Norges miljø- og biovitenskapelige universitet

Master's Thesis 2018 30 ECTS

School of Economics and Business

Sjur Westgaard

Creditworthiness and economic development in the Norwegian electric utility industry from 2007-2016

Magnus Nordrum Brøste

Joar Karlsen

Master of Business Administration

School of Economics and Business

Preface

This thesis marks the end of our two-year Master's Degree in Business Administration at the Norwegian University of Life Sciences.

We thank our supervisor Sjur Westgaard for helpful comments and suggestions throughout the writing process.

Neither the institution, nor our supervisor are responsible for weaknesses in either the methods or conclusions drawn in this thesis.

Abstract

This thesis consists of three parts. In the first part we implement five models of bankruptcy prediction, namely three versions of Altman Z-score, Ohlson O-score and Zmijewski's model. We rank the electric utilities and investigate the relationship between short-term probability of default and official credit ratings and automatically generated credit scores (ACS). We find these models better for relative ranking across the industry than for measuring a default probability for the utilities. All three Altman Z-scores result in noticeably low scores for the majority of the utilities, which may suggest that Altman Z-scores are unsuitable to measure creditworthiness for Norwegian electric utilities. Ohlson O-score and Zmijewski's model seem to give a more probable score according to the official credit ratings and the ACS.

In the second part we examine the economic development of the electric utilities in the ten-year period from 2007-2016, both relative performance and as an industry. The financial ratios utilized indicate that there has been a weakening in economic performance, mainly in the equity ratio, financial coverage, and EBITDA/total debt. The economic development seems to be driven by pressure from lower electricity prices. Green certificates and lower interest rates incentivize leveraging for historically advantageous hydro investments. The score from Zmijewski's model, which is implemented to investigate the historical development of creditworthiness, has on average increased (meaning a decline in creditworthiness) in the period. We see a slight improvement in the last few years, which may be a sign that the utilities have initiated measures to improve upon their creditworthiness. There are also apparent differences in creditworthiness across the utilities as shown especially in the solidity and profitability measures.

In the third part we utilize a Wilcoxon ranked-sum test to test whether there are any statistically significant differences in the financial ratios between the defined groups based on official credit ratings and ACS. The results indicate that the equity ratio, financial coverage, and EBITDA/total debt are the statistically significant different ratios.

List of contents

List of figures

List of tables

1. Introduction

This thesis consists of three main parts. The first part investigates the relationship between short-term default probability and official credit rating and ACS. The models utilized are all based on financial ratios, meaning they are objective measures, and that they are quite simple to implement. The analyses in this part are based on three versions of Altman Z-score, Ohlson O-score and Zmijewski's model. The three Altman Z-score models are the original model, the revised model for private firms and the revised model with four variables adjusted for asset turnover. The second part is a study where we examine the economic development of the electric utilities in the period from 2007-2016 according to financial ratios and Zmijewski's model. In the third part we utilize a non-parametric method to examine whether there are any statistically significant differences in the financial ratios between the defined groups based on official credit ratings and ACS.

This thesis mainly attempts to answer three questions:

1. Which of the five models is the most fitting to measure the relationship between short-term default probability and the official ratings and ACS?
2. What characterises the economic development of the electric utilities in the sample in the period from 2007 to 2016? Are there apparent differences in the relative performance of the utilities in the period?
3. Are there any statistically significant differences in financial ratios between the defined groups based on official credit ratings and ACS?

1.1 Motivation

The electric utilities are of huge interest to owners, creditors, employees, consumers and the government. The majority of the utilities are owned by municipalities, counties or the government (or in combination), which means that their creditworthiness and prospering is essential to support the local communities. Concurrently, it is problematic to raise capital by turning to the owners. This implies that they need to achieve capital through other channels such as the bond market and bank loans. Several of the electric utilities issue bonds on Oslo Stock Exchange, which increases the demand for credit information. The creditworthiness and probability of default will be thoroughly assessed by creditors when determining conditions for the loan, including size, payback time and interest rate.

The Norwegian electric utility industry has been, is, and will be vital for Norwegian energy supply and Norwegian industry. Norway, represented through the electric utility industry is an important provider of renewable energy for the neighbouring countries. Norway exports and imports electricity to neighbouring countries through interconnectors. The trade surplus has increased in the recent years. The EU have made ambitious plans for emission reductions. An example is the electrification of the transport industry which will increase the demand for renewable energy.

In the sample of 25 utilities, only four have an official credit rating, which makes this an interesting matter. The utilities in the sample are owned by municipalities, counties and the government (or in combination), which means rating them can be different compared to rating private companies owned by investors or public companies listed on a stock exchange. Companies listed on a stock exchange is often easier to evaluate because the value of the company reflects the market's point of view and occurring events influence the value. Companies with liquid bonds always have a kind of rating, measured in the value of the bonds. Large companies normally have an official credit rating which reflects their ability to handle their debt and probability of default.

1.2 Regulation of credit rating agencies

In the outcome of the Global Financial Crisis in 2008, the credit rating agencies were blamed for overly optimistic credit rating analyses, and several parts of the financial industry have been regulated to avoid new crises. According to the European Commission, credit rating agencies failed to measure the risk in complex financial instruments in a precise way. After recommendation from the European Securities and Markets Authority (ESMA), the European Commission decided to regulate the credit rating agencies (ESMA, 2018). Shadow rating of Norwegian utilities has been quite popular in the recent years, and several Nordic financial institutions shadow rated Norwegian electric utilities. This practice has now ended. Ratings now only includes automatically generated credit scores (ACS), and no qualitative adjustments are permitted.

By law, only official credit rating agencies are allowed to publish credit ratings with qualitative adjustments. In Europe, there are 26 official credit rating agencies, dominated by the three large agencies S&P, Moody's and Fitch with a market share of 93,2 percentage in the EU (ESMA, 2017).

2. Literature review

Credit rating and creditworthiness in the Norwegian electric utility industry seems to be a modestly debated topic in finance literature. The review focuses briefly on the background of the Norwegian electric utility industry along with a short paragraph on studies on the electric utility industry in the United States. Further, an introduction to the history of credit rating and bankruptcy prediction is presented.

Statistics Norway, which has the overall responsibility of statistics in Norway, publishes statistics and reports regarding the electric utility industry and power production in Norway. The industry has seen a major transition since its inception in the late 1800s. Greaker (2016) describes in his article how the focus from security of supply has been moved to a strong focus on profitability, after the deregulation of the market in 1991. Bye, Bergh & Holstad (2010) point out the establishment of the common power exchange in 1996 and the development of the interconnectors through the neighbouring countries as important events influencing the power market in Norway. The events have both increased the price and the amount of variables influencing the market. The establishment of the common market for emission allowances in Europe in 2005 has increased the price of finite energy resources such as coal and gas, which are determining price factors. Greaker (2016) investigates how the price of electricity is decisive on both coal and precipitation. The profitability in the electric utility industry rose sharply after year 2000, due to an increase of the price of coal of more than 50 percent. Further, he describes how the future electricity price is strongly affected of the climate policy in the EU and execution of the emission reduction targets.

Blacconiere, Johnson & Johnson (2000) investigate how deregulations in the U.S electric utility industry affect the relation between market value, book value and earnings. Based on a sample of 933 large electric utilities owned by investors with data from 1988-1996, their study support that the book value has decreased as an explanatory variable to market value, and earnings as an explanatory variable to market value has increased. Norton (1985) investigates how regulation affects the systematic risk for electric utilities. His findings support the view that more regulation lowers systematic risk, that the systematic risk is endogenous and that the systematic risk is lower for regulated compared to unregulated utilities.

2.1 Brief history on credit rating

In 1909, John Moody published credit analysis on United States railroads, and Standard & Poor's (S&P) published its first ratings in 1916. Since then, the credit rating agencies have been growing in importance. In fact, in the public and quasi-public bond market, issuers will not offer, and investors will not buy bonds that are not rated by Moody's, S&P or Fitch (Petitt, Pinto, & Pirie, 2015)

Credit rating agencies have a central role in the credit market. According to Moody's, the purpose of credit ratings is to "provide investors with a simple system of gradiation by which future relative creditworthiness of securities may be gauged" (Moody's Investor Service, 2018). Briefly stated, a credit rating is the probability of bankruptcy of a company according to the rating agencies. The companies that have a higher rating are perceived as the most creditworthy and will normally be assigned a lower interest rate, and vice versa: the companies with the lowest credit ratings are perceived as the least creditworthy and thus they will typically be assigned a higher interest rate by the creditors. This implies that credit ratings have the potential of massively impacting a company's interest expenses, which means that the rating can be crucial for a company's profitability. Low credit rating also tighten access to capital, because risk averse investors avoid junk bonds. To illustrate the importance of credit ratings we have cited this quotation from journalist and author Thomas L. Friedman:

"There are two superpowers in the world today in my opinion. There's the United States and there's Moody's Bond Rating Service. The United States can destroy you by dropping bombs, and Moody's can destroy you by downgrading your bonds. And believe me, it's not clear sometimes who's more powerful" (Partnoy, 2001).

Bankruptcy prediction literature dates back to the 1930's. The initial studies used univariate factor (single ratio) analysis to calculate the probability of bankruptcy. Fitzpatrick (1932) compared 19 successful and failed companies' ratios and reported that the successful companies had favourable ratios when compared to ratio trends and the "standard" ratios (Servigny & Renault, 2004). Merwin (1942) studied the economic character of small manufacturing corporations. He found that the financial characteristics of the failing firms began to differ from the successful firms several years in advance of their bankruptcy (Servigny & Renault, 2004). Chudson (1945) studied companies' assets and liabilities to see if there was a "normal" pattern in the financial structures. He found that the financial structure will vary across industries, and also across the various sizes of the corporations in the industries. Chudson's findings suggest for example that industry-specific models is a better application than general models. Beaver (1967) tested individual ratios' predictive abilities in categorizing bankrupt vs. non-bankrupt firms. Net income to total debt has the highest predictive ability in his study. He suggests that multiratio analysis may predict even better than single ratio analysis. Altman (1968) published his Z-score multivariate study in 1968. Since Altman's study, the number and depth of bankruptcy prediction studies have increased substantially. Dambolena & Schulman (1988) utilized a logit model to develop different bankruptcy prediction models. They suggest that financial analysts may be able to improve their liquidity forecasts by including net liquid balance indicators in their bankruptcy models. Skogsvik (1990) uses a probit model where he in addition investigates whether the predictive abilities of the model increases when inflation accounting is used. He concludes that the difference in prediction ability is insignificant, and that inflation adjusting implies additional work that may prove to be unnecessary. Shumway (2001) argues that hazard models are more appropriate than single-period models for forecasting bankruptcy. He proposes a model that implements financial ratios as well as market driven variables to create more accurate forecasts. Hillegeist, Keating, Cram & Lundstedt (2004) present a study where they argue that a market-based measure of a Black-Scholes-Merton option-pricing model performs better than the accounting-based measures of Z-score and O-score.

