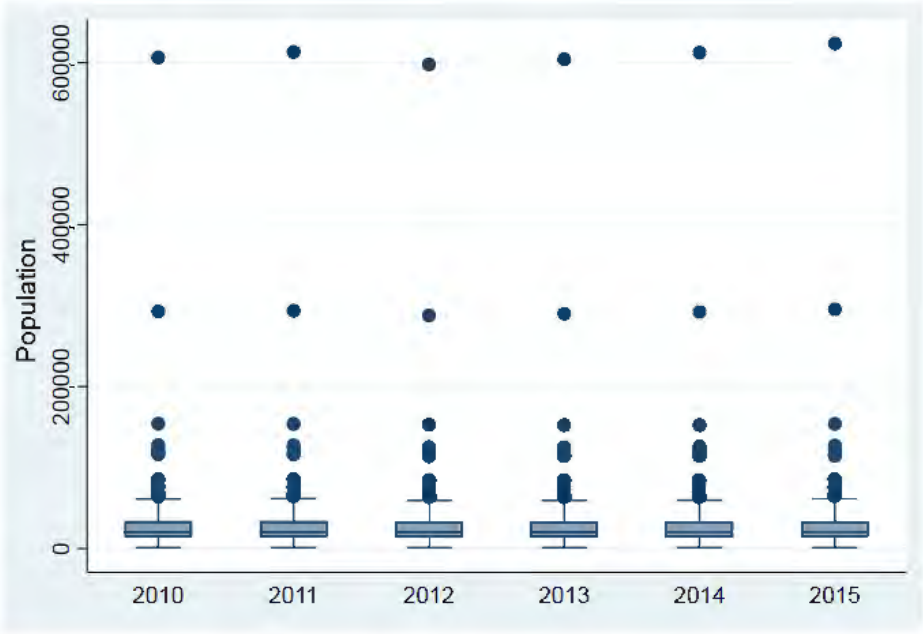
Variable	Freq.	Mean	Std. Dev.	Min	Max
population	1,020	33,159.67	54,633.61	1,081	623,738

In 2015, the population has its highest value; its lowest value is realised in the year 2010. The growing population of German municipalities with grid owner companies corresponds to the total population in Germany that has grown from 81.75 million in 2010 to 82.18 million in 2015 (Statista, 2019).

Table 9: Distribution of population per year

Year	Freq.	Mean	Std. Dev.	Min	Max
2010	170	33,263.78	54,711.54	1,081	606,588
2011	170	33,360.34	55,133.04	1,092	613,392
2012	170	32,773.72	53,831.38	1,101	597,939
2013	170	32,874.72	54,273,29	1,092	604,297
2014	170	33,071.51	54,857.31	1,083	612,441
2015	170	33,613.97	55,776.87	1,113	623,738

Figure 8: Boxplot population per year



The area varies between 6.5 square kilometres and 700.2 square kilometres and amounts to an average of 97.3 square kilometres. The standard deviation amounts to 127.1 square kilometres.

Table 10: Distribution of area

Variable	Freq.	Mean	Std. Dev.	Min	Max
Area	1,020	97.251	127.144	6.500	700.170

The minimum value (6.5 square kilometres) and the maximum value (700.2 square kilometres) are almost constant over the years.

Table 11: Distribution of area per year

Year	Freq.	Mean	Std. Dev.	Min	Max
2010	170	96.523	127.148	6.500	700.170
2011	170	97.221	127.345	6.500	700.170
2012	170	97.405	127.499	6.500	700.170
2013	170	97.425	127.499	6.500	700.170
2014	170	97.248	127.302	6.500	700.170
2015	170	97.684	127.946	6.500	700.160

Figure 9 shows the distribution of area. The blue line indicates the normal distribution. The lower level of area is more prevalent than the middle and the upper area. A logarithmic transformation (natural logarithm) shows a better approximation to the normal distribution (Figure 10). In the case of right-skewed distributions, the natural logarithm of the relevant variable is often used. The underlying assumption is that a logarithmic relationship between the independent and the dependent variable exists. The higher the value of the independent variable, the smaller the variation of the dependent variable when the independent variable varies by one further unit (Field, 2013).

Table 12: Distribution of area (natural logarithm) per year

Year	Freq.	Mean	Std. Dev.	Min	Max
2010	170	4.065	0.969	1.872	6.551
2011	170	4.071	0.973	1.872	6.551
2012	170	4.072	0.974	1.872	6.551
2013	170	4.072	0.974	1.872	6.551
2014	170	4.071	0.973	1.872	6.551
2015	170	4.073	0.976	1.872	6.551

Figure 9: Distribution of area (original)

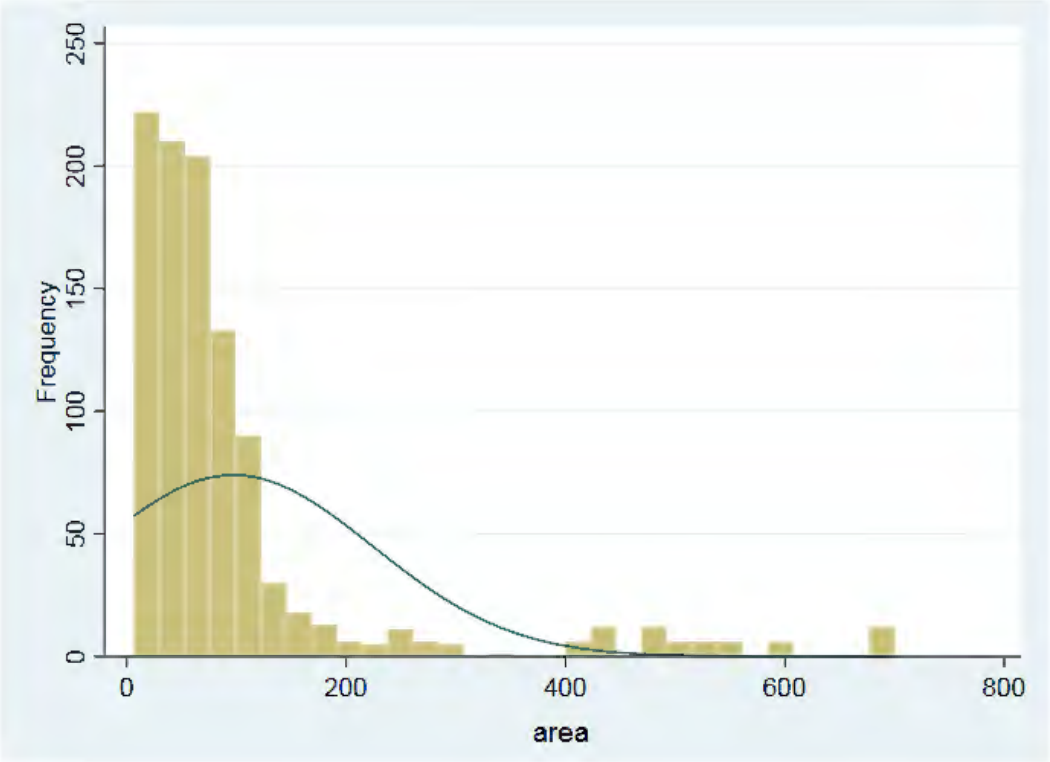
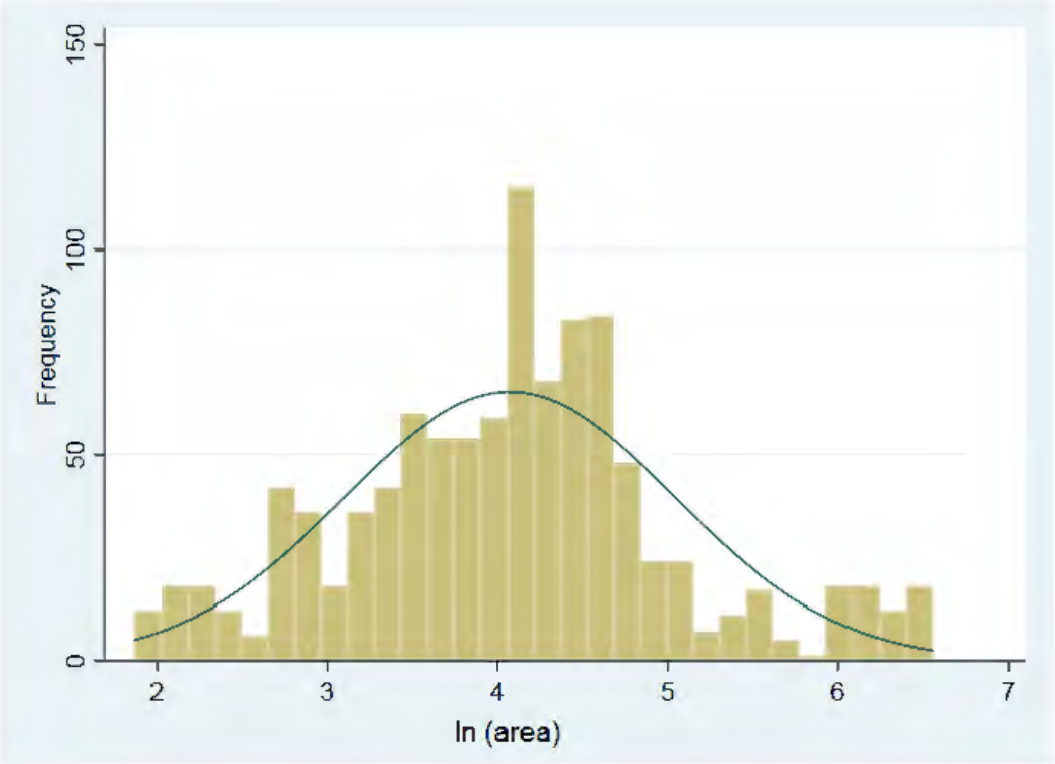


Figure 10: Distribution of area (natural logarithm)



As expected, the values of the private participation quota lie between 0 and 100 percent. The arithmetic mean amounts to 44.1 percent and does not vary over time, because the participations of the private energy company or the municipality are generally constant.

Table 13: Distribution of private participation quota

Variable	Freq.	Mean	Std. Dev.	Min	Max
private participation quota	1,020	44.141	18.493	0	100

Table 14: Distribution of private participation quota per year

Year	Freq.	Mean	Std. Dev.	Min	Max
2010	170	44.141	18.493	0.00	100.00
2011	170	44.141	18.493	0.00	100.00
2012	170	44.141	18.493	0.00	100.00
2013	170	44.141	18.493	0.00	100.00
2014	170	44.141	18.493	0.00	100.00
2015	170	44.141	18.493	0.00	100.00

In more than 80 percent of cases, the legal form of the grid owner company is a limited partnership with a limited liability company as general partner (GmbH & Co. KG). About 16 percent of the grid owner companies in the analysis are limited companies (GmbH). However, grid owner companies that have the legal form of a limited partnership with a public limited company as general partner (AG & Co. KG) are designated as missing values. With three companies all over Germany, the number of cases is simply too low. There is not enough data on grid owner companies with the legal form of a limited partnership with a public limited company as general partner to obtain a reliable regression model.

Table 15: Distribution of legal form

Legal form	Freq.	Percent	Cum.
AG & Co. KG	18	1.76	1.76
GmbH	162	15.88	17.65
GmbH & Co. KG	840	82.35	100.00
Total	1,020	100.00	

4.3 Regression analysis

Regression analysis is a set of statistical processes to estimate the relationships among variables. It means fitting a linear model to the data and using it to predict values of an outcome variable from one or more predictor variables (Field, 2013).

The researcher applies multiple regression analysis, i.e. an extension of simple regression in which an outcome is predicted by a linear combination of two or more predictor variables (Field, 2013). The structure of the linear model is as follows:

$$Y_i = (b_0 + b_1 * X_{1i} + b_2 * X_{2i} + b_3 * X_{3i}) + \varepsilon_i$$

The ROA as the outcome (dependent variable) is denoted as Y_i, and each predictor (independent variable) is denoted as X_i:

X_{1i} = population or natural logarithm of area as proxies for firm size

X_{2i} = private participation quota

X_{3i} = legal form

b_i = regression coefficient

ε_i = error term

Depending on which variable is used as a proxy to measure firm size, X_{1i} represents population or the natural logarithm of area.

Each predictor has a regression coefficient b_i associated with it that represents the gradient of the regression line in a simple regression. b_1 is the coefficient of the first predictor X_1, b_2 is the coefficient of the second predictor X_2, etc. The value of b stands for the change in the outcome resulting from a unit change in the predictor. b_0 is the value of the outcome when all predictors are zero (Field, 2013). The error term of the regression model is symbolised by ε_i. To assess the error in a regression model, the sum of squared errors is used, the so-called residual sum of

squares (Field, 2013). In all cases, the subscript $_i$ denotes an individual German grid owner company.

As the researcher is interested in the relationships between one or more predictor variables and an outcome variable (Field, 2013), the multiple linear regression model is suitable for the analysis. In order to find the optimal model, the OLS regression method is applied. Using the method of least squares means to estimate the values of b that describe the regression model that best fits the data (Field, 2013).