3. Theory

In this part we present the theoretical framework for this thesis. Firstly, central information and a brief history of power production in Norway is presented to give a better understanding of the electric industry. Secondly, we present the main factors of creditworthiness. This part includes a presentation of the five models implemented to investigate the relative performance and probability of default for the utilities in the sample. Ultimately, models used to determine the utilities' market value of equity are shortly presented.

3.1 A regulated industry

The electric utility industry in Norway is a regulated industry through its foundation on a natural resource. As of 2018, the utilities pay resource rent tax of 35.7 %, natural resource tax of 0.013 NOK per KWh of produced electricity (Skatteloven, 1999), as well as ordinary tax on profit of 23 % (Regjeringen.no, 2017). The resource rent tax is governmental and the natural resource tax is paid to the counties and municipalities where the production facility belongs.

3.2 Hydro power production in Norway

Power production in Norway has its roots back to the late 1800s. Since then, hydro power production has been an important part of Norway's energy supply as well as a fundament for the industry production. The industry has been strictly regulated over the years. In 1909 The Norwegian Parliament adopted the reversionary right "*hjemmfallsretten*", which without charge leaves the owner rights over the natural resources back to the Norwegian government after the licence period ends. As of today, approximately 90 % of the production capacity in Norway is owned by the government, municipalities and counties (Regjeringen.no, 2014).

In 1991, the Norwegian power market went through a liberalization, meaning that players in the market could choose their own supplier, and that the price was determined by supply and demand (Fornybar.no, 2016). Norway is able to export and import electricity from Sweden, Denmark, the Netherlands, Germany, Poland, the Baltic states, Russia and Finland through interconnectors between the countries. New transmissions to Great Britain and Germany are planned but not confirmed by the Norwegian Parliament (Greaker, 2016).

In 2016, Norway exported more than 22 TWh of renewable electricity to neighbouring countries, which represented approximately 15 % of total production in Norway that year. Total imports were less than 6 TWh the same year (Statistics Norway, 2017a).

3.3 Main factors of creditworthiness

The four Cs of credit analysis is a traditional approach in rating creditworthiness by examining capacity, collateral, covenants, and character (Petitt et al., 2015). Capacity refers to the issuers ability to handle its debt, in other words the ability to make the debt payments on time. In order to determine the capacity of a company, a traditional approach is to firstly analyse the industry, then proceed to more company specific analysis. In order to analyse the industry, one may use a framework, for example Porter's Five Forces (Porter, 2008). For a review of company specific analysis, we refer to chapter 5 of "Fixed Income Analysis" by Petitt et al. (2015). Collateral can be understood as asset value or a security for repayment. Collateral becomes highly relevant when a company is in danger of not repaying its debt obligations, in other words when the probability of default rises. Covenants consist of "affirmative" and "restrictive" covenants. They express what the issuer's management is obligated to do and limited in doing, respectively. Covenants are meant to protect creditors as well give the companies the flexibility in doing business for the sake of shareholders. Character is a trait that can be challenging to observe in a debtor. Ways of getting an indication of the character and the management of a company and the company as a whole is to assess the prudence of the current strategy, the success of former strategies, the use of aggressive accounting policies and tax strategies, history of illegal activity, and the treatment of previous bondholders (Petitt et al., 2015).

The aforementioned four Cs is a general approach to credit analysis. It is logical to tailor the analysis when analysing creditworthiness of companies in specific industries, because there will be factors that are more influential than others when implementing the analysis. The big credit agencies apply different methodologies and frameworks in different industries and cross-industries. In relation to these diversified frameworks, Moody's framework on "Unregulated Utilities and Unregulated Power Companies" is applicable to companies that sell electricity and gas to end-users in unregulated or lightly regulated markets, in other words where the commodity price is determined by market forces or is a negotiated contractual price agreed between buyer and seller. The framework focuses on four broad rating factors: scale, business profile, financial policy, and leverage and coverage (Moody's Investor Service, 2017).

Scale refers to the value of a company's assets, or simply put, how big a company is. It also refers to the size of the market the company is running their business. Bigger companies tend to better handle price fluctuations and competition from other players. Business profile refers to a company's ability to maintain its business model, in other words its ability to have consistent cash flows. Market diversification, asset quality, competitive positioning, degree of hedging, integration of generation and supply outlets, and business mix is taken into account when assessing the business profile. The company's risk tolerance and financial policies can give an indication of the future direction of the company's capital structure and credit profile. How the management and the company board balance shareholder returns at the expense of creditors and how they handle key events and their perception of the current business environment is taken into account. Leverage and coverage gauges the company's flexibility and long term viability in a business prone to volatility in wholesale prices. Moody's assess the leverage and coverage using financial metrics expressing the company's ability to handle interest payments and their comparative level of leverage in the industry (Moody's Investor Service, 2017). The factors are weighted according to their valuated significance.

Altman (1968) uses discriminant analysis to find a linear combination of independent variables to separate between bankrupt and non-bankrupt companies. He investigates which financial ratios, (independent variables) that most accurately predict probability of default. Ohlson (1980) and Zmijewski (1984) implement respectively logit and probit analysis, which are suitable if the dependent variable is binary. For the latter two models, the binary values are either bankrupt or non-bankrupt. The logit model, or logistic regression model, is a type of regression where the dependent variable is categorical. The main purpose of a probit model is to estimate the probability that an observation with defined characteristics will fall into one specific category.

3.5 Altman Z-score

The Z-Score model was developed by New York University professor Edward I. Altman in 1968 (Altman, 1968). He collected data from 66 companies, where half of the companies filed a bankruptcy petition from 1946-1965, while the other group were companies that still existed in 1966. The multivariate discriminant analysis (MDA for short) model consists of five variables in order to determine the distress of industrial corporations and to measure credit risk. The model produced good results even though he had a quite small sample with fairly small companies. The model had high 95 % predictive ability for the initial sample which used data one financial statement prior to bankruptcy. Two years prior to bankruptcy the model had 72 % accuracy. The accuracy drops down to 48 %, 29 %, and 36 % accuracy three, four and five years before bankruptcy, respectively. In a later study by Altman (Altman, 2002) the revised Z'-score model resulted in an accuracy between 82 % and 94 % to predict default 1 year prior to failure. There were observed 110 bankrupt companies in the period 1976-1995 which gave an accuracy at 85 % and 120 companies between 1995 to 1997 with an accuracy of 94 %. 2 years prior to failure the accuracy falls to 75 % and 74 %, respectively.

The total Z-Score measures the probability of default. The original model weights the variables as follows (Altman, 1968):

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 1.0X_5$$

The revised Z'-score for private firms weights the variables as follows (Altman, 2002):

$$Z' = 0.717X_1 + 0.847X_2 + 3.107X_3 + 0.420X_4 + 0.998X_5$$

The revised Z''-score adjusted for asset turnover weights the variable as follows (Altman, 2000):

$$Z'' = 6.56X_1 + 3.26X_2 + 6.72 X_3 + 1.05 X_4$$

X_1 – Working capital/Total Assets

Working capital shows the net liquid assets for the company, and is defined as the difference between current assets and current liabilities. This ratio shows the net liquid assets relative to the total capitalization for the company. Liquidity is essential when analysing probability of default.

X_2 – Retained Earnings/Total Assets

Retained earnings shows how much of the earnings the company has managed to reinvest in the company through its lifetime. A high retained earnings relative to total assets shows that the company has managed to finance more of its assets by earnings rather than by taking on debt. Mature companies often have higher retained earnings than younger companies, which increases the younger companies' probability of default. Statistics from Statistics Norway shows that only 49 % of all private companies established in 2010 were still in business 5 years later (Statistics Norway, 2017b).

X_3 – Earnings Before Interest and Taxes/Total Assets

Earnings before interest and taxes (EBIT) is a measure of the operating profit in the company. The size of EBIT is important to creditors because it measures how much money the company has to pay for its financing activities. EBIT is not influenced by taxes or leverage, and measures the productivity of the company's assets.

X_4 – Market Value of Equity/Book Value of Total Liabilities

Market value of equity is basically the total market value of all outstanding shares. Total liabilities is the sum of both short and long-term liabilities. This ratio is important because it measures how much the assets can decrease in value before liabilities exceeds the assets, and the company defaults.

X_5 – Sales/Total Assets

This ratio is called asset turnover and measures how efficient the company manages to make sales out of its assets. A higher ratio increases return on assets which is an important key ratio in financial analysis.

3.6 Revised Altman Z-score models (Z' & Z'')

Altman (2002) developed a revised Z-score model (Z') for private firms, where the market value of equity is substituted with the book value of equity. This revised model was developed to cover private firms where the market value of equity is undetermined. Altman (2002) also developed a revised Z-score model (Z'') with four variables where the fifth variable, asset turnover, is removed. The asset turnover varies strongly between industries, which makes it problematic to compare companies in different industries. This model also utilizes book value of equity instead of market value of equity in the fourth variable.

According to Altman (2003), the required Z-scores are:

In the original model:

$Z > 2.99$	"Safe" zone
$1.8 < Z < 2.99$	"Grey" zone
$Z < 1.8$	"Distress" zone

In the revised model for private firms:

Z’ > 2.9 “Safe” zone

1.23 < Z’ < 2.9 “Grey” zone

Z’ < 1.23 “Distress” zone

In the revised model with four variables:

Z’’ > 2.6 “Safe” zone

1.1 < Z’’ < 2.6 “Grey” zone

Z’’ < 1.1 “Distress” zone

3.7 Ohlson O-score

Similar to the Z-score, the Ohlson O-score model is a popular bankruptcy prediction model which utilizes financial ratios for predicting bankruptcy. The O-score was developed on a study where Ohlson (1980) used a logit model on a sample of over 2000 corporate successes and bankruptcies from 1970-1976, whereas the original Z-score model is based on a sample of 66 companies (Altman, 1968). Ohlson argued that his model was extremely accurate since he predicted 96.12 % correctly in his first model which were to predict bankruptcy within one year.