In the following regression analyses, the influence of population or area as proxies for firm size, private participation quota and legal form on ROA is investigated. The selection of the predictors is based on a sound theoretical rationale and well-conducted past research that has demonstrated their importance (Field, 2013). Thus, a multiple linear regression is applied and an OLS estimation method is used. With regard to the area, a new variable is created and applied, i.e. the natural logarithm of area: ln(area).

A model that also contains the individual years as categorical variables, i.e. a variable made up of categories (Field, 2013), does not appear to be significant to the reference year of 2010. Thus, the year specification is neglected in the analysis.

As the statistical model can be biased by unusual cases or by failing to meet certain assumptions, further examinations are necessary. In order to check whether the model is influenced by a small number of cases, outliers and influential cases have to be detected. An outlier denotes a case that differs substantially from the main trend of the data and affects the estimates of the regression coefficients. There are several residual statistics that can be used to assess the influence of a particular case (Field, 2013).

In order to identify potential outliers in the values, a first model is calculated with all values. An outlier is a value that differs substantially from the main trend of the data and can affect the estimates of the regression coefficients (Field, 2013). After having applied Cook’s distance, critical values are identified, eliminated and the

model is calculated again. Compared to other measures, Cook's distance measures the impact of a single case on the entire model, i.e. the impact that a case has on the model's ability to predict all cases. Highly influential observations have an extraordinary value for the dependent variable and an extraordinary combination of values for the independent variables. Only if both aspects are present, will the estimation of coefficients be strongly influenced by the respective observation (Kohler & Kreuter, 2016).

In general, values of Cook's distance greater than 1 respectively 4/number of observations seem to be critical and may be cause for concern (Cook & Weisberg, 1982; Field, 2013).

Multicollinearity describes a situation in which two or more variables are very closely linearly related, i.e. a strong correlation between two or more predictors exists. That makes it difficult to assess the individual importance of a predictor (Field, 2013).

Multicollinearity with regard to the independent variables is tested by variance inflation factors (VIF) for each independent variable. The VIF indicates whether a predictor has a strong linear relationship with other predictors in an ordinary least squares regression analysis. As a rule of thumb, a variable whose VIF values are greater than 10 needs further investigation. A tolerance value (1/VIF) lower than 0.1 is comparable to a VIF of 10 (Field, 2013).

Depending on which variable is used to measure firm size, Table 16 and Table 17 show the variance inflation factors and the tolerance values of each variable:

Table 16: VIF and tolerance - population

Variable	VIF	1/VIF
population	1.01	0.985342
private participation quota	1.05	0.951550
legal form	1.06	0.939262
Mean VIF	1.04	

Table 17: VIF and tolerance - area (natural logarithm)

Variable	VIF	1/VIF
ln(area)	1.00	0.997908
private participation quota	1.05	0.955586
legal form	1.05	0.954683
Mean VIF	1.03	

Table 18 and Table 20 visualise the comparison between the model estimation with and without the 7 (population) and 13 (natural logarithm of area) outliers. In general, the higher the adjusted R^2, the better the model fits with the data (Field, 2013). It is shown that the adjusted R^2 and the level of statistical significance are higher in the models without outliers. The application of the adjusted R^2 is a method of cross-validation, i.e. the accuracy of the model is assessed across different samples. In general, the adjusted value of R^2 measures how much variance in the ROA would be accounted for if the model had been derived from the population from which the sample was taken. It is the squared correlation between values of the outcome predicted by the model and the values observed in the data (Field, 2013). Furthermore, the values of significance are higher in the models without outliers.

Table 18: Comparison of the models with and without outliers - population

Variable	with outliers	without outliers
population	0.000	0.000**
private participation quota	0.001***	0.001***
legal form		
GmbH & Co. KG	0.010	0.021***
Intercept	-0.026	-0.012
N	297	290
adj. R^2	0.025	0.097

legend: * p<0.1; ** p<0.05; *** p<0.01

According to the regression model, the population as a proxy for firm size has a positive and significant influence on ROA. The influence of private participation quota on ROA is positive and even highly significant at the 0.01 level. Furthermore, limited partnerships with a limited liability company as general partner (GmbH & Co. KG) also have a positive and highly significant influence on ROA. This means that the ROA of grid owner companies with this legal form is 0.02 higher on average than the ROA of companies with the legal form of a limited liability company (reference category).

To sum up, the regression model with population as a proxy for firm size shows that 10 percent of the variation in ROA can be explained by population, private participation quota and legal form.

The following table provides estimates of the model parameters and the significance of these values:

Table 19: Estimation of coefficients (final model - population)

ROA	Coefficient	Std. Err. robust	T	P>t	95%-Confidence interval	
population	0.000	0.000	2.31	0.022	0.000	0.000
private participation quota	0.001	0.000	3.85	0.000	0.000	0.001
legal form						
GmbH & Co. KG	0.021	0.005	4.42	0.000	0.012	0.030
Intercept	-0.012	0.009	-1.39	0.166	-0.029	0.005
adj. R^2 = 0.097, N = 290						

If a variable significantly predicts an outcome, the value of the regression coefficient is different from zero. The t-test examines whether the values of the regression coefficients are significantly different from zero relative to the variation in b-values across samples. If the observed significance is less than 0.05, the result reflects a genuine effect (Field, 2013). Thus, in the underlying regression analysis, one cannot conclude that the relevant coefficients are 0. However, the regression coefficient of population is rounded towards 0 (0.000000168).

The t-test also serves as a measure of whether a predictor is making a significant contribution to the model. If the t-test associated with a predictor value is significant, i.e. the value of P>t is less than 0.05, the independent variable is making a significant contribution to the model. The smaller the value of P>t, the greater the contribution of the independent variable (Field, 2013). From the magnitude of the t-statistics one can see that all independent variables have a great impact on the ROA.

The regression analysis in Stata has been conducted by using the vce(robust) option. In general, the vce option specifies how to estimate the variance-covariance matrix (VCE) corresponding to the parameter estimates. The command vce(robust) uses the robust or sandwich estimator of variance. This estimator is robust to some types of misspecification as long as the observations are independent. The method is formally known as the Huber/White/sandwich estimator. The VCE obtained in this way is valid if the errors are independently distributed. It is neither required that the errors follow a normal distribution nor that they be identically distributed from one observation to the next. Overall, the variance-covariance matrix is robust to heteroscedasticity of the errors (Stata, 2018).

The confidence intervals for the regression coefficients are also given. The confidence intervals of the b-values are boundaries constructed such that in 95 percent of samples these boundaries contain the values of b. A bad model has confidence intervals that cross zero, i.e. in the population the predictor could have a negative as well as a positive relationship to the outcome (Field, 2013). It is not the case in this model and this means that the estimates for the model are likely to be representative of the values.

Table 20: Comparison of the models with and without outliers - area (natural logarithm)

Variable	with outliers	without outliers
ln(area)	0.015**	0.011***
private participation quota	0.001**	0.001***
legal form		
GmbH & Co. KG	0.012	0.017***
Intercept	-0.079***	-0.047***
N	297	284
adj. R^2	0.038	0.146

legend: * p<0.1; ** p<0.05; *** p<0.01

According to the regression model, the natural logarithm of area as a proxy for firm size has a positive and highly significant influence on ROA. Due to the transformation of the variable, one should pay attention when interpreting the coefficient. With a 10 percent increase in area, the ROA increases by b_1* ln (1.10) = 0.001018542. Thus, with an increase in area of one percent, an increase in ROA of approximately 0.00011 is expected. This interpretation is true only if the other predictors are held constant (Field, 2013).

The influence of private participation quota on ROA is also positive and highly significant at the 0.01 level.

Furthermore, limited partnerships with a limited liability company as general partner (GmbH & Co. KG) have a positive and highly significant influence on ROA. This means that the ROA of grid owner companies with this legal form is 0.017 higher on average than the ROA of companies with the legal form of a limited liability company (reference category).

As a result, the regression model with the natural logarithm of area as a proxy for firm size shows that 15 percent of the variation in ROA can be explained by area, private participation quota and legal form.

The following table provides estimates of the model parameters and the significance of these values:

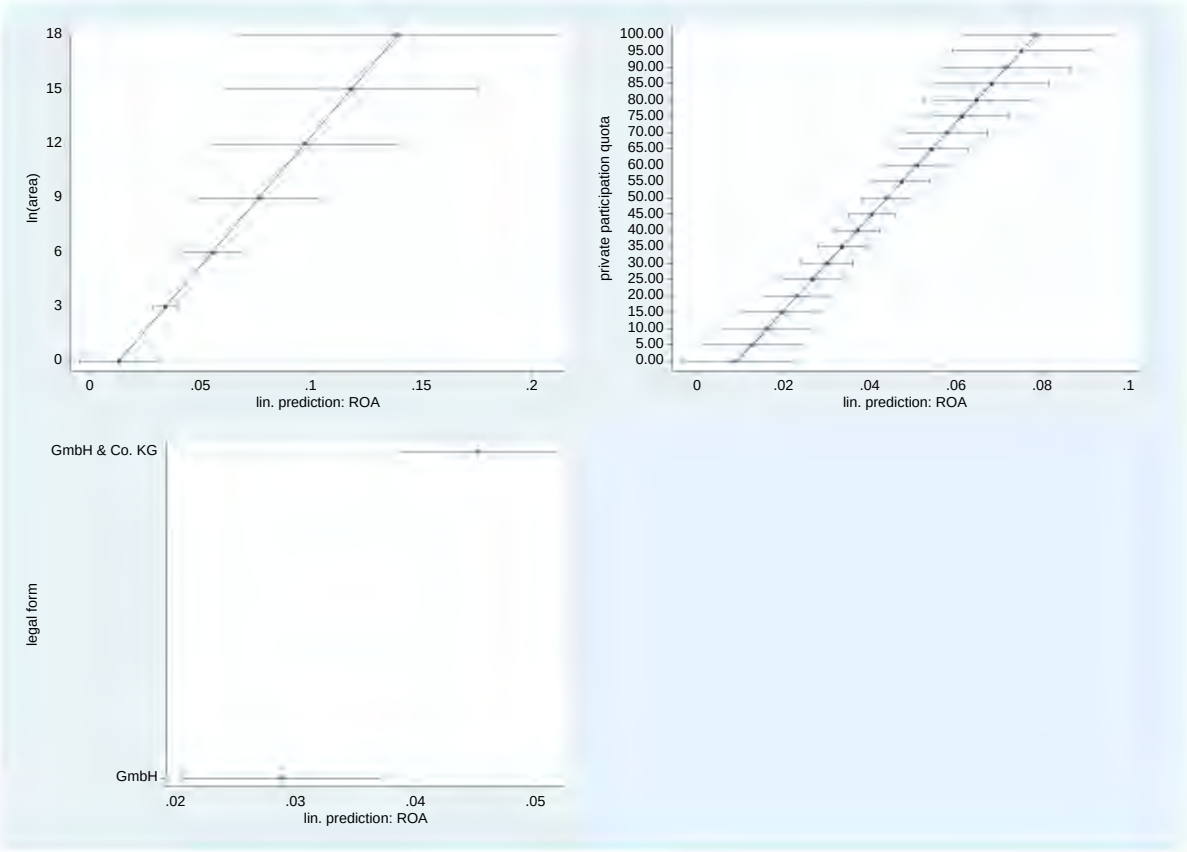
Table 21: Estimation of coefficients (final model - areal (natural logarithm))

ROA	Coefficient	Std. Err. robust	T	P>t	95%-Confidence interval	
ln(area)	0.011	0.002	4.57	0.000	0.006	0.015
private participation quota	0.001	0.000	4.03	0.000	0.000	0.001
legal form						
GmbH & Co. KG	0.017	0.004	4.12	0.000	0.009	0.025
Intercept	-0.047	0.011	-4.14	0.000	-0.069	-0.025
adj. R^2 = 0.146, N = 284						

The values of the t-test show that all relevant regression coefficients are significantly different from zero and all independent variables make a significant contribution to the model. Consequently, all independent variables have a great impact on the ROA. As the confidence intervals do not cross 0, the estimates for the model are likely to be representative of the values.

Figure 11 shows the marginplots for all independent variables and the related confidence intervals. It is possible to see how the linear prediction of ROA behaves at different levels of the independent variables.

Figure 11: Distribution of margins



In order to support private energy companies and municipalities when they are faced with the strategic decision to establish a grid owner company, it is important to examine to what extent each of the variables has an impact on the ROA. The regression function is as follows:

$Y_i = (-0.0468794 + 0.0106866 * X_{1i} + 0.0006167 * X_{2i} + 0.0169535 * X_{3i})$.

Based on the regression function, one can estimate that Y_i increases by 0.00011 (= coefficient b_1) when area, measured by X_1, grows by 1 percent. The private participation quota, measured by X_2, also has an impact on the ROA. Thus, with an increase in private participation quota of 1 percent, an increase in ROA of approximately 0.0006 (= coefficient b_2) is expected. Moreover, the legal form of a limited partnership with a limited liability company as general partner (GmbH & Co. KG) has a positive and significant influence on the ROA. The relevant coefficient b_3 amounts to 0.0169535. In comparison, the regression coefficient b_3 of the legal form (= X_3) as one of the examined factors has the highest value.

Furthermore, the correlation between the independent variables X_1, X_2 and X_3 has to be analysed. All pairwise correlation coefficients at a significance level of 0.05 are as follows:

Table 22: Pairwise correlation coefficients

	ROA	population	ln(area)	private participation quota
ROA	1.0000			
population	0.0835	1.0000		
ln(area)	0.1433*	0.4240*	1.0000	
private participation quota	0.1595*	0.0038	0.0926*	1.0000

* Significance level of 0.05

The correlation matrix shows the value of Pearson's correlation coefficient between every pair of variables. Pearson's product-moment correlation coefficient denotes a standardised measure of the strength of relationship between two variables. Its values vary between -1 and +1. Whereas -1 means that if one variable changes, the other changes in the opposite direction by the same amount, +1 shows that if one variable changes, the other changes in the same direction by the same amount. A value of 0 indicates that there is no relationship between the variables at all (Field, 2013; Kohler & Kreuter, 2016).

Along the diagonal of the matrix, the values of the correlation coefficients are 1 and thus represent the positive perfect correlation of each variable with itself. There is a weak to moderate correlation between population and natural logarithm of area. However, both variables represent proxies of firm size in the two different regression models and not in the same regression model. As there are no substantial correlations between predictors in the regression models (correlation coefficient < 0.9), there is no multicollinearity in the data (Field, 2013).

In order to test the assumption that E (ε) = 0 in the regression model, the residual-vs.-fitted-plot is applied. It denotes a scatterplot of the residuals of a linear regression against the predicted values (Figure 12). Due to the definition of a

regression model, the mean of the residuals in these graphics is always zero (Kohler & Kreuter, 2016).

Figure 12: Residual vs. fitted plot - population

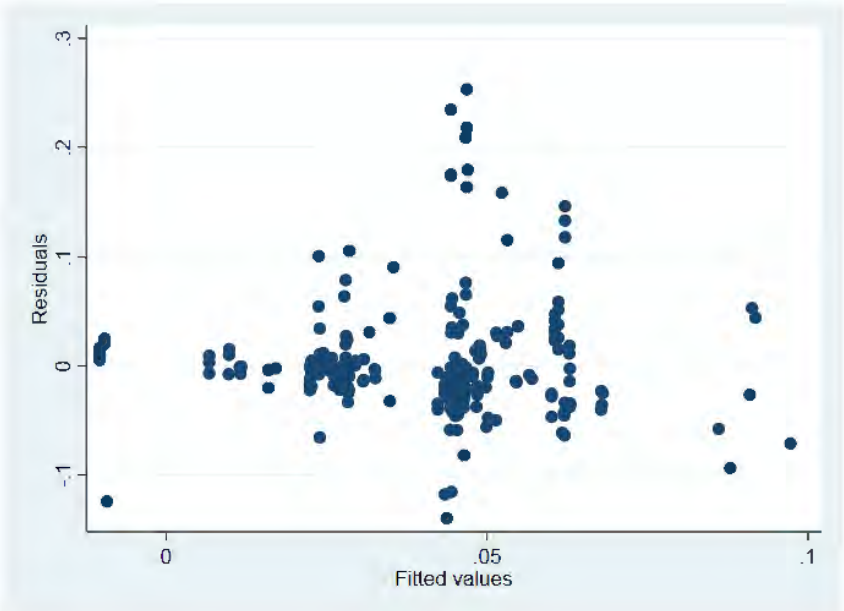
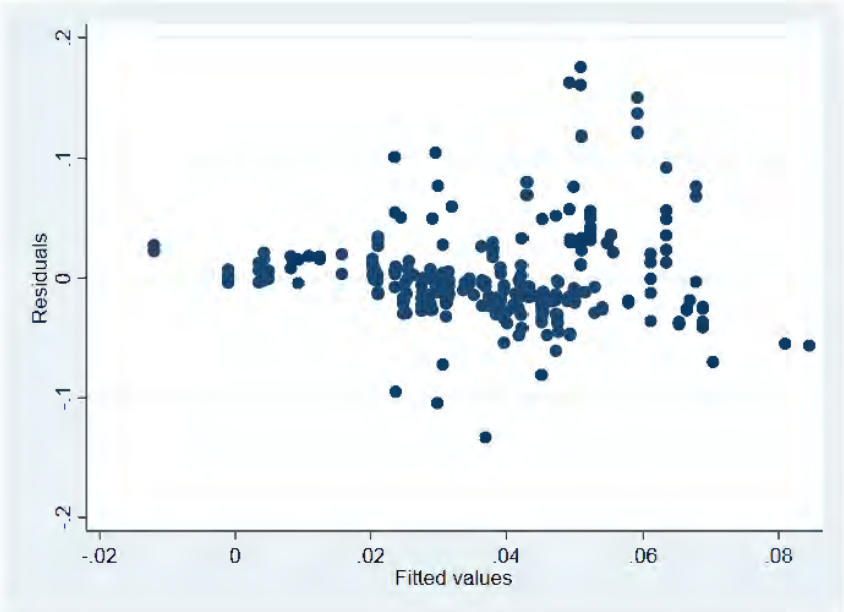


Figure 13: Residual vs. fitted plot - area (natural logarithm)



4.4 Conclusions

4.4.1 General remarks

In the following section, the question of to what extent each of the identified critical drivers of firm performance has an impact on the Return on Assets ratio of German grid owner companies is answered. The presentation is backed up with mathematical justification from the regression analysis. The focus is on the regression model with the natural logarithm of area as a proxy for firm size of German grid owner companies as it provides a better model fit than the regression model with population as a proxy for firm size.

4.4.2 Area as a proxy for firm size

First, the regression analysis has shown that there is a positive relationship between firm size and firm performance of grid owner companies in Germany. The natural logarithm of area, ln(area), as a proxy for firm size, has a positive and highly significant influence on ROA.

$Y = (-0.0468794 + \mathbf{0.0106866 * X_1} + 0.0006167 * X_2 + 0.0169535 * X_3)$

Based on the regression function, one can estimate that Y, symbolising the ROA, increases by 0.00011 (= coefficient b_1) when area (X_1 represents the natural logarithm of area) grows by 1 percent. This means that the bigger the grid owner company measured by the area, the higher its ROA. As a result, private energy companies and municipalities profit from grid owner companies with large grids.

4.4.3 Private participation quota

Second, the regression analysis has shown that the private participation quota, measured by X_2, also has an impact on the ROA. The influence of the private participation quota on ROA is positive and highly significant at the 1 percent level.

$Y = (-0.0468794 + 0.0106866 * X_1 + \mathbf{0.0006167 * X_2} + 0.0169535 * X_3)$

Based on the regression function, with an increase in the private participation quota of 1 percent, an increase in ROA of approximately 0.0006 (= regression coefficient b_2) is expected. I.e. the higher the private participation in a German grid owner company, the higher its profitability or level of firm performance.

4.4.4 Legal form

Third, the regression analysis has shown that the legal form of a limited partnership with a limited liability company as general partner (GmbH & Co. KG) has a positive and significant influence on ROA.

$$Y = (-0.0468794 + 0.0106866 * X_1 + 0.0006167 * X_2 + \mathbf{0.0169535 * X_3})$$

The relevant regression coefficient b_3 amounts to 0.0169535. In comparison, the regression coefficient of the legal form (= X_3) as one of the four examined regression coefficients has the highest value. The analysis has also shown that grid owner companies in Germany that are limited partnerships with a limited liability company as general partner have a higher firm performance than grid owner companies that are limited liability companies. At first glance, the result seems obvious as limited partnerships with a limited liability company as general partner have a lower overall tax burden than limited liability companies. Whereas limited partnerships with a limited liability company as general partner are only subject to trade tax and their partners are subject to income taxes, limited liability companies have to pay trade, corporate and solidarity tax. Trade tax amounts to 14 percent on average, corporate tax amounts to 15 percent and solidarity tax represents a 5.5 percent surcharge on corporate tax. However, higher administrative expenses for tax advice and auditing of the limited liability company as general partner could have led to different results.

Overall, the legal form of a limited partnership with a limited liability company as general partner seems an attractive financial option for municipalities and private energy companies when they are faced with the strategic decision of which legal form is suitable. Compared to a grid owner company with the legal form of a limited liability company, limited partnerships with a limited liability company as general partner realise higher returns on assets ratios. As grid owner companies

with the legal form of a limited partnership with a public limited company as general partner are underrepresented (with only three) in Germany, their influence on the ROA could not be analysed.

5. Conclusions and Recommendations

5.1 Introduction

In the following chapter, the results are presented in sequence and relative to each research question and implications for the decision-making situation of municipalities and private energy companies are discussed. The outcomes of the analysis and their significance are summarised and related to the landscape of current practice. As regression analysis can be applied to test a model based on causal relationships among variables, but does not imply that the tested relationships are causal (Field, 2013), aspects on causes and effects are also covered. Furthermore, implications of the findings are contextualised and recommendations with regard to the decision-making situation of municipalities and private energy companies as well as the optimal design of German grid owner companies are made.

5.2 Total population

Through the process of gathering data to determine the total population of German grid owner companies, 170 different German grid owner companies have been identified. The findings were made on the basis of the comprehensive screening of newly established German grid owner companies.

The population of grid owner companies consists of 140 limited partnerships with limited liability companies as general partners, 27 limited liability companies and 3 limited partnerships with public limited companies as general partners. Thus, the most popular legal form is the limited commercial partnership with a limited liability company as general partner at 82 percent and the limited liability company follows at 16 percent. The findings correspond to the reviewed literature and confirm the qualitative statements. In particular, Heim (2015a) points out that preferred legal forms for grid owner companies are limited liability companies or limited partnerships with limited liability companies as general partners.

Referring to the time frame, the German grid owner companies, forming the total population, were founded between the years 2007 and 2016. Most of the grid owner companies in Germany were established in 2014.

With regard to the geographical distribution over Germany, the registered offices of grid owner companies can be found in 11 of the 16 German Federal States. Most of the German grid owner companies are located in the Federal state of Baden-Württemberg, followed by North Rhine-Westphalia and Lower Saxony. Concerning the regional concentration of established grid owner companies, most are located in the western part of Germany, although during the reunification in the 1990s large numbers of new rights-of-way contracts with a duration of 20 years were negotiated, too. To sum up, more than 94 percent of the German grid owner companies are located in the former Western Germany. So, a decline from west to east is apparent.

5.3 Firm size

First, the regression analyses have shown that there is a significant and positive linear relationship between the firm size and firm performance of grid owner companies. Such a significant relationship exists both with population and with the natural logarithm of area as proxies for firm size. However, the regression model with the natural logarithm of area provides a better model fit than the regression model with population as a proxy for firm size.

With regard to the causes and effects, there are interesting aspects. The findings indicate that municipalities and energy companies as partners or shareholders of grid owner companies could increase ROA by increasing firm size.

On the one hand, the more people live in the municipality and thus are connected to the grid of a grid owner company, the more grid facilities like house connections, distribution lines or local network stations are required to supply these people with utilities like electricity, gas or water. These grid facilities are in turn leased to the respective distribution network operator who actually supplies the population with the utility. While the lease payments increase the net income of a grid owner company, the depreciation expenses on grid facilities decrease it.

However, as the calculated depreciation is part of the lease payments (section 2.4.2), the net income (numerator of the ROA) increases for example with every additional house connection installed that supplies the inhabitants. Moreover, every house connection, distribution line or local network station increases the total assets and hence the denominator of the ROA.

On the other hand, the larger the area of a grid owner company, the more grid facilities like distribution lines or local network stations are required to distribute energy to the customers. As a result, more grid facilities owned by the grid owner company are leased to the distribution network operator and net income as well as total assets increase.

However, the energy consumption of industrial companies depends less on the number of inhabitants or the area, and more on their power requirements. Hence, powerful grid facilities are required to supply industrial companies with energy. Both the grid facilities for the local residents and for the industrial companies are leased to the respective distribution network operators by the grid owner company. While the scope and the number of grid facilities increase the denominator of the ROA, the lease payments increase the net income of the grid owner company representing the numerator of the ROA.

In the end, whether a single municipality has a large or a small municipal district mainly determines the size of a single municipal grid. As long as a municipal council does not decide on the expansion of the distribution network area according to the content of the rights-of-way contract, for example a new development area to be connected, the grid owner company mainly grows by replacement investments and thus its financial performance.

The regulatory environment in Germany, in particular sections 4 to 10 of the German Electricity and Gas Network Charges Ordinances, ensures that investment in grids generates an adequate return, the calculated return on equity. Despite the German incentive regulation, the German energy grid sector remains a natural monopoly and grid investments are fostered by law (section 2.4.2). According to section 13 of the German Incentive Regulation Ordinance, the German Federal Network Agency for Electricity, Gas, Telecommunications, Post

and Railways determines the efficiency value of the distribution network operators and forces them to reduce unnecessary costs. Concerning the determination of the efficiency value, the German Federal Network Agency has to consider structure parameters of the distribution network operators, in particular characteristics of the supply tasks like urban versus rural or regional characteristics like geography, geology or topology of the grid territory. It should be particularly emphasised that the structural parameters also include the supplied area (section 13 (3) German Incentive Regulation Ordinance). If the lease payment of the distribution network operator to the grid owner company is based on the German Incentive Regulation Ordinance, it increases with every square kilometre and thus so does the net income of the grid owner company representing the numerator of the ROA.