Ohlson (1980) highlights some issues regarding MDA. He argues that the requirements of the distributional properties of the predictors in MDA is problematic and he therefore questions the method. He further argues that the output of MDA is hard to interpret intuitively, since it is based on an ordinal ranking. Lastly, he focuses on problems related to the “matching” procedures typically used in MDA. He argues that the criteria *size* and *industry* for matching failed and non-failed firms are somewhat arbitrary. Ohlson (1980) states that the use of conditional logit analysis avoids these issues regarding MDA. He further argues that since his study examines whether the company went bankrupt prior or after the release of public financial statements, he avoids “back-casting” (starting with a future outcome and working backwards to the present situation), which is an issue prior studies have neglected since most studies have used Moody’s Manual which do not specify what point in time the data was made available. Ohlson (1980) does not attempt to make “new or exotic” ratios. His arguments for the selection of variables is simplicity and the popularity of these measures in preceding literature. Moreover, he argues that his model is easy to implement and interpret and easy to use in practical applications (Ohlson, 1980).

The O-score is a linear combination of nine factors which predict bankruptcy within one year:

$$O - score = -1.32 - 0.407 \log\left(\frac{TA_t}{GNP}\right) + 6.03\left(\frac{TL_t}{TA_t}\right) - 1.43\left(\frac{WC_t}{TA_t}\right) + 0.0757\left(\frac{CL_t}{CA_t}\right)$$

$$- 1.72X - 2.37\left(\frac{NI_t}{TA_t}\right) - 1.83\left(\frac{FFO_t}{TL_t}\right) + 0.285Y - 0.521\ \frac{(NI_t - NI_{t-1})}{|NI_t| + |NI_{t-1}|}$$

(Ohlson, 1980).

Where the variables in the model are:

1. log(TA/GNP) = log of total assets divided by the GNP price level index. This is a calculation of the size of the company relative to inflation. In our calculations, we use consumer price index statistics from Statistics Norway (Statistics Norway, 2018).
2. TL/TA = total liabilities divided by total assets.
3. WC/TA = working capital divided by total assets.
4. CL/CA = current liabilities divided by current assets.
5. X = dummy variable. One if total liabilities exceeds total assets, zero otherwise.
6. NI/TA = Net income divided by total assets.
7. FFO/TL = Funds from operations divided by total liabilities. We have defined funds from operations as net income + depreciation and amortization – sale of assets. We have included sales of both operational and financial assets, since this is not a part of the main operations of the firms.
8. Y = One if the net income was negative the last two years, zero otherwise.
9. $(NI_t-NI_{t-1})/(|NI_t| + |NI_{t-1}|)$ = This variable measures change in net income. Absolute values are used to indicate the level change.

An O-score of > 0.5 indicates that the company will go bankrupt within one year, while a score < 0.5 indicates safety (Ohlson, 1980).

3.8 Zmijewski's model

Zmijewski (1984) developed a probit model (probability + unit) which was to some extent based on Ohlson's (1980) model. The probit model is a regression model with binary classification. In this case, the study aims to classify companies as either bankrupt or non-bankrupt. Zmijewski (1984) studies the bias related to "oversampling" distressed firms, called choice-based sample bias, as well as sample selection-bias, which relates to using a complete data sample selection criterion. He argues that choice-based selection, which means drawing samples by observing the dependent value (attributes or group) instead of randomly drawing observations and then the dependent and independent variables are observed, can lead to biased estimated coefficients unless the model is built on the entire population. Zmijewski (1984) argues that his results do not result in significant changes even though it shows a choice-based selection bias and sample selection bias. His study examines 40 bankrupt and 800 non-bankrupt firms all listed on the American stock exchanges between 1972 and 1978. According to the original model, the correlation coefficient between the estimation sample frequency rate and the percentage of firms classified correctly is 94.9 %. Zmijewski (1984) introduced three variables based on accounting ratios to predict bankruptcy:

$$Zmijewski = -4.3 - 4.5X_1 + 5.7X_2 + 0.004X_3$$

X_1 = Net income/total assets
X_2 = Total liabilities/total assets
X_3 = Current assets/current liabilities

"Safe zone": Zmijewski score < 0.5
"Distress zone": Zmijewski score ≥ 0.5

3.9 Critique of the Ohlson O-score and Altman Z-score

The Z-score model uses data from smaller firms, and one may argue that the model's relevance is dropping due to its old age. The fact that it relies on data collected from the balance sheet makes it somewhat problematic to utilize on companies that has a lot of off-balance-sheet items. The O-score model does account for the total assets adjusted for GNP price level, but the model does not, like the Z-score, account for industry specific factors and economic conditions. The model also puts a lot of emphasis on the size of the company. According to Mansi, Maxwell and Zhang (2010), the studies of the Z-score and the O-score by Altman and Ohlson suffer from problems in defining failure and in putting together the distressed sample, which they argue means that the results will be quite sample specific. They argue that the studies have different definitions in the way they define financial distress, and that the models do not handle distress signals like dividend cuts or omission. They further address the issue that companies can encounter financial distress prior to or later than the actual default or bankruptcy filing date, and that some firms file for "strategic" bankruptcies (Mansi, Maxwell & Zhang, 2010).

3.10 Critique of Zmijewski's model

Zmijewski's model is a static model with three components, which Shumway (2001) criticises for vastly overstating the significance of the parameters and he argues that the model is a "one-variable model" since the total liabilities/total assets and net income/total assets are correlated. Grice & Dugan (2001) argue that the model of Ohlson (1980) and Zmijewski (1984) accuracies may decline when using the models on periods, industries and financial distress situations other than those used develop the model originally.

3.11 Determining the market value of equity for the original Z-score model

The original Z-score model requires the market value of equity in variable X_4. To determine this value we have chosen to implement the dividend discount model with stable growth. To do so we need to calculate the regression beta for a public traded firm, adjust for leverage using the bottom-up method, use the Capital Asset Pricing Model to find return on equity and dividend discount model with stable growth to determine the final value.

Bottom-up beta

To find the beta for private firms we find it suitable to use the bottom-up method (Damodaran, 2012). The first step in the process is to determine which business the company operates in. The second steps includes finding publicly traded firms to be able to calculate the utilities' stock beta. The average of these betas is used to calculate an average industry beta. The average industry beta needs to be unlevered to adjust for leverage. Level of leverage should be based on the average debt to value ratio for the selected sample. Average debt beta for the sample is needed to calculate the unlevered industry beta. The formula to calculate the unlevered beta is as follows:

$$\beta_{U=A} = \frac{D}{D+E}\beta_D + \frac{E}{D+E}\beta_E$$

Reference: (Berk & DeMarzo, 2017)

In this formula:

$\beta_{U=A}$ = The unlevered beta

D= market value of debt (net of cash)

E = market value of equity

β_E = equity beta

β_D= debt beta

The third step includes calculating how much value your firm derives from different business segments. In the fourth step, calculate the weighted average of the unlevered betas from the different business segments. In the fifth and last step, lever the beta to find the equity beta for the firm by using the formula below:

$$\beta_E = \beta_U + (\beta_U - \beta_D)\frac{D}{E}$$

The debt beta and the debt to equity ratio is firm specific information and is needed to calculate the equity beta. The CAPM is implemented to determine the cost of capital. The model is given by the following formula:

$$r_E = r_F + \beta_i(r_M - r_F)$$

Constant dividend growth model

The constant dividend growth model can be used to calculate the market value of equity for a mature firm. Mature firms often pays out dividend to stock holders and expected future dividend can be used to value the equity.

$$MV = \frac{Div}{r_E - g}$$

MV = Market value of equity

Div = Expected dividend

r_E = Return on equity

g = Long-term growth rate

Reference: (Berk & DeMarzo, 2017)

3.12. A non-parametric method

Non-parametric methods can be used when the observations are independent and when there is reason to believe that the data does not have a specific probability distribution, which means comparing numbers and ranking is a foundation in these methods (Hagen, 2014). Non-parametric methods are because of this also called distribution-free tests (Johnson & Bhattacharyya, 2011).

We apply a non-parametric statistical method called the Wilcoxon rank-sum test, also called the Wilcoxon-Mann-Whitney-test. The method is a way of testing if the medians of two independent samples is statistically different from one another. When using the test, we state the following hypothesis:

$H_0 : m_1 = m_2$
$H_1 : m_2 > m_1$ (or $H_1 : m_2 < m_1$)

When the null hypothesis holds, the samples will statistically have the same distribution, and the data will be equally spread out in the two samples. When the null hypothesis does not hold, sample number two will be statistically larger (smaller) than sample one. In other words, we are testing whether one sample is shifted towards the right or the left of the other sample. In order to implement these tests, one does not need to know the absolute values of the observations, it is satisfactory to be able to rank them. We find that this test is good for the purpose of examining the relative differences of the key ratios of the firms in the business.

$$\mathrm{E(W)} = \frac{\mathrm{n_1(n+1)}}{2} \text{ and } \mathrm{Var(W)} = \frac{\mathrm{n_1 n_2 (n+1)}}{12}$$

Then we calculate the significance probability q:

$$q = P(W \leq \sum W \mid H_0) \approx G\left(\frac{\sum W + 0.5 - E(W)}{Var\ (W)}\right)$$

Then this number is compared to the normal distribution table to check its significance on a 5 % significance level.

4. Data and methods

4.1 Sample and limitations

In this thesis we study utilities where electricity production and retail are the core business areas. The sample of electric utilities consists of 25 of the largest electric producing utilities in Norway. These utilities produce in total approximately 80 % of all electricity in Norway (Statistics Norway, 2017a). Arendals Fossekompani ASA and Norsk Hydro ASA are excluded, even though they are among the largest producers of electricity in Norway. Norsk Hydro ASA is withdrawn because their core business is aluminium production. Of their total revenue of 82 billion in 2016, only 7 billion was revenue from electricity, which is less than 9 % (Norsk Hydro, 2017). Arendals Fossekompani is withdrawn because their core business is investments. In 2016 only 113 million out of their total revenue of 6.52 billion was revenue from electricity, which is less than 2 % of the total revenue (Arendals Fossekompani, 2017). Both Arendals Fossekompani ASA and Norsk Hydro ASA are listed on Oslo Stock Exchange, and are not owned by the government, counties and municipalities, as the rest of the utilities in the sample are. Statkraft AS is included in the sample, notwithstanding their position as the largest provider of renewable energy in Europe. Statkraft is 100 % owned by the Norwegian government, which differ them from the other utilities. Statkraft's revenue of 51 billion in 2016 was more than 3 times the revenue of the second largest electric utility, Hafslund AS. Fredrikstad Energi AS is included in the sample, although they do not produce electricity. They are included because they operate in the same industry and hence it is interesting to investigate if their performance differs from the rest of the sample. The utilities' revenue reaches from 150 million to 51 billion, and their annual hydro production span from zero to 52.10 TWh.