The findings concerning the positive and significant relationship between firm size and firm performance correspond to some views in the literature. In particular, Heim (2015a) concludes that a minimum size of local grids is required and can be achieved by large grid owner companies consisting of the local grids of several municipalities. Thus, municipalities faced with the decision on the design of a grid owner company can be recommended to establish a grid owner company with a grid as large as possible.

However, the cooperation of several municipalities with one or more private energy companies offers the possibility to establish grid owner companies that comprise more than one municipal grid and thus large profitable grid owner companies. For example, the Hessian Municipal Code encourages economic activities of several municipalities together as they may operate generation, storage, distribution and supply of electricity, heat and gas from renewable energies when the activities take place in the regional environment in the form of intermunicipal cooperations (section 121 (1a) Hessian Municipal Code). In addition, large grid owner companies might offer the possibility of a unitary regional infrastructure policy between municipalities in favour of the citizens.

Moreover, the financing costs of loans in order to finance the grid acquisitions and the ongoing investments might be lower in a grid owner company with more than one grid as banks are faced with higher financing volumes. However, it has to be

considered that grid investments leading to a higher firm size of grid owner companies must be financed, either by operating cash flow, equity or debt. As municipalities and energy companies as partners or shareholders of German grid owner companies normally do not have unlimited capital and bank financing also has a finite nature, investments are restricted. Thus, the increase in firm size might be limited by the financial situation of a grid owner company and their partners or shareholders.

In contrast to German distribution network operators (section 27 (2) German Electricity or Gas Network Charges Ordinances), German grid owner companies are neither obliged to report their data on grid structures to the German Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways nor to disclose them in their annual reports. In order to enable even more precise analyses, comparisons and predictions of the impact of firm size on the financial performance of German grid owner companies, it is recommended that they report specific data on population and the area supplied to the German Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways. Furthermore, they should disclose them in their annual reports which in turn should be published in the German Federal Gazette.

5.4 Private participation quota

The descriptive statistics show that the mean of the private participation quota amounts to 44.1 percent. A municipality obtains the majority of shareholding or partnership with a participation quota of more than 50 percent, for example 50.1 percent. In turn, this means a private participation quota of lower than 50 percent, for example 49.9 percent. The findings show that with 44.1 percent there is a lower private participation quota on average than 49.9 percent. The findings indicate that private energy companies as cooperation partners in German grid owner companies forgo the higher participation quota in favour of the participation quota of municipalities. A possible explanation could be that the probability of becoming the preferred cooperation partner in a grid owner company during the concession award procedure increases if the municipality is given a higher participation quota than 50.1 percent. As the annual payout of a grid owner company normally depends on the participation quota, the municipality benefits financially from a

higher participation quota. Thus, any percentage of participation quota increases the financial scope of a municipality, for example to reduce budget deficits. The findings also correspond to the opinions expressed in the literature. In particular, Heim (2015a) argues that the preferred organisational structure of a grid owner company is a municipal majority interest and a minority interest of the chosen cooperation partner.

Moreover, the regression analysis has shown that the higher the percentage of private ownership, the higher the level of firm performance of grid owner companies. It means that the private participation quota, measured by X_2, also has a positive and highly significant impact on the ROA. The influence of the private participation quota on ROA is significant at the 0.01 level.

Further reflecting on the causes and effects, the findings generally indicate that the participation of private energy companies might have an important influence on the performance of German grid owner companies, measured by ROA. Basically, private energy companies provide professional business and technical experience as well as operational know-how to German grid owner companies (Wagner & Berlo, 2017).

Compared to municipalities, private energy companies are used to own, to plan and to operate grids. Their influence in the shareholders' meeting or meeting of partners might contribute to investment and financing decisions that lead to profitable results. In his daily business, the researcher experienced that investment and financing decisions in grid owner companies are part of the overall planning of private energy companies. Whereas municipalities often base their investment and financing decisions on political reasons, private energy companies strongly adhere to profitability aspects. For example, a decision in favour of the citizens could be the cabling of a whole municipality instead of overhead lines just for aesthetical reasons. Group affiliation of private energy companies and grid owner companies reinforces the adherence to profitability, in particular if the group is geared to the capital market. In contrast to municipal requirements that mainly refer to liability issues (section 122 of the Hessian Municipal Code), private energy companies often must fulfil economic goals like maximising ROA, etc.

In contrast, large numbers of German municipalities have neither capital to finance significant investments in grids nor know-how or experience to operate grids (Heim, 2015a). As the operating and investment expertise as well as the economic power of private energy companies to finance significant grid investments seem to be important requirements for the profitability of grid owner companies, municipalities seem to choose experienced private energy companies when they found a grid owner company together with a private partner. An appropriate influence at the operational level as well as in the bodies of a grid owner company is normally ensured by an adequate level of shareholder participation of the private energy company. Besides, economic activity or participation of the municipality must be particularly subject to the economic principle (section 121 (1a) Hessian Municipal Code). Although section 122 (1) of the Hessian Municipal Code requires municipalities to ensure an appropriate influence on the grid owner company in order to inform the municipal council with regard to the fulfilment of the public purpose, it does not mean that the influence has to be ensured only by the level of participation quota. Moreover, an adequate level of influence of the municipality can also be achieved by a disproportionate representation on the supervisory board of a grid owner company (Dietlein & Ogorek, 2018). In short, the result of the regression analysis that the higher the percentage of private ownership, the higher the level of firm performance of grid owner companies indicates that municipalities might increase ROA by increasing the participation quota of private energy companies.

However, another interpretation might be that in general private energy companies apply for more profitable cases of grid owner companies and municipalities are better off if they limit private participation. Thus, ROA might increase from the perspective of a municipality. Undoubtedly, with their engagement in grid owner companies, private energy companies aim at maximising profit. This implies that they apply for and engage in grid owner companies that meet a certain level of return. Nevertheless, the economic activity or participation of a municipality must be particularly subject to the economic principle (section 121 (1a) Hessian Municipal Code), too. It is known that municipalities not only pursue economic interests, but also social and political interests like influence on local infrastructure, supporting renewable energies, etc. If municipalities find financially well-equipped private energy companies with operating, investment and economic expertise, it

cannot be ruled out that municipalities deliberately limit the private participation quota in grid owner companies to gain more payout based on the participation quota.

5.5 Legal form

The regression analysis has demonstrated that the legal form of a limited partnership with a limited liability company as general partner (GmbH & Co. KG) has a positive and significant influence on ROA. The analysis has also shown that grid owner companies in Germany that are limited partnerships with a limited liability company as general partner have a higher firm performance than grid owner companies that are limited liability companies (GmbH). As grid owner companies with the legal form of a limited partnership with a public limited company as general partner are represented by three firms in Germany, their influence on the ROA could not be validly analysed.

In general, the high penetration of limited partnerships with a limited liability company as general partner, exactly 140 grid owner companies, corresponds to the finding that grid owner companies with this legal form realise a high ROA. Moreover, the findings correspond to and confirm the views in the literature. For example, Heim (2015a) points out that the preferred legal form of remunicipalised companies is the grid owner company with the legal form of a limited liability company or limited partnership with a limited liability company as general partner. Both legal forms enable private energy companies to participate in companies together with municipalities (Heil, 2018).

Apart from the financial influence on the ROA, the establishment of a cooperation model in the form of a grid owner company facilitates the consolidation of municipal enterprises into fiscal units (“steuerlicher Querverbund”) (Fellenberg et al., 2012). The income of profitable grid owner companies is offset with the losses of other municipal activities (public transportation, energy supply, port and airport) (Rosenberger, 2012), and reduces the tax burden of the municipality (Wagner & Berlo, 2015). Often, municipal swimming baths and public transport belong to important infrastructures and services that can be offered to the public in spite of significant losses (Wagner & Berlo, 2015).

According to section 8b of the German Corporate Income Tax Act, 95 percent of the expenses are tax-free when a limited liability company pays dividends to another corporation. In turn, borrowing costs in conjunction with the investment in the limited liability company cannot be claimed (section 8b (5) German Corporate Income Tax Act). Thus, municipalities that participate in grid owner companies with the legal form of a limited liability company receive income from grid owner companies at 95 percent tax free, but cannot claim borrowing costs in conjunction with the investment in the grid owner company. However, grid owner companies with the legal form of a limited partnership with a limited liability company as general partner make it possible to claim borrowing costs in conjunction with the investment in the grid owner company by supplementary tax balance sheets. Due to budget deficits, municipalities often take up loans in order to participate in grid owner companies, i.e. to finance shareholders' equity (DStGB, 2017).

Concerning the question of causality, i.e. what may be the cause and the effect, the question asks whether it is the form that causes the ROA advantage or the investment and financing requirements of the grid owner company. The assumption might be that grid owner companies having considerable investment and financing requirements choose limited partnerships with limited liability companies as general partners while grid owner companies that do not invest do not choose limited partnerships with limited liability companies as general partners, but other legal forms and thus accept a lower level of ROA.

In general, the decision on the legal form is a fundamental decision that is made by the shareholders or partners of a grid owner company at the beginning of the operating activities. At that time, regular investment and financing decisions over the whole lifetime of a grid owner company are not certain or not known at all. For example, the establishment of development areas and investment in new grid technologies like smart meters or electric vehicle charging stations are often not known at that stage. Consequently, due to the uncertainty about future investment and financing conditions of a grid owner company, these factors might not primarily determine the choice of the legal form of a grid owner company. However, the decision on the initial purchase of the grid might have an impact on the choice of the legal form as grid owner companies with the legal form of a limited partnership with a limited liability company as general partner make it

possible to claim borrowing costs in conjunction with the investment in the grid owner company. Due to budget deficits, municipalities often take up loans in order to participate in grid owner companies, i.e. to finance shareholders' equity (DStGB, 2017). Although municipalities that participate in grid owner companies with the legal form of a limited liability company receive income from grid owner companies at 95 percent tax free, but cannot claim borrowing costs in conjunction with the investment in the grid owner company, it does not mean that municipalities and private energy companies as shareholders of grid owner companies with the legal form of limited liability companies invest less than grid owner companies with the legal form of a limited partnership with a limited liability company as general partner. The level of investment of a grid owner company also depends on the decisions of municipal councils to connect development areas, etc. Furthermore, a certain level of investment in grids is necessary in order to guarantee the security of supplies (section 11 of the German Energy Industry Act). Thus, it is not consistent that grid owner companies that do not invest at a certain level choose other legal forms than limited partnerships with limited liability companies as general partners and suffer from an ROA disadvantage. To sum up, the assumption that grid owner companies having considerable investment and financing requirements choose limited partnerships with limited liability companies as general partners while grid owner companies that do not invest do not choose limited partnerships with limited liability companies as general partners, but other legal forms and thus accept a lower level of ROA, is rather doubtful.

Overall, grid owner companies with the legal form of limited partnerships with a limited liability company as general partner, unlike limited liability companies, offer the possibility for municipalities to participate in grid owner companies without having equity by taking up loans and reducing tax burden. Thus, municipalities that are faced with the strategic decision of which legal form they should choose could be recommended to establish grid owner companies with the legal form of limited partnerships with a limited liability company as general partner.

5.6 Significance of the findings

To the researcher's best knowledge, this thesis is the first comprehensive theoretical and practical study that is solely dedicated to the new phenomenon of

grid owner companies in Germany. It provides fundamental financial insights as no one has studied financial aspects and causal relationships of German grid owner companies before. Whereas several authors have described German grid owner companies, studied their legal foundations and compared different cooperation models, it is the first time that the financial dimension of German grid owner companies has been empirically researched. An empirical analysis was conducted that addresses the relationships between firm size, ownership structure, legal form and firm performance of German grid owner companies. Although for example the Hessian Municipal Law requires municipal participation in grid owner companies to adhere to the economic principle, no one has analysed the influence of firm size, ownership structure and legal form on the financial performance of German grid owner companies.

In general, the findings of the thesis are not only unique, they also have significant practical and policy implications.

First, the result that there is a significant and positive relationship between firm size and firm performance of grid owner companies might reinforce the efforts to focus on large grid owner companies in favour of profitable German grid owner companies. The findings of this thesis correspond to the statements of Heim (2015a) who concludes that a minimum size of local grids is required and can be achieved by large grid owner companies consisting of the local grids of several municipalities. In general, the qualitative statements of Heim (2015a) as well as the empirical findings of this thesis provide the German legislature and the supervision of local authorities with the fundamental insight that large grid owner companies result in higher firm performance. They should determine that German grid owner companies require a certain size and promote large grid owner companies. A means to promote large grid owner companies is to support the cooperation of municipalities, so that local grids of several municipalities can be combined in a single grid owner company. Administrative expenses can be reduced and finally the distribution and supply of energy to the customers remains reasonably-priced according to the aims of section 1 of the German Energy Industry Act.

While distribution network operators have to report data on their grid structures like population or area to the German Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways (section 27 (2) German Electricity or Gas Network Charges Ordinances), there is no corresponding obligation for grid owner companies. In order to enable further analyses, comparisons and predictions of the impact of firm size on the financial performance of German grid owner companies, the German legislature should oblige German grid owner companies to report specific data on population and the area supplied to the German Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways. Furthermore, grid owner companies should disclose them in their annual reports which in turn should be published in the German Federal Gazette.

The findings indicate that the larger the population or the area of a grid owner company, the more grid facilities like distribution lines or local network stations are installed and owned by the grid owner company. These grid facilities are in turn leased to the respective distribution network operator who actually supplies the population with the utilities. Thus, firm performance of grid owner companies increases.