Data collected for this thesis is financial information from the annual reports from 2007-2016. The corporate group for a normal utility in the sample usually consists of production, distribution, retail, and a parent company dealing with administration. Some utilities also operate in other businesses such as broadband and entrepreneur business and these business units are included in the balance sheet of the corporate group. Although the utilities' core business areas are electricity production and retail, several utilities are diversified with business units operating in distribution, broadband, district heating and construction operations. Because several utilities do have more business units, we have collected data from the corporate group (concern), where all assets and revenues are included.

4.2 Current official credit ratings and ACS

In the sample of Norwegian electric utilities only 4 out of 25 utilities have an official rating. The rating reaches from BBB- up to A-.

Table 1: Official ratings

Utility	Rating	Outlook	Agency	Date
Agder Energi AS	BBB+	Stable	Scope Ratings AG	22.08.2017
Eidsiva Energi AS	BBB-	Stable	Scope Ratings AG	08.12.2017
Lyse AS	BBB+	Stable	Scope Ratings AG	30.05.2017
Statkraft AS	A- Baa1	Stable Stable	S&P Moody's	28.08.2017 20.06.2017

Before the new regulations of shadow rating, several banks and other financial institutions used shadow ratings to rate Norwegian electric utilities. Now, as previously mentioned, the measures are a solely quantitative approach, namely automatically generated credit scores (ACS).

Table 2: ACS from financial institutions.

Utilities	Financial institution 1 ACS	Financial institution 2 ACS	Financial institution 3 ACS
Agder Energi AS	bbb+	bbb+	bbb
Akershus Energi AS	bbb	a-	-
BKK AS	bbb	bbb+	bbb-
E-CO Energi Holding AS	bbb	bbb	bbb
Eidsiva Energi AS	bbb	bbb	bbb
Fredrikstad Energi AS	bbb	bbb-	-
Glitre Energi AS	bbb+	bbb+	bbb
Hafslund AS	a	a	a-
Helgeland Kraft AS	bbb	bbb	-
Lyse AS	bbb+	a-	bbb
Nord-Salten Kraft AS	-	a-	-
Nord-Trøndelag Elektrisitetsverk Holding AS	bbb+	bbb	bbb
Ringeriks-Kraft AS	-	bbb	-
Sogn og Fjordane Energi AS	bbb	bbb+	bbb
Sognekraft AS	bb+	bb	bb+
Statkraft AS	a-	a+	a-
Sunnfjord Energi AS	bbb	a	bbb-
Sunnhordland Kraftlag AS	bbb	a-	bb+
Tafjord Kraft AS	bbb	bbb	bbb
Troms Kraft AS	bbb	bb+	-
TrønderEnergi AS	a-	a	bbb
Tussa Kraft AS	bbb	bbb+	-
Valdres Energiverk AS	bbb-	bbb	-
Vardar AS	bb+	b+	-
Østfold Energi AS	bbb	bb	-
Median	***bbb***	***bbb+***	***bbb***

All three reports are from 2017. The institutions required confidentiality.

4.3 Grouping the utilities

We have divided the utilities in three categories according to their current official ranking and ACS in order to follow their economic development in the sample period. The categories are: upper medium grade (UMG – from "a-" and upwards), medium low grade (MLG – "bbb" and "bbb+"), and low grade (LG – "bbb-" and downwards). We then have eight utilities in the upper medium grade category, eleven utilities in the medium low grade category, and six utilities in the low grade category.

Table 3: Grouping of the utilities.

Utilities	Rating	Group
Akershus Energi AS	a-	UMG
Hafslund AS	a	UMG
Lyse AS	a-	UMG
Nord-Salten Kraft AS	a-	UMG
Statkraft AS	a+	UMG
Sunnfjord Energi AS	a	UMG
Sunnhordland Kraftlag AS	a-	UMG
Trønderenergi AS	a	UMG
Agder Energi AS	bbb+	MLG
BKK AS	bbb+	MLG
E-CO Energi Holding AS	bbb	MLG
Glitre Energi AS	bbb+	MLG
Helgeland Kraft AS	bbb	MLG
Nord-Trøndelag Elektrisitetsverk Holding AS	bbb	MLG
Ringeriks-Kraft AS	bbb	MLG
Sogn og Fjordane Energi AS	bbb+	MLG
Tafjord Kraft AS	bbb	MLG
Tussa Kraft AS	bbb+	MLG
Valdres Energiverk AS	bbb	MLG
Eidsiva Energi AS	bbb-	LG
Fredrikstad Energi AS	bbb-	LG
Sognekraft AS	bb	LG
Troms Kraft AS	bb+	LG
Vardar AS	b+	LG
Østfold Energi AS	bb	LG

4.4 The market value of equity

None of the utilities in the sample are listed on a stock exchange. However, Hafslund AS (HNB) was listed on Oslo Stock Exchange in the period from 1980 until 2017. To determine the market value of the utilities we use the regression beta from Hafslund in the period calculated with monthly data from july 2008 until july 2017. To find the beta of Hafslund we implement data from Oslo Stock Exchange OBX (total return) for the same period. The selected index consists of the 25 most liquid companies listed on Oslo Stock Exchange (Oslo Stock Exchange, 2018). The dependent variable in the regression is the monthly return from the index and the independent variable is the monthly return from Hafslund AS (HNB). This method to value the utilities is called bottom-up and can be used for private companies not listed on any stock exchange with tradeable stocks (Damodaran, 2012).

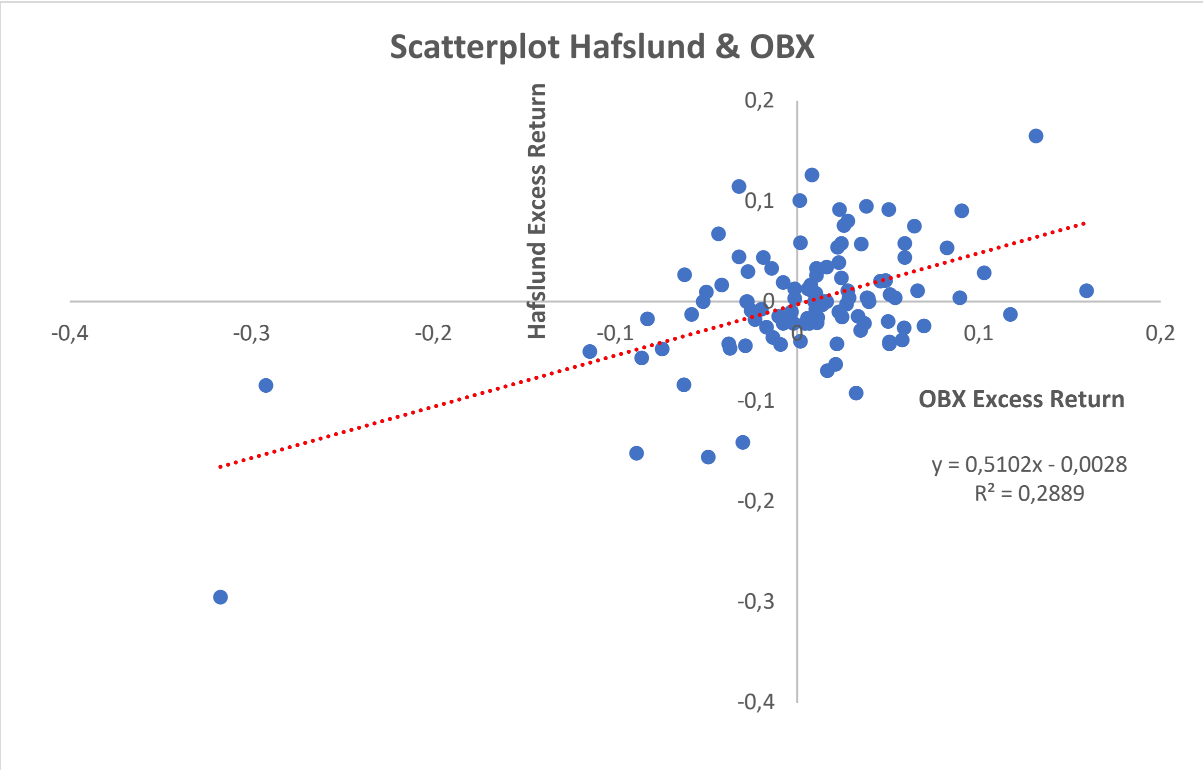


Figure 1: Scatterplot of monthly excess return for Hafslund vs. Oslo Stock Exchange OBX. Reference: Thomson Reuters Datastream.

The stock beta of Hafslund is equal 0.5102. To find the unlevered beta we need to insert equity-to-value and debt-to-value ratios for Hafslund AS for 2016. Since we do not have the market value of equity and debt for the other utilities in the sample, we utilize book values to unlever the asset beta. We assume the debt beta to be zero. The book value of debt is not adjusted for cash.

$$\beta_{U=A} = \frac{17.17B}{17.17B + 9.57B}0 + \frac{9.57B}{17.17B + 9.57B}0.5102$$

B = Billion Norwegian kroner

$$\beta_{U=A} = 0.1826$$

The unlevered beta is equal 0.1826, which is also called the asset beta. To find the equity beta for each utility we have levered the beta for the utilities according to their book capital structure.

$$\beta_E = \beta_U + (\beta_U - \beta_D)\frac{D}{E}$$

Reference: (Berk & DeMarzo, 2017)

We have made the following assumptions for the debt beta according to average industry betas by rating (Berk & DeMarzo, 2017): utilities in upper-medium grade: 0.0, utilities in medium-low grade: 0.1, and utilities in low grade: 0.17. To find the return on equity we implement the capital asset pricing model (CAPM). We also assume that the risk free interest rate (r_f) is equal a 10 years Norwegian government bond. This bond is trading close to 2 % by March 2018 (Norges Bank, 2018). The market return (r_M) is calculated to be 10 %, which is the geometric average return on Oslo Stock Exchange the past 23 years (Oslo Stock Exchange, 2018). In order to calculate the market value of equity we have analysed the utilities and calculated expected dividend for the utilities and further used the constant dividend growth model to determine the market value of equity. In this model we assume dividend, return on equity and growth rate to be constant forever for reasons of simplicity. Since the main income source for most of the utilities is production of electricity through hydro power plants, we assume that cash flows from these utilities will sustain. The expected dividend to the firm is based on historical dividend, future production of electricity together with the expected price of electricity. The cost of equity is calculated using the CAPM. The constant growth rate is assumed to be 2 %.

The amount of dividend a utility decides to pay out depends on its profits, strategy, capital structure, risk tolerance, future capital needs and owners' required return. The main factor that influences the profitability for the utilities is the price of electricity. According to Statnett's long-term market analysis for the Nordic countries and Europe (2016-2040), expected average power price in the south of Norway is estimated to be 44 €/MWh in 2030 and 43 €/MWh in 2040 (Bøhnsdalen et al., 2016). This is respectively 18 and 17 €/MWh over the price level we observed in the south of Norway in 2016. A power price at this forecast, where we assume an exchange rate of 9 NOK per Euro will result in an increase of the power price of 153-162 NOK/MWh. In our forecast for expected dividend we assume an increase of 150 NOK/MWh.

For each utility we have extracted the mean power production to estimate future revenue from power production (appendix 2). Dividend payout is based on profit after tax, which is why we need estimates for future tax rates. In 2016, the resource rent tax were 33 % and the corporate tax were 25 %, which results in a total tax rate of 58 % (Regjeringen.no, 2016). A higher power price will not increase the natural resource tax, but it will increase the resource rent tax since this tax fluctuates with power prices. We have assumed the tax rates to be identical to what they were in 2016 in the model for this surplus revenue due to a higher level of the power price. We make the assumption that 50 % of the revenue surplus after tax will be attributed to retained earnings, and the remaining 50 % is paid out as dividend. Our estimate of future dividends consists of this surplus dividend after tax and the dividend paid out by the utilities in 2016. Compared to the highest dividend paid out in the period from 2007-2016, our estimate is on average 80 % with a median of 79 %. The spread in this estimate is between 24 % and 138 % compared with the highest dividend paid out in the mentioned ten-year period. This results in a market value of equity/book value of equity ratio with a median of 2.28, an average of 2.60, and a spread of 1.14 - 5.95 (appendix 1). Fredrikstad Energi AS, the only electric utility in the sample which do not produce power, is valued simply by what they paid out as dividend in 2016. Vardar Kraft AS did not pay out dividend in 2016. Here we have taken the dividend paid out in 2015.

4.5 Key financial ratios for analysing the economic development

Financial ratios as a measure of economic performance is an objective measure with no qualitative adjustments as one of its main advantages. Financial ratios are a measure of historical performance and do not include any expectations for future growth nor profitability, and are easy to interpret, easy to understand and suitable as a basis for comparison with other utilities. However, accounting regulation and qualitative adjustments can bias the balance sheet and hence make financial ratios biased and less suitable for comparison. Special occurring events and strategic decisions can influence the balance sheet and make financial ratios biased. Therefore, calculating different financial ratios for the same utility across time will strengthen the reliability and validity of the analysis.

In the following section we present the financial ratios used in analysing the economic development in the sample between groups from 2007-2016. Westgaard & van der Wijst (2001) present a study where they estimate default probability and expected loss in corporate bank portfolios. The study focuses on the estimation of probability of default of the customer (or counterparty). They develop a logistic model where financial variables as well as other firm characteristics affect the default probability. The main conclusion is that default probabilities decreases as a function of the following ratios: cash flow over total debt, financial coverage, liquidity ratio, and equity ratio. In their sample, there were substantial differences in these financial ratios of the non-bankrupt sample versus the bankrupt sample.

Cash flow over total debt is measured as operating income plus depreciation divided by the total debt. It is essentially the same as EBITDA/total debt, so we will call it that from here on. This measure gives an indication of the company's earnings from their main operations taking away the effects of asset value loss in relation to the company's total debt. Financial coverage is measured as net income plus financial costs divided by financial costs. The ratio gauges the financial flexibility of the company, and indicates how many times the net income (before deduction of interest expenses) covers financial costs. If the financial coverage is small, the company has a major constraint in investment and financing decisions, which means that the company cannot grow. The lower the financial coverage, the closer the company is to go bankrupt. The financial coverage will therefore affect the credit ratings because of its value. Inversely, the credit ratings will have a substantial effect on the financial coverage, since the top rated firms normally get a lower interest rate on their debt obligations. Liquidity rate is a ratio which describes the relationship between current assets and current debt. It generally indicates if a firm has sufficient short term assets to cover its short term debt. A low liquidity rate is normally an indication of a company in financial distress, especially in the short term. On the other hand, one generally does not want to have excessive current assets tied up in the company. The latter may be an indication that the company is struggling with transforming their assets into cash, or in the opposite situation, that it is lacking investment alternatives for their (excessive) cash. Taking these aspects into account, companies generally seek neither too high nor too low liquidity rate. Solidity, measured as equity divided by total capital, also known as equity ratio. The ratio gives an indication of the overall risk of the company. The optimal level of debt to equity ratio will strongly depend on the overall risk of the business and also depend on the debt level the management and equity investors prefer. Utilities that seek stable revenues for their equity holders will commonly aspire for a good level of solidity.

There are several benefits of using debt to finance the firm's operations. In most countries, interest payments on debt is tax deductible. It can also make the managers of the company more disciplined and increasingly aware of the company's expenditures and investment decisions. On the other hand, too much debt financing can be costly due to increased interest expenses and potentially increased cost of capital, or a downgrade in credit rating. Debt holders can impose covenants on the firm and in that way affect the company's operating, investment and finance decisions (Palepu, Healy, & Peek, 2016). The following paragraphs present further ratios we have included in the analysis.

Return on assets

There is at least two ways to calculate return on assets. One way is to measure it as net income divided by total assets. The other way is to measure it as net income plus interest expenses divided by total assets (called ROA 2). The first method shows how much profit the firm is able to generate for each dollar (or kroner) invested in assets of the company. The second method includes interest expenses in the numerator because total assets in the denominator have been funded of both equity and debt. According to Berk & Demarzo (2017), the most suitable way to measure return on assets is to include interest expenses. In the electric utility industry, this is an interesting ratio because the utilities are normally quite sizeable in terms of assets.

Return on equity

Return on equity (ROE), measured as net income divided by the total shareholder's equity. ROE is a good way of measuring how well the company is managing the shareholders' funds to generate returns. More specifically, it shows how much profit each dollar generates for the shareholders' equity. Over long periods, large publicly traded firms in Europe generate ROEs in the range of eight to ten percent (Palepu, Healy, & Peek, 2016). However, what is a good (or perhaps satisfactory) level of ROE depends on the cost of equity and the normal level of ROE in the business.

EBIT-margin and EBITDA-margin

EBIT-margin equals EBIT/total sales and EBITDA-margin is EBITDA/total sales. Earnings before interest and taxes (EBIT) is a measure of the operating profit in the company. The size of EBIT is important to creditors because it is the size of EBIT which measures how much money the company has to pay for its financing activities. EBIT is not influenced by taxes or leverage.

EBITDA eliminates the effect of depreciation and amortization in addition to the effect of taxes and leverage. Lie & Lie (2002) argues that EBITDA is a better measure than EBIT since the depreciation expenses possibly disfigures the realistic asset value drop which may lead to biased values of earnings.

Cash flow spread

Cash flow spread is calculated by finding the maximum and minimum value of the increase or decrease in cash or cash equivalents over a ten-year period from 2007-2016. Then we take this spread divided by the average cash flow over the period to find the cash flow spread.

Ratios in relation to total assets

Working capital/total assets is included to more easily scale the working capital to the size of the company. Working capital equals current assets minus current debt. This measurement is the same as the liquidity rate, the only difference being that the working capital is in absolute measures. Net income after tax/total assets is heavily weighted in Zmijewski's model. It scales the net income to the size of the company. EBIT/total assets is heavily weighted in the Ohlson O-score model. It scales the EBIT in relation to the total assets.

5. Results

5.1 Part 1

Which of the five models is the most fitting to measure the relationship between short-term default probability and the official ratings and ACS?

The benchmark score is based on the official ratings and the financial institutions' ACS. It is important to note that this is just an indicator of the accuracy of the model, no statistic significant analysis is implemented.

Table 4. Scores, all utilities.

Utilities	Score	Z (16)	Z'(16)	Z"(16)	O (16)	Zmj. (16)
Statkraft AS	a+	2.04	0.90	1.56	-4.25	-1.45
Hafslund AS	a	1.60	1.12	1.32	-2.66	-0.87
Sunnfjord Energi AS	a	1.29	1.00	2.20	-2.32	-0.98
Trønderenergi AS	a	1.71	1.08	2.93	-3.92	-1.78
Akershus Energi AS	a-	1.85	0.90	2.37	-2.29	-1.09
Lyse AS	a-	1.41	0.93	1.94	-2.30	-0.46
Nord-Salten Kraft AS	a-	2.58	1.15	2.50	-2.05	-1.64
Sunnhordland Kraftlag AS	a-	3.83	1.43	3.63	-2.59	-2.00
Agder Energi AS	bbb+	1.51	0.72	0.45	-1.21	0.05
BKK AS	bbb+	1.69	0.68	0.60	-2.30	-0.87
Glitre Energi AS	bbb+	1.46	0.79	1.90	-2.62	-0.90
Sogn og Fjordane Energi AS	bbb+	1.56	0.84	1.53	-2.29	-0.99
Tussa Kraft AS	bbb+	1.63	1.04	1.81	-2.08	-0.79
E-CO Energi Holding AS	bbb	2.64	0.79	1.48	-2.44	-0.81
Helgeland Kraft AS	bbb	1.41	0.93	2.38	-2.38	-0.97
Nord-Trøndelag Elektrisitetsverk Holding AS	bbb	1.53	0.98	1.60	-2.24	-1.27
Ringeriks-Kraft AS	bbb	1.80	0.96	1.43	-1.15	-0.63
Tafjord Kraft AS	bbb	1.39	0.90	1.55	-1.87	-0.38
Valdres Energiverk AS	bbb	1.30	0.95	1.65	-1.36	-0.63
Eidsiva Energi AS	bbb-	1.44	0.72	1.08	-2.27	-0.53
Fredrikstad Energi AS	bbb-	0.98	0.70	0.59	-1.11	-0.47
Troms Kraft AS	bb+	1.16	0.98	1.02	-1.00	0.19
Sognekraft AS	bb	1.42	0.66	1.45	-1.05	-0.15
Østfold Energi AS	bb	2.61	1.00	2.93	-3.09	-1.31
Vardar AS	b+	1.03	0.49	0.65	-1.56	0.06

Altman Z-score (original)

For all the Z-score models, the higher the score, the lower the probability of default. Based on the Z-scores for 2016, only one utility has a Z-score above 2.99 and is classified in the "safe" zone. Six utilities have a Z-score between 1.8 and 2.99 which classify them in the "grey" zone. The remaining 18 utilities have a Z-score below 1.8 which classify them in the "distress" zone.