However, beyond the size or scope of the grid facilities, the aging structure of the grid facilities could be a crucial factor for the firm performance of grid owner companies. First, the regulatory framework stipulates different return on equity rates for new and old grid facilities (section 1.4.6). Second, the low-interest environment in the eurozone economy as a consequence of the low-interest-rate policy of the European Central Bank led to a significant decline in return on equity rates of the German Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways. Whereas the pre-tax rates of the second regulatory period (electricity from 2014 to 2018 and gas from 2013 to 2017) were 9.05 percent for new facilities and 7.14 percent for old facilities, the current rates are 6.91 percent for new facilities and 5.12 percent for old facilities. The rates reflect the interest rates in the capital markets and consist of a base rate (2.49 percent), based on the ten-year average for risk-free investments, and an appropriate risk premium as a compensation for the risk that arises from the investment in grids (3.15 percent). The application of the return on equity rates is limited to a maximum of 40 percent of the value of operating assets. Exceeding amounts are

subject to the base rate (Bundesnetzagentur, 2018c). In case the low-interest environment in the eurozone economy as a consequence of the low-interest-rate policy of the European Central Bank continues and leads to a further decrease in interest rates in future regulatory periods, the profitability of grid owner companies might be affected, too. Thus, the economic principle or profitability of German grid owner companies is even more in focus. As rights-of-way contracts or grid owner company models are normally negotiated with a duration of 20 years (section 46 (2) German Energy Industry Act), municipalities and private companies as shareholders or partners of grid owner companies have to take long-term determinations of the German Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways into account. In particular, they have to anticipate future decisions of the German Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways in their business cases. In general, the determinations of the German Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways have to take into account that the distribution network operators and grid owner companies are in a position to take on the large investments required for the energy transition in Germany.

However, while distribution network operators have to report data on their grid aging structure, i.e. the regulated asset base of new facilities and old facilities (section 1.4.6), to the German Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways (section 6 German Incentive Regulation Ordinance and section 28 German Electricity or Gas Network Charges Ordinances), there is no corresponding obligation for grid owner companies. In order to enable analyses of the impact of grid aging structures on the financial performance of German grid owner companies, the German legislature should oblige German grid owner companies to report data on their grid aging structure to the German Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railways. In addition, grid owner companies should disclose them in their annual reports.

Second, the finding that the higher the percentage of private ownership, the higher the level of firm performance of grid owner companies, shows that the participation of energy companies in grid owner companies increases firm performance. It indicates that the influence of energy companies on the performance of German grid owner companies results in better financial results. On the one hand, energy companies provide professional experience and operational know-how to German grid owner companies compared to municipalities (Wagner & Berlo, 2017). On the other hand, large numbers of German municipalities have neither capital nor know-how or experience to operate a grid (Heim, 2015a). As the expertise to operate a grid and the economic power of the energy company are important requirements for the profitability of a grid owner company, the German legislature and the supervision of local authorities should support the participation of energy companies in German grid owner companies. However, according to section 122 (1) of the Hessian Municipal Code, the municipality has to ensure an appropriate influence on the grid owner company in order to inform the municipal council with regard to the fulfilment of the public purpose. Whether the degree of influence of the municipality is appropriate or not must be determined on the basis of a case-by-case assessment. In any case, an appropriate influence of the municipality requires sufficient influence and control over a grid owner company. This comprises an adequate level of shareholder participation at the operational level according to the participation quota and the participation of the municipality in supervisory and control bodies like a supervisory board. Thus, the required influence of the municipality can be achieved by a disproportionate representation in the supervisory board of a grid owner company (Dietlein & Ogorek, 2018). As long as the shareholder participation of the municipality at the operational level corresponds to the participation quota and the influence of the municipality in the supervisory board of the grid owner company is ensured, it is not necessary that the municipality becomes majority shareholder of a grid owner company. Moreover, the energy company might even become majority shareholder of a grid owner company and provide its operational know-how and professional experience in planning, building and maintaining grids. One way to support the participation of energy companies in German grid owner companies could be the legal obligation to involve energy companies when municipalities decide upon the establishment of a grid owner company. A suitable source is the municipal law of the sixteen German federal states. Another possible solution to involve private

energy companies as shareholders or partners in German grid owner companies could be the gradual increase of their participation quota, depending on the firm performance of the relevant grid owner company. The better the firm performance of a grid owner company becomes over a certain time, the higher the participation quota of the private energy company. The idea is that although the participation quota of the municipality decreases at the same time, the level of firm performance might increase with the participation of the private energy company, so that the payout level remains at a similar level. Nevertheless, the trade-off between the appropriate influence of municipalities on the grid owner company and the level of participation of private energy companies remains challenging.

Third, the outcome that grid owner companies in Germany that are limited partnerships have a higher firm performance than grid owner companies that are limited liability companies leads to further policy implications. Although municipalities must be guaranteed the right to regulate all local affairs on their own and the right of self-government, within the limits prescribed by the laws (article 28 of the Basic Law for the Federal Republic of Germany), the German legislators might oblige municipalities to establish grid owner companies only with the legal form of limited partnerships. By this means, the probability to meet the economic principle, for example according to 121 and 122 of the Hessian Municipal Code, might increase. Comparable to section 122 (3) of the Hessian Municipal Code, after that a municipality shall only establish a public limited company if the public purpose cannot be fulfilled equally well in another legal form; a municipality shall only establish, take over, substantially expand or participate in a grid owner company with the legal form of a limited partnership unless another legal form is more appropriate to meet the economic principle or other public purposes (Dietl, 2018).

For the first time, the total population of German grid owner companies has been determined and data on important characteristics of grid owner companies have been gathered. This comprises federal state, legal form, date of foundation, divisions, balance sheet and profit and loss account items as well as other characteristics. Thus, the distribution and regional concentration of grid owner companies in Germany as well as comparisons between different types of grid owner companies are possible. According to German municipal law, for example

section 121 (1a) of the Hessian Municipal Code, economic activity or participation of the municipality must be particularly subject to the economic principle. Hence, profitability of grid owner companies is not only an important aspect for private energy companies, but also for municipalities. As a violation of the economic principle might result in a violation of municipal law, the findings of the thesis are of high importance for municipalities and their supervisory authorities. Overall, the knowledge of the population of German grid owner companies facilitates further research on German grid owner companies.

The performance of grid owner companies was the object of research. Especially the relationships between critical drivers and the performance of grid owner companies, which were analysed by regression analyses. For the first time, statistical methods have been applied to German grid owner companies. Based on the philosophical stance of positivism, for the first time an existing technique, namely multiple linear regression analysis using ordinary least squares, has been applied to sample data from 2010 to 2015 in order to analyse the relationships between the firm size, the ownership structure, the legal form and performance of German grid owner companies. An existing technique was applied to a new context and the applicability of regression techniques to the new phenomenon of German grid owner companies was shown.

Better and comprehensive information about the population as well as on the causes and effects with regard to the financial performance of grid owner companies are essential to municipalities when they are faced with the strategic decision of whether to renew their rights-of-way contracts or to establish a grid owner company. As many recently renewed rights-of-way contracts between municipalities and energy companies contain options to establish grid owner companies (Kunze, 2012), a quantitative aid to the decision-making of municipalities as well as energy companies has been made by regression analyses.

The knowledge of the population, their characteristics and the relationships between firm size, legal form, ownership structure and firm performance of German grid owner companies enables municipalities and energy companies to take well-informed decisions on the foundation and the design of grid owner

companies. In this thesis, they are provided with an analysis of the impacts of their choices of firm size, legal form and ownership structure on the financial performance of German grid owner companies. Moreover, the knowledge of critical drivers of firm performance of German grid owner companies facilitates the approval decisions of regulatory authorities. According to German municipal law, for example section 127a of the Hessian Municipal Code, municipalities have to submit their decisions on the establishment, the first-time participation as well as the substantial increase in participation in an enterprise to the supervision of local authorities. The written notification has to be made without delay no later than six weeks before the realisation. From the notification, the supervision of local authorities has to identify whether the relevant legal requirements are met (section 127a Hessian Municipal Code). Therefore, the notification has to contain the relevant supporting documents, for example whether the requirements of sections 121 and 122 of the Hessian Municipal Code are met. As these sections require that economic activity or participation of the municipality must be particularly subject to the economic principle (sections 121 and 122 Hessian Municipal Code), the theoretical and empirical findings of this thesis may support municipalities in preparing the notification and demonstrating that the economic principle is met. Furthermore, it might be necessary to include decisions of municipal bodies, draft contracts or advisory opinions (Dietlein & Ogorek, 2018). Likewise, advisory opinions can be based on the findings of this thesis and finally supervision of local authorities can be convinced of the financial performance of relevant German grid owner companies. In general, the findings of the thesis support legislators and supervision of local authorities in assessing whether a grid owner company meets the economic principle or not. By the ROA a valid measure of financial performance is given and by the firm size, ownership structure and legal form three critical drivers or indicators are presented.

As an original contribution to knowledge, the findings of this thesis also create transparency and reveal which models of German grid owner companies currently prevail. The chronological development of established grid owner companies has been presented. Moreover, the geographical distribution of German grid owner companies shows which grid owner companies already exist in the respective region. This knowledge offers the possibility to think about cooperations with existing grid owner companies in order to establish large grid owner companies.

Beyond academic interest, the research on grid owner companies might provide municipalities, energy companies, business associations, research institutes, managers, consultants and policymakers with meaningful information on the new phenomenon. As the economic principle plays an important role with regard to grid owner companies, the question of what factors determine profitability might be one of high importance for researchers and practitioners like investors, managers, etc. In particular, municipalities that are faced with the strategic decision of whether they should renew their rights-of-way contracts or establish a grid owner company will profit from the findings. The research supports their decision-making processes. Furthermore, energy companies could profit from the findings of the thesis as they also adhere to the economic principle.

The findings on grid owner companies might also accelerate current policy debates. Local distribution networks are essential for the integration of renewable energies and other decentralised energy types such as electricity produced from combined heat and power units. The development of renewable energies and the atomic disaster in Fukushima in 2011 led to further political initiatives to phase out the use of nuclear energy, to increase the percentage of renewables in energy consumption and to remunicipalise energy activities (Becker, 2017). By the end of the year 2050, 80 percent of the German energy consumption should be provided by renewables (Bundesministerium für Wirtschaft und Technologie, 2013). More than 95 percent of the electricity produced by renewable energies is supplied with local grids and therefore a critical factor of success (Kinkel, 2014). Therefore, local distribution networks owned by grid owner companies are the backbone of a turna-round in German energy policy towards sustainable energy systems (Wagner & Berlo, 2015).

Overall, the thesis provides municipalities and energy companies with the necessary information to assess which model of grid owner company suits them best and what their financial impacts are. Municipalities and energy companies that are faced with the strategic decision of how to design a grid owner company could be recommended to found a large grid owner company with as much private participation quota as possible and with the legal form of a limited partnership with a limited liability company as general partner.

Furthermore, the researcher of this thesis gained new and valuable insights for his professional practice and for his personal development. Having studied Business Administration, Economics and Corporate Law and worked for more than 14 years in the accounting and auditing sectors, the researcher is used to the concepts of firm size, ownership structure, legal form and firm performance. Moreover, he has taken part in the foundation of more than 10 German grid owner companies. The empirical findings of the thesis sharply expand his individual experience as well as the problem-solving and consulting abilities. The entire research process has helped him to better understand the new phenomenon of German grid owner companies and to question his experiences and thoughts on grid owner companies. He is now better prepared to analyse different structures of grid owner companies, to examine relationships between different critical drivers and firm performance and to recommend an optimal design of German grid owner companies to a variety of addressees. In particular, the research on grid owner companies led to the awareness that the economic principle is relevant not only to private energy companies but, according to German municipal law, also to municipalities (section 121 (1a) Hessian Municipal Code). Hence, profitability of grid owner companies is not only an important aspect for private energy companies, but also for municipalities. This is especially relevant for the decision to establish a grid owner company. Moreover, as municipalities have to submit their decisions on the establishment to the supervision of local authorities (section 127a Hessian Municipal Code) that has to identify whether the relevant legal requirements are met, a thorough proof of legal compliance is facilitated. In view of the findings, consultants of municipalities and private energy companies are required to pay more attention to the economic aspects. Political aims of the municipalities do not lose their meaning, but the focus on financial aspects might objectify the relevant decision-making processes and discussions on grid owner companies. The establishment of a grid owner company exclusively due to political motives might be prevented. Financial aspects are becoming more important, so that the goal of a reasonably-priced public supply of electricity and gas according to section 1 of the German Energy Industry Act is approached. In addition, the clear focus on the performance of grid owner companies could help grid owner companies become more important when other municipal projects are launched. For example, the financial results of grid owner companies from the lease of the electricity or gas grids could be taken to finance the expansion of broadband

supply and the connection of renewable energies. In the end, positive financial results might contribute to the achievement of political goals, too. In general, every municipal project has to be financed.