Table 5: Average Z-scores by S&P bond Rating (1996-2001). Reference: Altman (2003).

Average Z-Score by S&P Bond Rating (1996-2001)					
Rating	Firms	Z-Score (average)	SD (average)	Z-score (sample average)	Utilities*
AAA	66	6.20	3.06	-	
AA	194	4.73	2.36	-	
A	519	3.74	2.29	2.04	8
BBB	530	2.81	1.48	1.57	13
BB	538	2.38	1.85	1.73	3
B	390	1.80	1.91	1.03	1
CCC+CC	9	0.33	1.16	-	

**The sample of electric utilities.*

The utilities are classified according to the Z-score for 2016. According to the statistics, companies with a low Z-score have a lower credit rating. It is also important to take into account that the standard deviation is large and the Z-scores are average Z-scores. Based on both this table from S&P Bond Rating and the classification of zones developed by Altman, the Z-scores are noticeably low. Due to the lack of studies of Z-scores on Norwegian utilities, we have selected ten companies from Oslo Stock Exchange as a benchmark. The companies are picked from the OBX total return index, which mean they are among the top 25 most traded stocks and that the market value of equity is easily obtainable. The companies picked as the benchmark for the utilities are not representative for the industries in total, but it may be an indicator of the general performance of the electric utilities.

Table 6: Sample from Oslo Stock Exchange.

Company	Industry
Aker BP	Energy
Subsea 7	Energy
TGS-NOPEC Geophysical Company	Energy
Norsk Hydro	Materials
Yara International	Materials
Grieg Seafood	Seafood
Marine Harvest	Seafood
Lerøy Seafood Group	Seafood
Orkla	Consumption
Telenor	Telecom

Table 7. Z-scores and variables compared to sample from Oslo Stock Exchange.

2016	Electric utilities*	Avg. all industries compared	Energy	Materials	Seafood	Telecom	Consumption
Avg. Z-score	1.72	3.15	3.04	3.04	3.82	1.82	3.96
X_1=WC/TA	−0.68 %	10.28 %	9.57 %	14.64 %	34.33 %	−11.94 %	4.79 %
X_2= RE/TA	20.95 %	36.50 %	31.7 %	50.31 %	23.59 %	20.26 %	56.61 %
X_3= EBIT/TA	6.04 %	9.47 %	4.82 %	6.32 %	20.89 %	8.27 %	7.04 %
X_4=MVE/TL	1.58	2.62	3.50	2.04	2.62	1.29	3.67
X_5=Sales/TA	28.31 %	63.42 %	30.4 %	72.42 %	82.34 %	63.97 %	67.91 %

*The sample

Four out of five industries have above 3 in average Z-score which would categorize them in the “safe” zone. Variable WC/TA stands out unfavourably for the utilities as it is negative on average for the electric utilities, and span from about 5 % for the consumption companies to almost 35 % for the seafood companies. Telecom has a more negative WC/TA than the electric utilities. The compared industries all have a higher RE/TA, except Telecom. All industries except Energy have a higher EBIT/TA. According to our calculations, MVE/TL also measures smaller than four out of five of the industries. In SA/TA, all the compared industries have a higher ratio.

Revised Altman Z’-score

Based on the Z’-scores for 2016, none of the utilities have a Z’-score above 2.9. Only one utility has a Z’-score which is between 1.23 and 2.9 which classifies the utility in the “grey” zone. The remaining 24 utilities have a Z’-score below 1.23 which classify them in the “distress” zone. As for the original Z-score model, the scores are noticeably low.

Revised Altman Z''-score (four variables)

Based on the Z''-scores for 2016, three of the utilities have a Z''-score above 2.6. 16 utilities have a Z''-score which is between 1.1 and 2.6 which classify them in the "grey" zone. The remaining six utilities have a Z-score below 1.1 which classify them in the "distress" zone. The scores are also noticeably low for both the revised Z-score models.

Zmijewski's model

For the Zmijewski-score, the lower metric the lower probability of default. All the utilities in the sample have a Zmijewski-score below 0.5 which classify them in the "safe" zone, which seems to be a true and fair classification according to the official credit ratings and ACS. The utilities in the sample ranges from -2.0 to 0.19.

Ohlson O-score

For the Ohlson O-score, the lower ratio, the lower probability of default. The utilities in the sample ranges from -4.25 to -1.0. All the utilities in the sample have an O-score below 0.5 which classify them into the "safe" zone. This seems to a be a true and fair classification according to the official credit ratings and ACS.

Table 8: Ranking, all utilities.

Utilities	Score	Rank Z	Rank Z'	Rank Z"	Rank O	Rank Zmj.
Statkraft AS	a+	5	14	13	1	4
Hafslund AS	a	11	3	19	4	12
Sunnfjord Energi AS	a	22	7	7	9	9
Trønderenergi AS	a	8	4	2	2	2
Akershus Energi AS	a-	6	16	6	13	7
Lyse AS	a-	19	12	8	11	20
Nord-Salten Kraft AS	a-	4	2	4	17	3
Sunnhordland Kraftlag AS	a-	1	1	1	6	1
Agder Energi AS	bbb+	14	20	25	21	23
BKK AS	bbb+	9	23	23	10	13
Glitre Energi AS	bbb+	15	19	9	5	11
Sogn og Fjordane Energi AS	bbb+	12	17	15	12	8
Tussa Kraft AS	bbb+	10	5	10	16	15
E-CO Energi Holding AS	bbb	2	18	16	7	14
Helgeland Kraft AS	bbb	18	13	5	8	10
Nord-Trøndelag Elektrisitetsverk Holding AS	bbb	13	8	12	15	6
Ringeriks-Kraft AS	bbb	7	10	18	22	16
Tafjord Kraft AS	bbb	20	15	14	18	21
Valdres Energiverk AS	bbb	21	11	11	20	17
Eidsiva Energi AS	bbb-	16	21	20	14	18
Fredrikstad Energi AS	bbb-	25	22	24	23	19
Troms Kraft AS	bb+	23	9	21	25	25
Sognekraft AS	bb	17	24	17	24	22
Østfold Energi AS	bb	3	6	3	3	5
Vardar AS	b+	24	25	22	19	24

Sunnhordland Kraftlag AS is overall the best ranked utility in the sample based on the five models. They have the highest solidity ratio and which is an important variable in all the five models. In addition they have a high return on assets affecting O-score and Zmijewski-score positively. On the opposite side of the scale we find Vardar AS, which also is the lowest ranked utility in the sample based on the ACS. Vardar AS has one of the lowest equity ratios and liquidity ratios, which seem to widely explain the low ranking. Surprisingly, Østfold Energi AS which has a “bb” ACS, is much higher ranked according to the models. Østfold Energi AS is ranked between the sixth and third highest utility in the five models. The main reason seems to be due to a high equity ratio and high liquidity ratio, where the liquidity ratio is measured as current assets divided by current liabilities. Østfold Energi AS has a low ACS, which may be due to low net profit after tax in the last five years. The utilies with the highest spreads in ranks had ranks from 2-18, 3-19 and 9-25.

It does not seem to be a straight-forward relationship between short-term probability of default and official credit ratings and ACS. Although all the models predict the short-term probability of default, the majority of the utilities' relative performance vary for each model.

5.2 Part 2

What characterises the economic development of the electric utilities in the sample in the period from 2007 to 2016? Are there apparent differences in the relative performance of the utilities in the period?

The economic development from 2007-2016 between groups

The equity ratio has, on average, been trending downwards in the three defined groups. The LG-category stands out negatively, where the ratio has weakened 38.86 % in relative measures or 18.35 percentage points. The MLG and UMG-category have also become less solid in terms of the capital structure, but in a less apparent manner. The same goes for the financial coverage, where all the groups show a deteriorating economic development. The UMG-category stands out as the ratio has declined 50.27 % over the period. Still, the UMG-category proves quite solid compared to the lower categories. The same applies for the EBITDA to debt ratio, which measures the utility's ability to generate revenue from operations disregarding depreciation. All the groups show a declining tendency. As for the liquidity ratio, the MLG-group has had a minor improvement in the average, while the UMG and LG-category show a downward path. The UMG-category is averaging 1.35 in 2016, while the other two categories average below 1, meaning the current debt is on average surpassing the current assets. All the profitability measures included in the analysis, EBIT-margin, EBITDA-margin, ROA, ROA with financial costs, ROE, and net income after tax divided by total assets are all headed in a unfavourable direction. The only exception is the ROE for the LG-category which has improved. At the same time, the equity ratio in the LG-category has dropped from 47.22 % on average to 28.87 % on average, which may be an indication that the ROE is increasing because of a declining equity ratio. Working capital/total assets and net income after tax divided by total assets have both declined. Over the same period, the groups have on average grown in size according to the total assets.

Table 9: Economic development in the financial ratios between groups.