The findings on important characteristics of grid owner companies like regional concentration, firm size, ownership structure, legal form, etc. facilitate comparisons among grid owner companies. For example, the findings enable the researcher to better assess whether the establishment of a grid owner company in a certain region corresponds to the existing types or leads to advantages or disadvantages. As municipalities normally exchange their experiences before the establishment of a grid owner company and also during the terms of the contracts, conflicts or disadvantages might be avoided. By knowing such characteristics and specialities of grid owner companies, negotiations between municipalities and private energy companies as well as between these parties and their consultants are put on a firm footing. Furthermore, negotiations might be more goal-oriented and faster. Overall, it helps with behaving even more law-abiding.

With regard to the accounting of grid owner companies, the researcher also has learnt a lot. The most important insight is that the accounting of all identified grid owner companies is very similar as all of them have to meet the requirements of the German Commercial Code. However, there are peculiarities as different grid owner companies apply different nomenclatures for the accounting of the advances and contributions in aid of construction and building connections.

From the perspective of the researcher of this thesis, the following quotation of Jarvis (2006, p. 50) summarises best his development:

“The wider our experience of life and the more we learn to reflect on it and not take it for granted, the more we learn and the more we become whole people.”

5.7 Limitations

For the first time, a comprehensive study is dedicated to the new phenomenon of German grid owner companies. To the researcher’s best knowledge, no one before has examined the phenomenon of German grid owner companies from a

financial perspective. The thesis contributes to the understanding of the practical phenomenon of grid owner companies from a financial and legal perspective by analysing the relationship between the legal form, ownership structure, firm size and performance, measured by the ROA of these companies. However, as with all new phenomena, there are also limitations to the study.

As there is no single database that contains the total population by selection, the determination of the total population of German grid owner companies was not an easy task. Depending on the date and the databases of the research, the total population of German grid owner companies could vary. Every day, a new grid owner company could be established and become part of research on grid owner companies. Hence, the total population and the samples taken from that population are subject to variation and possible outcomes may differ. Furthermore, it cannot be ruled out that not all legal forms were identified. In Germany, a variety of private and public legal forms exist and by the choice of the databases for the search, in particular the German Federal Gazette, the Common Register Portal of the German Federal States or the German Company Register, individual grid owner companies and their legal forms were detected. However, there might be other grid owner companies with different legal forms like joint municipal enterprises that are not part of any public register.

Another type of limitation is that of statistical or data limitations. Due to the novelty of the phenomenon of grid owner companies in Germany, i.e. most of the German grid owner companies were established in 2014, the researcher is not able to gather enough financial data on grid owner companies in order to conduct a panel data analysis. Thus, the findings of the thesis only result from a multiple linear regression model.

The data gathered on German grid owner companies from different sources like the German Federal Gazette, Common Register Portal of the German Federal States, etc. represents secondary data. It has been gathered by those other than the researcher and might also be influenced by the accounting policy of the management of grid owner companies. Although all figures of the annual financial statements found must comply with the German Commercial Code and lots of annual financial statements were audited by independent German auditors, it is

not ruled out that the annual financial statements contain errors or are biased by accounting discretion or even management fraud. Official statistical data provided by the Statistical Offices of the German States or the Federal Statistical Office also constitutes secondary data. Although statistical data have been compiled in a neutral and professionally independent manner (Statistische Ämter des Bundes und der Länder, 2019), it cannot be ruled out that they contain errors or bias. For example, municipalities may have incorrectly submitted data on population or area to the Statistical Offices of the German States or the Federal Statistical Office. In general, any ratio is necessarily dependent on the accuracy of the data and also on the fairness with which the data represent the relevant economic reality (Ryan & Collett, 2017).

Concerning the specific independent variables or proxies applied, there are also limitations. First, the population of a grid owner company is not an established figure. The population of each municipality has to be added up in order to determine the population of a grid owner company. The more people supplied by a grid owner company, the larger its own infrastructure or facilities should be. However, in contrast to a specifically determined population of a grid owner company, there could be bias. For example, the determined population of a grid owner company is large, but there is more than one grid owner company in the relevant municipality and the grid facilities are owned by these grid owner companies. This could be the case if there are several rights-of-way contracts for individual districts. Second, the area of a grid owner company is also not an established figure. It may be that the area of one or more municipalities is large, but the grid owner company owns only a few grid facilities. This could occur if an area is governed by more than one rights-of-way contract, so there is more than one distribution network operator and thus more than one grid owner.

The ROA as a traditional financial figure does not measure non-financial performance. This means that there are other indicators of performance that go beyond ROA such as environmental issues, outages and corporate social responsibility. Therefore, modifications to the traditional ROA have to be made or other measures have to be used in order to take into account the non-financial performance of German grid owner companies.

Moreover, since one cannot handle all the variables that could possibly influence firm performance of German grid owner companies in one thesis, the scope of the thesis is restricted to firm size, ownership structure and legal form as independent variables and firm performance as the dependent variable.

Overall, the limitations of the thesis provide a starting point for future research directions with regard to German grid owner companies.

5.8 Future research directions

When breaking new ground with a topic like German grid owner companies, it is likely that there are lots of new research directions that need to be discovered. Based on the results of this thesis, there are several starting points for further research directions with regard to the interesting topic of grid owner companies. In the following section, ideas for further research directions are discussed.

First, according to the regression analysis, 15 percent of the variation in ROA can be explained by the natural logarithm of area as a proxy for firm size, private participation quota and legal form. Although it is a significant result, there must be other drivers that determine the profitability of German grid owner companies. The determination of other drivers of firm performance of grid owner companies provides an interesting research direction for the research on German grid owner companies. However, it requires that there is sufficient data to perform appropriate analyses. In particular, the analysis of relationships between these factors and the performance of German grid owner companies still remains an interesting field of research. The more factors or critical drivers of firm performance of German grid owner companies that are identified, the more profound the recommendations to municipalities and private energy companies as shareholders or partners of grid owner companies.

Second, a panel data analysis in the form of a longitudinal time-series data analysis of grid owner companies could be conducted. The financial or statistical data of grid owner companies are observed across time and analysed. As the phenomenon of German grid owner companies is relatively new and most of the grid owner companies were established in 2014, at the moment there are not

enough data to conduct a valid and reliable panel data analysis. However, with every further year, the database grows and provides financial or statistical data to be analysed. Then, the relationships between firm size, ownership structure, legal form and firm performance of German grid owner companies could be analysed across time.

Third, the impact of the capital structures of grid owner companies on their firm performance could be subject to forthcoming studies. The capital structures of German grid owner companies have to be identified and then analysed with regard to the impact on firm performance. The capital structures consist of a combination of debt and equity. This requires a profound gathering of equity and debt data on German grid owner companies, for example from the German Federal Gazette. In particular, the research question of whether bank loans or shareholder loans result in higher firm performance could be of high interest for municipalities and private energy companies. In this context, the analysis of the sale of a grid or the contribution of a grid in exchange for shares of a grid owner company might be interesting, too. If the private energy company contributes a grid in exchange for shares in a grid owner company, the equity ratio can amount to 100 percent. As the sale of a grid to a grid owner company by a private energy company or the former concessionaire might be financed with equity and/or debt capital, the equity ratio of a grid owner company will be different from the situation of a contribution in exchange for shares. Overall, a comparative analysis of the financial impacts on firm performance of German grid owner companies would be revealing for all parties concerned.

Fourth, the impact of composition and size of the supervisory board on firm performance of grid owner companies is an interesting field of research. Unfortunately, the data gathered by the researcher is not enough to conduct a valid and reliable regression analysis on this issue. Due to the novelty of the phenomenon of grid owner companies, there are not enough units to examine the relationship between the structure of the supervisory board and the firm performance of a grid owner company. The question whether a supervisory board of a grid owner company consists of members that are appointed by the municipality or of members that are appointed by the private energy company could have an influence on the firm performance of a grid owner company.

Furthermore, the qualifications or the tenure of a member of the supervisory board seem to be critical drivers of firm performance of grid owner companies.

Fifth, being aware of the fact that balance sheets and profit and loss statements are influenced by earnings management and do not always show the “real picture of the world”, it is important to acknowledge qualitative data in the annual reports. For example, the notes and the management reports have to be analysed with regard to the use of accounting discretion. In general, the management reporting of a grid owner company could be an interesting future research direction. In particular, different risk management and corporate governance procedures might also have an impact on the performance of German grid owner companies.

Sixth, non-financial measures, i.e. measures expressed in non-monetary units, could also be important in assessing firm performance of German grid owner companies. For example, key indicators of service performance like efficiency, quality and effectiveness might be applied to German grid owner companies (Bradbury & Hooks, 2015). In this context, the measurement of motives and objectives of municipalities with regard to their engagements in German grid owner companies could also be part of the research (section 1.3.3.2). Furthermore, opinions of other stakeholders of grid owner companies could be analysed.

Seventh, the number of different divisions of a grid owner company, i.e. electricity, gas, water, street lighting, etc. also might have an influence on the firm performance of grid owner companies. On the one hand, the profitability of each division could be analysed with regard to the performance of a grid owner company. On the other hand, profitability comparisons between different divisions and between different grid owner companies could be conducted. As in the cases before, the financial data of each division has been insufficient to conduct a thorough regression analysis due the novelty of the phenomenon of grid owner companies. This might be a good basis for further research.

Eighth, with the establishment of grid owner companies, municipalities also pursue the goals of regaining influence on local infrastructure and generating financial profits for the municipal budgets (Groneberg, 2018). Moreover, municipalities

might use grid owner companies as a vehicle or starting point for entry into other areas along the energy industry value chain like generation of renewable energies, electromobility, smart metering, etc. (Heil, 2018). As the underlying thesis solely focuses on pure grid owner companies, research on grid owner companies with other divisions and the influence of different critical factors on their financial performance might be a fruitful future research direction.

Ninth, with the establishment of a grid owner company a variety of different contracts typically have to be negotiated: in particular the rights-of-way contract, the consortium agreement, the company agreement, the lease contract, etc. As German grid owner companies normally do not have employees, commercial management contracts are concluded between the grid owner company and the private energy company or the municipality. The optimal design of contracts of grid owner companies is also an interesting field of research. In this context, the design of contracts and their influence on the financial performance and other parameters of grid owner companies might be objects of research.

Tenth, as a grid owner company is a common business enterprise, further decisions on the operating business of a grid owner company might be investigated. This could comprise the interactions between the company meeting, the supervisory board and the management of a grid owner company. Classical principal-agent problems resulting from asymmetric information could be analysed, new insights could be gained and recommendations could be made. In particular, conflicts between the involved actors of a grid owner company could be analysed. Beyond quantitative research, qualitative research in the form of interviews, etc. could be applied.

Eleventh, as grid owner companies generally lease grids to private energy companies, the phenomenon is suitable for an analysis of the new accounting lease standard IFRS 16. According to this new accounting standard on leases, in general all leases are to be reported on the balance sheet for reporting periods beginning on or after 1st January 2019 (IFRS 16). From the perspective of the grid owner company as the lessor, the accounting remains similar to current practice according to IAS 17. It means that the lessor has to classify leases as finance and operating leases (IFRS 16.61). However, the private energy company as the

lessee has to recognise a right-of-use-asset as well as a liability (IFRS 16.22). Overall, the new lease accounting standard affects various key figures of a company and the research on its application to German grid owner companies might be an interesting future research direction.

After all, a considerable amount of research must be conducted before we are able to gain a full understanding of the process of remunicipalisation and the fascinating phenomenon of German grid owner companies.

5.9 Summary of conclusions

- In Germany, electricity and gas distribution are regularly governed by rights-of-way contracts. A process began ten years ago to phase out more than 20,000 rights-of-way contracts throughout Germany. Often, a grid owner company is established whose shareholders are the current distribution grid operator and the municipality.

- A systematic literature review on the new phenomenon known as grid owner companies demonstrated that grid owner companies in Germany are already the subject of research by academics and practitioners, but principally from a narrative or qualitative perspective and with regard to the advantages and disadvantages of the process of remunicipalisation of public services. Empirical data is rarely used. The research on critical drivers determining firm performance provides an extensive body of knowledge. The relationships between firm size, ownership structure or legal form and firm performance have been examined empirically from a number of theoretical perspectives. However, there is no consensus on the effects as they are complex and empirically ambiguous: positive linear, negative linear, curvilinear or there is no relation at all.

- In general, the research contributes to the understanding of grid owner companies in Germany. For the first time, the total population of German grid owner companies has been determined and important characteristics and causal relationships have been identified. Better information on the causes and effects of grid owner companies are essential to private energy companies and municipalities when they are faced with the decision of whether to renew their rights-of-way contracts or to establish a grid owner company.

- According to German municipal law, for example section 121 (1a) of the Hessian Municipal Code, economic activity or participation of the municipality must be particularly subject to the economic principle. Hence, profitability of grid owner companies is not only an important aspect for private energy companies, but also for municipalities.

- Through the process of gathering data to determine the total population of German grid owner companies, 170 different German grid owner companies that were founded between the years 2007 and 2016 and can be found in 11 of the 16 German Federal States have been identified.

- As many recently renewed rights-of-way contracts between municipalities and energy companies contain options to establish grid owner companies (Kunze, 2012), a quantitative aid to decision-making has been made by regression analyses:

  1) There is a significant and positive relationship between firm size and the firm performance of grid owner companies.

  2) The higher the percentage of private ownership, the higher the level of firm performance of grid owner companies.