Equity ratio	Average 2007	Average 2016	Percentage change	Absolute change
UMG	49.60 %	44.60 %	-10.08 %	-5.00 %
MLG	39.88 %	35.66 %	-10.58 %	-4.22 %
LG	47.22 %	28.87 %	-38.86 %	-18.35 %
Financial coverage	Average 2007	Average 2016	Percentage change	Absolute change
UMG	12.32	6.13	-50.27 %	-6.19
MLG	4.73	4.12	-12.95 %	-0.61
LG	5.80	2.86	-50.69 %	-2.94
EBITDA/total debt	Average 2007	Average 2016	Percentage change	Absolute change
UMG	0.37	0.17	-53.08 %	-0.19
MLG	0.21	0.15	-28.26 %	-0.06
LG	0.28	0.11	-60.71 %	-0.17
WC/TA	Average 2007	Average 2016	Percentage change	Absolute change
UMG	20.25 %	5.80 %	-71.36 %	-14.45%
MLG	6.00 %	3.00 %	-50.00 %	-3.00%
LG	9.67 %	5.00 %	-48.28 %	-5.67%
Liquidity rate	Average 2007	Average 2016	Percentage change	Absolute change
UMG	1.79	1.35	-24.76 %	-0.44
MLG	0.92	0.99	7.11 %	0.07
LG	1.60	0.97	-39.29 %	-0.63
EBIT-margin	Average 2007	Average 2016	Percentage change	Absolute change
UMG	54.70 %	26.57 %	-51.42 %	-28.13 %
MLG	30.82 %	24.82 %	-19.47 %	-6.00 %
LG	39.77 %	25.71 %	-35.37 %	-14.07 %
EBITDA-margin	Average 2007	Average 2016	Percentage change	Absolute change
UMG	66.40 %	37.69 %	-43.23 %	-28.70 %
MLG	41.98 %	36.47 %	-13.14 %	-5.52 %
LG	48.55 %	38.60 %	-20.49 %	-9.95 %
ROA	Average 2007	Average 2016	Percentage change	Absolute change
UMG	4.77 %	2.92 %	-38.86 %	-1,86 %
MLG	4.56 %	2.57 %	-43.67 %	-1,99 %
LG	4.67 %	2.83 %	-39.44 %	-1,84 %
ROA 2	Average 2007	Average 2016	Percentage change	Absolute change
UMG	6.35 %	4.53 %	-28.70 %	-1.82 %
MLG	6.89 %	4.46 %	-35.19 %	-2.42 %
LG	6.70 %	5.46 %	-18.57 %	-1.25 %
ROE	Average 2007	Average 2016	Percentage change	Absolute change
UMG	11.33 %	7.20 %	-36.43 %	-4.13 %
MLG	11.77 %	7.42 %	-36.94 %	-4.35 %
LG	8.83 %	12.24 %	38.54 %	3.40 %
NIAT/TA	Average 2007	Average 2016	Percentage change	Absolute change
UMG	4.77 %	3.76 %	-21.33 %	-1.02 %
MLG	4.56 %	2.57 %	-43.67 %	-1.99 %
LG	4.67 %	3.28 %	-29.84 %	-1.39 %

The utilities in the top categories generate the highest average cash flow, but they also have the highest volatility as indicated by the cash flow spread (MLG surpassing UMG in the average spread when excluding Statkraft).

Table 10: Cash flow average 2007-2016 (numbers in 1000 NOK).

Cash flow	Average 2007-2016	Spread average 2007-2016
UMG	103 964	3 898 166
UMG excluding Statkraft	47 244	838 333
MLG	21 945	1 046 476
LG	16 425	537 490

Over this ten-year period, the average price in Norway peaked in 2010 and hit its lowest level in 2015. The cash flow averages show that the two top categories generate the highest cash flows when the price is high (2010) but also the most negative cash flows when the price is at low levels (2015). When excluding Statkraft, the cash flow average is positive in 2015.

Table 11: Cash flow in 2010 and 2015 (numbers in 1000 NOK)

Cash flow	Average 2010	Average 2015	Percentage change	Absolute change
UMG	1 758 225	- 435 508	-124.77 %	-2 193 733
UMG excluding Statkraft	96 686	17 291	-82.12 %	-79 395
MLG	191 390	- 54 989	-128.73 %	-246 379
LG	139 524	- 5 124	-103.67 %	- 144 648

The whole sample, equity ratio

Of the 25 utilities in the sample, 17 utilities have a lower equity ratio in 2016 compared to 2007. The utility with the largest reduction in equity ratio has experienced a decline of 36.3 %, while the utility with the largest increase has experienced a raise of 15.6 %. The average change in equity ratio between the two years is -7.9 %, with the median being -4.0 %. The average decrease in equity ratio is 14.9 % for the utilities that have experienced a decreased equity ratio, while the average is at 7 % for the utilities with an increased equity ratio. In 2007, the highest equity ratio was at 86.8 %, while the highest ratio in 2016 was 56.4 %. The lowest equity ratio in 2007 was 24.1 %, while the same low was 17 % in 2016. The average equity ratio in 2007 was 44.8 %, while the same average 36.9 % in 2016. The solidity, represented in the equity ratio, is trending downwards through most of the sample (appendix 3).

Table 12: Equity ratio in 2016, 2007 and change between the two years.

Equity ratio	2007	2016	Absolute change
Sunnhordland Kraftlag AS	40.8 %	56.4 %	15.6 %
Statkraft AS	40.3 %	50.1 %	9.8 %
Trønderenergi AS	43.7 %	52.9 %	9.2 %
Tussa Kraft AS	28.4 %	35.6 %	7.2 %
Lyse AS	24.1 %	30.0 %	5.9 %
Fredrikstad Energi AS	25.4 %	30.6 %	5.2 %
Glitre Energi AS	36.2 %	38.4 %	2.2 %
E-CO Energi Holding AS	34.8 %	36.0 %	1.2 %
Valdres Energiverk AS	36.1 %	35.3 %	-0.8 %
Ringeriks-Kraft AS	35.8 %	33.7 %	-2.1 %
Sunnfjord Energi AS	41.8 %	38.6 %	-3.2 %
Sogn og Fjordane Energi AS	43.0 %	39.6 %	-3.4 %
Agder Energi AS	26.8 %	22.8 %	-4.0 %
Nord-Trøndelag Elektrisitetsverk Holding AS	52.9 %	46.6 %	-6.3 %
Tafjord Kraft AS	36.5 %	28.6 %	-7.9 %
BKK AS	46.7 %	36.0 %	-10.7 %
Akershus Energi AS	55.0 %	42.5 %	-12.5 %
Eidsiva Energi AS	44.9 %	31.6 %	-13.3 %
Østfold Energi AS	65.6 %	47.0 %	-18.6 %
Vardar Kraft AS	42.0 %	21.5 %	-20.5 %
Helgeland Kraft AS	61.5 %	39.7 %	-21.8 %
Hafslund AS	64.3 %	35.8 %	-28.5 %
Troms Kraft AS	48.4 %	17.0 %	-31.4 %
Sognekraft AS	57.0 %	25.5 %	-31.5 %
Nord-Salten Kraft AS	86.8 %	50.5 %	-36.3 %

EBIT-margin

The analysis is based on the average EBIT-margin between 2015 and 2016 compared to the average between 2007 and 2008. Of the 25 utilities in the sample 19 utilities have a lower EBIT-margin in 2015/16 compared to 2007/08. The average EBIT-margin in 2007/08 was 34.9 % compared to 23.4 % in 2015/16, and the median EBIT-margin in 2007/08 was 29.7 % compared to 21.2 % in 2015/16. The highest EBIT-margin in the sample in 2007/08 was 71.4 % and only 55.4 % in 2015/16. The lowest EBIT-margin was 9.81 % in 2007/08 while the lowest was 5.4 % in 2015/16. The EBIT is overall trending downwards in our sample (appendix 4).

Table 13: EBIT-margin in 2007/08 and 2015/16 and change between the two periods.

EBIT-margin	Average 07-08	Average 15-16	Absolute change
Fredrikstad Energi AS	9.81 %	17.24 %	7.43 %
Nord-Salten Kraft AS	25.84 %	33.02 %	7.19 %
Nord-Trøndelag Elektrisitetsverk Holding AS	19.23 %	21.15 %	1.93 %
Troms Kraft AS	10.56 %	12.33 %	1.77 %
Vardar Kraft AS	24.01 %	25.54 %	1.54 %
Hafslund AS	14.72 %	16.24 %	1.53 %
Sogn og Fjordane Energi AS	29.68 %	28.83 %	−0.85 %
Sunnfjord Energi AS	23.41 %	21.59 %	−1.83 %
Ringeriks-Kraft AS	18.28 %	13.61 %	−4.68 %
Agder Energi AS	24.70 %	19.99 %	−4.72 %
Glitre Energi AS	36.88 %	32.07 %	−4.81 %
Valdres Energiverk AS	13.54 %	5.39 %	−8.15 %
Tussa Kraft AS	26.32 %	17.46 %	−8.86 %
Helgeland Kraft AS	28.23 %	18.54 %	−9.70 %
BKK AS	49.25 %	35.15 %	−14.10 %
Akershus Energi AS	53.52 %	37.95 %	−15.57 %
Eidsiva Energi AS	36.27 %	20.45 %	−15.82 %
E-CO Energi Holding AS	71.40 %	55.43 %	−15.97 %
Lyse AS	45.96 %	27.25 %	−18.71 %
Trønderenergi AS	37.70 %	18.64 %	−19.06 %
Tafjord Kraft AS	40.84 %	18.61 %	−22.23 %
Sunnhordland Kraftlag AS	54.21 %	30.29 %	−23.92 %
Østfold Energi AS	61.58 %	26.57 %	−35.01 %
Sognekraft AS	60.05 %	24.32 %	−35.73 %
Statkraft AS	55.62 %	6.78 %	−48.84 %

The numbers are based on the average return on equity (ROE) between 2015 and 2016 compared to the average between 2007 and 2008. Of the 25 utilities in the sample 18 utilities have a lower ROE in 2015/16 than in 2007/08. The average ROE was 10.6 % in 2007/08 and 7.1 % in 2015/16, while the median ROE was 9 % in 2007/08 and 7.1 % in 2015/16. The highest ROE in 2015/16 was 18.8 % compared to 30.5 % in 2007/08. The ROE and ROA are overall trending downwards in our sample (appendix 3).

Table 14: Return on equity in 2007/08 and 2015/16 and change between the two periods.