  3) Grid owner companies in Germany that are limited partnerships have a higher firm performance than grid owner companies that are limited liability companies.

- Municipalities and private energy companies that are faced with the strategic decision of how to design a grid owner company could be recommended to found a large grid owner company with as much private participation quota as possible and with the legal form of a limited partnership with a limited liability company as general partner.

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Appendix 1: Total Population

company name	legal form	federal state	date of foundation	private participation quota
Abens-Donau Netz	GmbH & Co. KG	Bayern	02.11.2016	50,00
Bingen Netz	GmbH & Co. KG	Rheinland-Pfalz	07.01.2016	49,00
Brüggen.E-Netz	GmbH & Co. KG	Nordrhein-Westfalen	20.01.2015	25,10
Cremlinger Energie	GmbH	Niedersachsen	02.06.2015	49,00
Dorsten Netz	GmbH & Co. KG	Nordrhein-Westfalen	17.12.2013	49,00
Elektrizitätsnetzgesellschaft Grünwald	GmbH & Co. KG	Bayern	22.12.2015	49,00
EMB Netz	GmbH & Co. KG	Hessen	29.10.2015	39,00
Energie Dannstadter Höhe	GmbH & Co. KG	Rheinland-Pfalz	04.11.2013	35,00
Energie Kirchheim unter Teck	GmbH & Co. KG	Baden-Württemberg	14.11.2013	25,10
Energie Mechernich	GmbH & Co. KG	Nordrhein-Westfalen	16.01.2014	49,00
Energie Region Kassel	GmbH & Co. KG	Hessen	14.12.2011	49,00
Energiegesellschaft Leimen	GmbH & Co. KG	Baden-Württemberg	26.08.2011	74,90
Energienetz Neufahrn/Eching	GmbH & Co. KG	Bayern	17.11.2016	49,00
EnergieRegion Taunus - Goldener Grund -	GmbH & Co. KG	Hessen	14.10.2014	49,00
Energieversorgung Denzlingen	GmbH & Co. KG	Baden-Württemberg	14.01.2010	49,90
Energieversorgung Horstmar/Laer	GmbH & Co. KG	Nordrhein-Westfalen	27.01.2015	49,00
Energieversorgung Immenstaad	GmbH & Co. KG	Baden-Württemberg	13.01.2014	25,10
Energieversorgung Kranenburg Netze	GmbH & Co. KG	Nordrhein-Westfalen	24.02.2015	25,10
Energieversorgung Niederkassel	GmbH & Co. KG	Nordrhein-Westfalen	14.01.2014	49,00
Energieversorgung Strohgäu	GmbH & Co. KG	Baden-Württemberg	27.02.2015	49,00
Energieversorgung Timmendorfer Strand	GmbH & Co. KG	Schleswig-Holstein	22.12.2014	51,00
Energieversorgung Vechelde	GmbH & Co. KG	Niedersachsen	23.05.2013	49,00
EVB Gasnetz	GmbH & Co. KG	Bayern	05.02.2013	49,00
EVB Stromnetz	GmbH & Co. KG	Bayern	05.02.2013	49,00
Gasnetz Bad Oeynhausen	GmbH & Co. KG	Nordrhein-Westfalen	03.02.2016	49,00
Gasnetz Bornheim	GmbH & Co. KG	Nordrhein-Westfalen	24.06.2014	49,00
Gasnetz Dillingen Lauingen	GmbH & Co. KG	Bayern	17.04.2014	49,00
Gasnetz Ebersbach	GmbH & Co. KG	Baden-Württemberg	27.09.2013	25,10
Gasnetz Günzburg	GmbH & Co. KG	Bayern	01.08.2013	49,00
Gasnetz Löhne	GmbH & Co. KG	Nordrhein-Westfalen	21.12.2015	49,00
Gas-Netzgesellschaft Elsdorf	GmbH & Co. KG	Nordrhein-Westfalen	11.07.2016	49,00
Gas-Netzgesellschaft Kolpingstadt Kerpen	GmbH & Co. KG	Nordrhein-Westfalen	22.10.2014	49,00
Gasnetzgesellschaft Laatzen-Nord	GmbH	Niedersachsen	09.04.2013	49,00
Gasnetzgesellschaft Laatzen-Süd	GmbH	Niedersachsen	20.12.2012	49,00
Gasnetzgesellschaft Laupheim	GmbH & Co. KG	Baden-Württemberg	21.12.2011	50,10
Gasnetzgesellschaft Schorndorf	GmbH & Co. KG	Baden-Württemberg	07.01.2014	25,10
Gasnetzgesellschaft Winnenden	GmbH	Baden-Württemberg	23.10.2012	25,10
Gasnetzgesellschaft Wörrstadt	GmbH & Co. KG	Rheinland-Pfalz	17.07.2013	49,00
Gasversorgung Unterschleißheim	GmbH & Co. KG	Bayern	28.02.2014	49,00
Gemeindewerke Bad Sassendorf Netze	GmbH & Co. KG	Nordrhein-Westfalen	20.01.2015	25,10
Gemeindewerke Bissendorf Netze	GmbH & Co. KG	Niedersachsen	16.02.2015	49,00

Gemeindewerke Bodanrück	GmbH & Co. KG	Baden-Württemberg	09.05.2014	49,00
Gemeindewerke Brühl	GmbH & Co. KG	Baden-Württemberg	28.11.2013	74,90
Gemeindewerke Gräfelfing	GmbH & Co. KG	Bayern	08.08.2013	49,00
Gemeindewerke Plüderhausen	GmbH	Baden-Württemberg	22.01.2013	25,10
Gemeindewerke Wallenhorst Netz	GmbH & Co. KG	Niedersachsen	01.03.2016	15,00
Gemeindewerke Wedemark	GmbH	Niedersachsen	27.11.2009	49,00
Gemeindewerke Wietze	GmbH	Niedersachsen	10.12.2007	49,00
Gemeinsame Netzgesellschaft SWLB/STWWN	GmbH & Co. KG	Baden-Württemberg	29.07.2014	0,00
GrundNetz	GmbH	Hessen	09.02.2012	0,00
HaseNetz	GmbH & Co. KG	Niedersachsen	26.01.2016	25,10
HCL Netze	GmbH & Co. KG	Nordrhein-Westfalen	26.01.2016	25,10
Hochsauerland Netze	GmbH & Co. KG	Nordrhein-Westfalen	20.01.2015	25,10
Infrastrukturgesellschaft Plochingen	GmbH & Co. KG	Baden-Württemberg	03.04.2014	25,10
KAWAG	AG & Co. KG	Baden-Württemberg	20.03.2012	49,00
KAWAG Netze	GmbH & Co. KG	Baden-Württemberg	18.04.2012	49,00
Kommunale Energienetze Rielasingen-Worblingen	GmbH & Co. KG	Baden-Württemberg	12.02.2015	49,00
Kommunale Netzgesellschaft Steinheim a. d. Murr	GmbH & Co. KG	Baden-Württemberg	09.04.2014	49,00
Kommunalwerk Rudersberg	GmbH & Co. KG	Baden-Württemberg	12.07.2012	49,90
Stromnetz Gersthofen	GmbH & Co. KG	Bayern	07.04.2015	49,00
LEO Energie	GmbH & Co. KG	Baden-Württemberg	13.08.2012	49,00
Lohmar Netzeigentumsgesellschaft	GmbH	Nordrhein-Westfalen	01.09.2015	0,00
MN Münsterland Netzgesellschaft	GmbH & Co. KG	Nordrhein-Westfalen	16.12.2014	49,00
MNG Stromnetze	GmbH & Co. KG	Nordrhein-Westfalen	20.01.2015	25,10
Murrhardt Netz	AG & Co. KG	Baden-Württemberg	22.09.2015	49,00
Neckar Netze	GmbH & Co. KG	Baden-Württemberg	28.03.2012	49,00
Netze Pforzheim-Region	GmbH & Co. KG	Baden-Württemberg	05.01.2016	60,00
Netzeigentumsgesellschaft Dettighofen	GmbH & Co. KG	Baden-Württemberg	13.12.2013	49,00
Netzeigentumsgesellschaft Mörfelden-Walldorf	GmbH & Co. KG	Hessen	29.12.2014	49,90
Netzeigentumsgesellschaft Rheinstetten	GmbH & Co. KG	Baden-Württemberg	01.08.2013	49,00
Netzgesellschaft Auetal	GmbH	Niedersachsen	12.01.2012	49,00
Netzgesellschaft Bad Münder	GmbH & Co. KG	Niedersachsen	27.02.2013	49,00
Netzgesellschaft Barsinghausen	GmbH & Co. KG	Niedersachsen	31.10.2013	49,00
Netzgesellschaft Besigheim	GmbH & Co. KG	Baden-Württemberg	24.06.2013	25,10
Netzgesellschaft Bühlertal	GmbH & Co. KG	Baden-Württemberg	15.09.2011	49,90
Netzgesellschaft Edingen-Neckarhausen	GmbH & Co. KG	Baden-Württemberg	21.05.2014	48,00
Strom-Netzgesellschaft Elsdorf	GmbH & Co. KG	Nordrhein-Westfalen	29.09.2014	49,00
Netzgesellschaft Elz-Neckar	GmbH & Co. KG	Baden-Württemberg	28.11.2011	50,10
Netzgesellschaft Ennepetal	GmbH & Co. KG	Nordrhein-Westfalen	19.11.2015	49,00
Netzgesellschaft Erwitte	GmbH & Co. KG	Nordrhein-Westfalen	09.06.2016	51,00
Netzgesellschaft Espelkamp	GmbH & Co. KG	Nordrhein-Westfalen	04.03.2016	49,00
Netzgesellschaft Gehrden	GmbH	Niedersachsen	09.12.2008	49,00
Netzgesellschaft Grimma	GmbH & Co. KG	Sachsen	18.12.2013	49,00
Netzgesellschaft Hemmingen	GmbH	Niedersachsen	15.01.2009	49,00
Netzgesellschaft Hennigsdorf Gas	GmbH	Brandenburg	30.01.2017	50,00
Netzgesellschaft Hennigsdorf Strom	GmbH	Brandenburg	11.11.2016	50,00
Netzgesellschaft Hildesheimer Land	GmbH & Co. KG	Niedersachsen	14.12.2012	49,00

Netzgesellschaft Hohen Neuendorf Gas	GmbH & Co. KG	Brandenburg	10.07.2014	49,00
Netzgesellschaft Hohen Neuendorf Strom	GmbH & Co. KG	Brandenburg	27.06.2014	49,00
Netzgesellschaft Hüllhorst	GmbH & Co. KG	Nordrhein-Westfalen	10.01.2017	49,00
Netzgesellschaft Korb	GmbH & Co. KG	Baden-Württemberg	14.10.2011	49,90
Netzgesellschaft Kreisstadt Bergheim	GmbH & Co. KG	Nordrhein-Westfalen	30.09.2014	49,00
Netzgesellschaft Laatzen	GmbH & Co. KG	Niedersachsen	24.01.2007	49,00
Netzgesellschaft Lauf	GmbH & Co. KG	Baden-Württemberg	13.09.2011	49,90
Netzgesellschaft Leinfelden-Echterdingen	GmbH	Baden-Württemberg	07.12.2012	25,10
Netzgesellschaft Leutenbach	GmbH & Co. KG	Baden-Württemberg	28.01.2013	49,90
Netzgesellschaft Maifeld	GmbH & Co. KG	Rheinland-Pfalz	16.12.2014	49,00
Netzgesellschaft Marbach	GmbH & Co. KG	Baden-Württemberg	13.12.2012	49,00
Netzgesellschaft Ottersweier	GmbH & Co. KG	Baden-Württemberg	26.09.2011	49,90
Netzgesellschaft Oyten	GmbH	Niedersachsen	18.03.2014	0,00
Netzgesellschaft Rehburg-Loccum	GmbH & Co. KG	Niedersachsen	14.02.2017	49,00
Netzgesellschaft Rheda-Wiedenbrück	GmbH & Co. KG	Nordrhein-Westfalen	28.01.2013	51,00
Netzgesellschaft Ronnenberg	GmbH & Co. KG	Niedersachsen	24.03.2014	49,00
Netzgesellschaft Salach	GmbH & Co. KG	Baden-Württemberg	17.05.2013	25,10
Netzgesellschaft Schwetzingen	GmbH & Co. KG	Baden-Württemberg	19.02.2015	35,10
Netzgesellschaft Sontheim	GmbH & Co. KG	Baden-Württemberg	15.10.2009	74,90
Netzgesellschaft Steinheim	GmbH & Co. KG	Baden-Württemberg	22.09.2009	74,90
Netzgesellschaft Südwestfalen	GmbH & Co. KG	Nordrhein-Westfalen	14.03.2016	49,00
Netzgesellschaft Syke	GmbH	Niedersachsen	25.06.2014	49,00
Netzgesellschaft Tuttlingen	GmbH & Co. KG	Baden-Württemberg	15.01.2015	50,00
Netzgesellschaft Vaihingen	GmbH & Co. KG	Baden-Württemberg	04.12.2013	25,10
Netzgesellschaft Wenden	GmbH & Co. KG	Nordrhein-Westfalen	27.10.2014	49,00
NG Netzgesellschaft Schmalkalden	GmbH & Co. KG	Thüringen	05.08.2013	74,90
NGK Netzgesellschaft Kyritz	GmbH	Brandenburg	14.04.2014	49,00
NHG Netzgesellschaft Herrenwald	GmbH & Co. KG	Hessen	25.08.2011	51,00
NiersEnergieNetze	GmbH & Co. KG	Nordrhein-Westfalen	19.03.2013	51,00
Niestetal Netz	GmbH	Hessen	13.05.2014	99,00
Oschatz Netz	GmbH & Co. KG	Sachsen	08.05.2012	74,90
Rathenower Netz	GmbH	Brandenburg	29.01.2013	35,00
Recklinghausen Netzgesellschaft	GmbH & Co. KG	Nordrhein-Westfalen	27.12.2013	50,10
Regionalwerk Hochrhein	GmbH & Co. KG	Baden-Württemberg	28.12.2012	25,10
Remstalwerk Netzgesellschaft	GmbH	Baden-Württemberg	23.12.2015	0,00
Sandersdorf-Brehna Netz	GmbH & Co. KG	Sachsen-Anhalt	28.11.2011	49,00
Scharbeutzer Energie- und Netzgesellschaft	GmbH & Co. KG	Schleswig-Holstein	16.01.2015	51,00
Selm Netz	GmbH & Co. KG	Nordrhein-Westfalen	20.07.2015	25,10
Stadtversorgung Pattensen	GmbH & Co. KG	Niedersachsen	18.11.2011	49,00
Stadtwerke Geseke Netze	GmbH & Co. KG	Nordrhein-Westfalen	20.01.2016	25,10
Stadtwerke Goch Netze	GmbH & Co. KG	Nordrhein-Westfalen	19.01.2015	25,10
Stadtwerke Lippe-Weser	GmbH & Co. KG	Nordrhein-Westfalen	26.05.2014	0,00
Stadtwerke Waltrop Netz	GmbH & Co. KG	Nordrhein-Westfalen	04.12.2015	25,10
Stadtwerke Wiesloch - Gas -	GmbH & Co. KG	Baden-Württemberg	12.07.2016	0,00
Stadtwerke Wiesloch - Strom -	GmbH & Co. KG	Baden-Württemberg	17.09.2015	25,10
Stauferwerk Netzgesellschaft	GmbH & Co. KG	Baden-Württemberg	15.07.2013	16,60

Stauferwerk-EVF-Gasnetz	GmbH & Co. KG	Baden-Württemberg	28.01.2016	0,00
Stromgesellschaft March	GmbH & Co. KG	Baden-Württemberg	18.03.2015	25,10
Stromnetz Blaubeuren	GmbH	Baden-Württemberg	10.05.2010	49,90
Stromnetz Bornheim	GmbH & Co. KG	Nordrhein-Westfalen	07.03.2014	49,00
Stromnetz Diez	GmbH & Co. KG	Rheinland-Pfalz	02.08.2012	25,10
Stromnetz Euskirchen	GmbH & Co. KG	Nordrhein-Westfalen	22.07.2015	100,00
Stromnetz Günzburg	GmbH & Co. KG	Bayern	23.07.2013	49,00
Stromnetz Hofheim	GmbH & Co. KG	Hessen	29.07.2014	49,00
Stromnetz Langenau	GmbH & Co. KG	Baden-Württemberg	12.12.2011	50,10
Stromnetz Neckargemünd	GmbH	Baden-Württemberg	24.06.2014	0,00
Stromnetz Verbandsgemeinde Katzenelnbogen	GmbH & Co. KG	Rheinland-Pfalz	09.10.2013	49,00
Stromnetz VG Diez	GmbH & Co. KG	Rheinland-Pfalz	22.03.2013	49,00
Stromnetz Würmtal	GmbH & Co. KG	Bayern	15.09.2016	100,00
Stromnetze Peiner Land	GmbH	Niedersachsen	29.06.2016	49,00
Stromnetzgesellschaft Albershausen	GmbH & Co. KG	Baden-Württemberg	24.05.2013	50,10
Stromnetzgesellschaft Bad Salzdetfurth - Diekholzen	GmbH & Co. KG	Niedersachsen	02.09.2014	49,00
Stromnetzgesellschaft Barsinghausen	GmbH & Co. KG	Niedersachsen	13.10.2015	49,00
Stromnetzgesellschaft Ebersbach	GmbH & Co. KG	Baden-Württemberg	21.05.2013	25,10
Stromnetzgesellschaft Gescher	GmbH & Co. KG	Nordrhein-Westfalen	29.02.2016	25,10
Stromnetzgesellschaft Hechingen	GmbH & Co. KG	Baden-Württemberg	15.02.2011	74,90
Stromnetzgesellschaft Heilbronn	GmbH & Co. KG	Baden-Württemberg	05.05.2014	100,00
Strom-Netzgesellschaft Kolpingstadt Kerpen	GmbH & Co. KG	Nordrhein-Westfalen	29.09.2014	49,00
Stromnetzgesellschaft Laupheim	GmbH & Co. KG	Baden-Württemberg	19.12.2011	50,10
Stromnetzgesellschaft Neuenhaus	GmbH & Co. KG	Niedersachsen	12.03.2015	49,00
Stromnetzgesellschaft Neunkirchen-Seelscheid	GmbH & Co. KG	Nordrhein-Westfalen	08.08.2013	49,00
Stromnetzgesellschaft Östlicher Schurwald	GmbH & Co. KG	Baden-Württemberg	04.07.2013	25,10
Stromnetzgesellschaft Schwalmtal	GmbH & Co. KG	Nordrhein-Westfalen	10.02.2014	51,00
Stromnetzgesellschaft Winnenden	GmbH	Baden-Württemberg	20.08.2014	25,10
Stromnetzgesellschaft Wunstorf	GmbH & Co. KG	Niedersachsen	11.02.2016	49,00
Stromversorgung Unterschleißheim	GmbH & Co. KG	Bayern	29.01.2014	49,00
Stuttgart Netze	GmbH	Baden-Württemberg	01.11.2014	25,10
Netzgesellschaft Südwestfalen	GmbH & Co. KG	Nordrhein-Westfalen	14.03.2016	49,00
SWTE Netz	GmbH & Co. KG	Nordrhein-Westfalen	19.08.2014	85,00
Taubernetze	GmbH & Co. KG	Baden-Württemberg	07.12.2015	33,00
Untermain EnergieProjekt	AG & Co. KG	Hessen	10.04.2013	49,00
Wadersloh Netz	GmbH & Co. KG	Nordrhein-Westfalen	05.01.2017	25,10
WVG Netz	GmbH	Nordrhein-Westfalen	18.12.2014	100,00

Appendix 2: Stata Do-File

```
cls

set more off

clear

version 15.0

cd "/Users/OP/Documents"

import excel "Daten_NetzG_29082017_BKZ_ergaenzt.xlsx", sheet("Daten") firstrow


capture mkdir Grafiken

capture mkdir Tabellen

capture mkdir Logfiles


ssc install corrtable

ssc install outreg2

ssc install log2html


foreach v of varlist A-G K {

   local x : variable label `v'

   rename `v' `x'

}


foreach v of varlist _all {

   capture rename `v' `=lower("`v'")'

 }


keep pj ng ky io gb dl pi nf kx IN ga dk rd rc rb ra qz qy rk rj ri rh rg rf rm rn ro rp rq rr rs rt ru rv rw rx rechtsform j

order pj ng ky io gb dl pi nf kx IN ga dk rd rc rb ra qz qy rk rj ri rh rg rf rm rn ro rp rq rr rs rt ru rv rw rx rechtsform j
```

```
rename (pj-dl) (roa2010 roa2011 roa2012 roa2013 roa2014 roa2015)

rename (rm ro rq rs ru rw) (einwohner2010 einwohner2011 einwohner2012
einwohner2013 einwohner2014 einwohner2015)

rename (rn rp rr rt rv rx) (flaeche2010 flaeche2011 flaeche2012 flaeche2013 flaeche2014
flaeche2015)

rename j beteiligung

replace rechtsform = "GmbH & Co. KG" if rechtsform == "GmbH & Co. KG "

gen id = _n


reshape long roa einwohner flaeche, i(id) j(jahr)


encode rechtsform, gen(rechtsform2)

drop rechtsform

rename rechtsform2 rechtsform

tab rechtsform

replace rechtsform = . if rechtsform == 1


gen flaeche_ln = log(flaeche)


label variable roa "ROA"

label variable einwohner "Einwohnerzahlen"

label variable flaeche_ln "Flächen (log.)"

label variable flaeche "Flächen"


log using "Logfiles/log_file", replace
```

```
************************
* Descriptive statistics
************************


* AV: ROA Werte
su roa
histogram roa, title("ROA")
graph export Grafiken/01_roa_hist.png, replace


table jahr, contents(n roa mean roa sd roa min roa max roa)
graph box roa, over(jahr) ytitle("ROA") title("ROA nach Jahr")
graph export Grafiken/01_roa_box.png, replace


* UV1: Einwohnerzahlen
su einwohner
histogram einwohner, title("Einwohnerzahlen")
graph export Grafiken/01_einwohner_hist.png, replace


table jahr, contents(n einwohner mean einwohner sd einwohner min einwohner max
einwohner)
graph box einwohner, over(jahr) ytitle("Einwohnerzahlen") title("Einwohnerzahlen nach
Jahr")
graph export Grafiken/01_einwohner_box.png, replace


* UV2: Flächen
su flaeche flaeche_ln
histogram flaeche, title("Flächen")
graph export Grafiken/01_flaeche_hist.png, replace


histogram flaeche_ln, title("Flächen log.")
```

```
graph export Grafiken/01_flaeche_hist_ln.png, replace


table jahr, contents(n flaeche mean flaeche sd flaeche min flaeche max flaeche)

table jahr, contents(n flaeche_ln mean flaeche_ln sd flaeche_ln min flaeche_ln max
flaeche_ln)

graph box flaeche_ln, over(jahr) ytitle("Flächen log.") title("Flächen log. nach Jahr")

graph export Grafiken/01_flaeche_box.png, replace


hist flaeche, freq normal

graph export Grafiken/01_flaeche_normal.png, replace

hist flaeche_ln, freq normal

graph export Grafiken/01_flaeche_ln_normal.png, replace


* UV: Beteiligungsquote (Prozentsatz Privat) (J)

su beteiligung

table jahr, contents(freq mean beteiligung sd beteiligung min beteiligung max beteiligung)

hist beteiligung, freq normal title("Beteiligungsquote")

graph save Grafiken/01_beteiligung, replace


* UV: Rechtsform

tab rechtsform

graph bar, over(rechtsform) ytitle("Prozent") title("Rechtsform")

graph save Grafiken/01_rechtsform, replace


**********

** 2. Simple tests

**********


pwcorr roa einwohner flaeche_ln beteiligung, star(.05)

corrtable roa einwohner flaeche_ln beteiligung
```

```
graph export Grafiken/01_corrplot_spezial.png, replace


******************

** 3. Regression

******************


global kv beteiligung i.rechtsform


***

* Model1: Einwohnerzahlen


qui: reg roa einwohner $kv

outreg2 using Tabellen/m1b, replace ctitle(alle Fälle) label word excel dec(3) adec(3) fmt(f) addstat(adj. R2, e(r2_a))

predict cook, cooksd

local N = e(N)

reg roa einwohner $kv if cook <= 4 / `N', vce(robust)

outreg2 using Tabellen/m1b, append ctitle(ohne Ausreißer) label word excel dec(3) adec(3) fmt(f) addstat(adj. R2, e(r2_a))


* Final Model

reg roa einwohner $kv if cook <= 4 / `N', vce(robust)

vif

rvfplot

graph export Grafiken/04_m1_rvfplot.png, replace

predict r, resid

hist r, normal

graph export Grafiken/04_m1_resplot.png, replace


qui: reg roa einwohner $kv if cook <= 4 / `N', vce(robust)
```

```
outreg2 using Tabellen/Gesamt_ohneSparten, replace ctitle(Modell 1) label word excel dec(3) adec(3) fmt(f) addstat(adj. R2, e(r2_a))


drop cook r


***

* Model2: Flächen


qui: reg roa flaeche_ln $kv

outreg2 using Tabellen/m2b, replace ctitle(alle Fälle) label word excel dec(3) adec(3) fmt(f) addstat(adj. R2, e(r2_a))

predict cook, cooksd

local N = e(N)

reg roa flaeche_ln $kv if cook <= 4 / `N', vce(robust)

outreg2 using Tabellen/m2b, append ctitle(ohne Ausreißer) label word excel dec(3) adec(3) fmt(f) addstat(adj. R2, e(r2_a))


* Final Model

reg roa flaeche_ln $kv if cook <= 4 / `N', vce(robust)

vif

rvfplot

graph export Grafiken/04_m2_rvfplot.png, replace

predict r, resid

hist r, normal

graph export Grafiken/04_m2_resplot.png, replace


qui: reg roa flaeche_ln $kv if cook <= 4 / `N', vce(robust)

outreg2 using Tabellen/Gesamt_ohneSparten, append ctitle(Modell 2) label word excel dec(3) adec(3) fmt(f) addstat(adj. R2, e(r2_a))


drop cook r
```

```
capture log close

log2html "Logfiles/log_file", replace



cd "Grafiken"

shell ls *.gph

shell rm *.gph
```