Return on equity	Average 07-08	Average 15-16	Absolute change
Troms Kraft AS	3.65 %	18.78 %	15.14 %
Hafslund AS	−0.04 %	14.45 %	14.49 %
Fredrikstad Energi AS	1.43 %	11.21 %	9.78 %
Nord-Salten Kraft AS	4.75 %	9.38 %	4.63 %
Ringeriks-Kraft AS	6.39 %	8.51 %	2.12 %
BKK AS	11.46 %	12.70 %	1.24 %
Sunnfjord Energi AS	7.82 %	7.84 %	0.02 %
Sogn og Fjordane Energi AS	8.95 %	6.20 %	−2.76 %
Glitre Energi AS	7.70 %	4.48 %	−3.22 %
Helgeland Kraft AS	10.43 %	7.14 %	−3.29 %
Sognekraft AS	11.31 %	7.94 %	−3.38 %
Østfold Energi AS	−1.03 %	−5.31 %	−4.29 %
Nord-Trøndelag Elektrisitetsverk Holding AS	7.73 %	3.44 %	−4.29 %
Agder Energi AS	20.52 %	16.08 %	−4.44 %
Trønderenergi AS	8.17 %	3.67 %	−4.50 %
Akershus Energi AS	9.10 %	4.59 %	−4.52 %
Tussa Kraft AS	11.73 %	6.73 %	−5.00 %
Eidsiva Energi AS	12.04 %	6.45 %	−5.59 %
Vardar Kraft AS	5.91 %	−0.63 %	−6.54 %
E-CO Energi Holding AS	16.87 %	9.51 %	−7.36 %
Valdres Energiverk AS	7.31 %	−0.24 %	−7.55 %
Tafjord Kraft AS	16.15 %	7.88 %	−8.27 %
Lyse AS	21.85 %	11.16 %	−10.69 %
Sunnhordland Kraftlag AS	25.15 %	6.01 %	−19.15 %
Statkraft AS	30.46 %	−1.45 %	−31.91 %

Dividend

Combined in 2007 and 2008 the utilities paid out in total 28.1 billion in dividend to its owners. In 2015 and 2016 together the utilities paid out 13.4 billion in dividend which is a decrease of 14.7 billion between the two-year periods. The highest amount of dividend paid out in the ten-year period was in 2008 where 15.4 billion was paid out. In 2015 only 5.2 billion was paid out as dividend to owners. Combined in 2007 and 2008 16 of the 25 utilities in the sample paid higher dividend in percent of net income after tax than they did in 2015/16. The median utility paid out dividend at a size of 72 % of net income after tax in 2007/08, while the median in 2015/16 is 47 %. The trend is that the utilities pay out less dividend measured in total amount and in percent of net income after tax.

The scores from Zmijewski's model resulted in a distribution which was the most fitting of the five models according to benchmark. Therefore we implement this model to investigate the development of the creditworthiness over the period.

Table 15: Average and median Zmijewski-score.

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Avg.	-1.36	-1.21	-1.17	-0.83	-0.72	-0.71	-0.78	-0.73	-0.75	-0.83
Med.	-1.32	-1.16	-1.05	-0.58	-0.50	-0.61	-0.81	-0.62	-0.70	-0.87

The average score according to Zmijewski's model increases from 2007 until 2012 (meaning a declining creditworthiness). After 2012, the average and median score seems to flatten out with a slight decrease. In 2007 the median and average Zmijewski-score were at its lowest values in the whole period. According to the Zmijewski-score, 18 out of 25 utilities have a higher score in 2016 compared to 2007. Compared to 2012, 15 utilities have a lower score in 2016. On average, the score is 0.53 higher in 2016 compared to 2007, and 0.11 lower compared to 2012, supporting the argument that the creditworthiness have declined in the period in total, with a slight improvement in the last few years. When examining the Zmijewski-score in the three groups, we observe that from 2007-2016, all values have increased on average, with 0.33, 0.30, and 1.12 for the UMG, MLG and LG-group respectively, signaling an unfavorable economic development. The lowest Zmijewski-score in 2016 in the sample is -2.0, and the highest is 0.19, from an average of -0.83, meaning there are also big differences across the sample.

There are definitely apparent differences in the relative performance of the electric utilities in the sample as shown in the key ratios and Zmijewski-scores. Some of the utilities have become more solid in terms of financial structure, while the majority of the utilities have experienced declining ratios. The spread between the best and the worst performing utilities is 39.4 %, 51.2 %, and 32.19 % in respectively the equity ratio, EBIT-margin and ROE.

5.4 Part 3

Are there any statistically significant differences in financial ratios between the defined groups based on official credit ratings and ACS?

At 95 % significance, we found that with the Wilcoxon rank-sum test the equity ratio, financial coverage, EBITDA/total debt and working capital/total assets have significant differences between the groups in the sample. We found that there is a significant difference between the equity ratio of the UMG and MLG-group and the UMG and LG-category. It may indicate that the best ranked utilities have the highest equity ratio. The top ranked utilities have an equity ratio in the range of about 30 to 55 %, while the LG-group span from about 20 to 30 %, with one outlier of almost 50 %. This is an indication that the equity ratio is an important metric for the official credit ratings and ACS.

We found significance between the UMG and LG-group and the MLG and LG-group in the financial coverage. As mentioned, the financial coverage is an important metric for depicting the companies' elbowroom in debt servicing (Westgaard & van der Wijst, 2001). In the UMG-group the financial coverage span from 4-10, a bit more spurred from about 2-6 in the MLG-group and from 1-3 in the LG category. We found significance between the UMG and LG and the MLG and LG-group in the EBITDA/total debt metric, indicating the utilities that are perceived as the least creditworthy were at a significantly lower level of net income plus depreciation. This is naturally a metric that fluctuates annually as the operating income may fluctuate due to incurring events such as volatile power prices. But while the UMG and MLG-group have an EBITDA/total debt metric of 0.08 to 0.24 the LG-group span from 0.09 to no higher than 0.12. Between the UMG and LG-group there is a significant difference in the working capital/total assets ratio. The best group have mostly positive numbers, indicating that they have enough current assets to cover the short-term debt. The LG category only have two utilities with positive numbers out of the six in the sample. None on the ROA-measures show a significant difference between groups. As for other ratios; return on equity, EBIT-margin, EBITDA-margin, cash flow spread, net income in relation to total assets, and EBIT in relation to total assets, the results between the groups show no clear tendency, at least no significant difference for this Wilcoxon rank sum-test.

6. Discussion

The scores from Zmijewski's model resulted in a distribution which was the most fitting of the five models according to benchmark. The model focuses a lot on the solidity of the utilities, which is an indicator that much of the ranking is based on the equity ratio and the short term-ability to handle debt obligations.

The results based on the five models that all predict risk of bankruptcy are different in terms of variables and how they are developed. Zmijewski's model and Ohlson O-score classify the utilities in two zones: "safe" or "bankrupt", while the Altman Z-score classifies them in three: "safe", "grey" or "distress". The utilities in the sample are from a heavily taxed and regulated industry and they are not owned by private investors. However, the demand of renewable energy seems to be inexhaustible at the moment, and the marginal cost of hydro power production is low (Sidelnikova et al., 2015). These are factors that speak for a creditworthy industry and those factors need to be considered when assessing the overall risk. Coincidently, the utilities operate in other business units with a different risk profile.

All the five models implemented in this thesis result in a score or a probability of default in the short term, one to two years, based on financial ratios. There is not necessarily a relationship between short-term probability of bankruptcy and credit rating. Therefore, we find these models better for relative ranking across the industry than for an absolute ranking and hence a default probability for the utilities. A company with an outdated non-profitable business model can have a low short-term probability of default due to a high equity ratio. Companies with an official credit rating do have a short- and long-term credit rating with a stable, negative or positive outlook. An official credit rating will be a more accurate indicator of creditworthiness in the long-term compared to the models. Historical financial ratios may not be particularly informing of future income or profitability. Future cash flow is included in the calculation of the market value of equity, which is a variable in the original Altman Z-score. It is important to be aware of the underlying assumptions and that these forecasts of expected cash flows are uncertain. There is although a connection between the average Z-scores and the credit rating according to Altman (2003), presented in table 5. One must also have in mind that the scores only express how close the utility's score is according to other companies which have filed for bankruptcy. All the three Altman Z-scores result in noticeably low scores for the majority of the utilities. For the original model, 18 utilities have a Z-score below 1.8 which classify them in the distress zone. This may suggest that Altman Z-scores are unsuitable to measure creditworthiness for Norwegian electric utilities.

The market value of equity was implemented to calculate the original Z-score. The dividend discount model was suitable for our purpose because all the utilities have paid out dividend in the ten-year period. Hafslund AS' A and B stocks were worth 18.46 billion at the end of 2016, which indicates a value ratio of 1.93 to its book value of equity. The valuation model values Hafslund AS to 17.92 billion, and it is based on the expected power prices forward 2030 and 2040. Since the model focuses on expected power prices, utilities with a large production capacity have a greater advantage since they will be more strongly affected by an increase in price. We implement linear regression to calculate Hafslund's stock beta. Since we do not have the market value of the utilities, the betas are both unlevered and levered with book value of equity and debt. Since the market value of equity usually is higher than the book value, this method will overestimate the debt-equity ratio. The dividend used to value the equity has a median of 79 % and an average of 80 % compared to the highest dividend paid out in the mentioned ten-year period, which do not seem unrealistic. There seems to be a general agreement that the power price will be substantially higher compared to the level we experienced in 2015 and 2016, which may increase the dividend payout (Greaker, 2016), (Bye, Berg & Holstad, 2010) and (Bøhnsdalen et al., 2016).

In the period from 2007-2016 we have seen large fluctuations in electricity prices and we have experienced both a financial crisis (2007-2009) and an oil crisis (2014-2016). The Paris Agreement that was signed in 2015 has created huge ambition of emission reductions, and the trend towards a carbon neutral society has started.

The price of electricity is influenced by several factors due to the interconnectors to adjacent countries. Some essential factors are the price of coal, price of emission allowances, and weather conditions such as precipitation and temperature (Fantoft, 2014). The electricity price is obviously decisive for the economic performance of the electric utilities in the sample. We have seen a downward trend from 2010, where the price was at its highest with an average price of 441 NOK/MWh and the lowest in 2015 with an average price of 181 NOK/MWh. In 2010, a year of low precipitation, imports exceeded imports, which are important reasons of the price peak (appendix 7).

Approximately 96 % of all power generation in Norway is from hydro power. The total amount of power stations and therefore the production capacity has increased in the ten-year period. Of a total increase of 405 stations, 390 are hydro power stations, four are thermal power stations and the remaining eleven are wind power stations (appendix 8). Of the total increase of 3740 MW, hydro power has increased with 2860 MW, thermal power with 340 MW and wind power with 540 MW (Statistics Norway, 2017a). The production has fluctuated between 124 TWh (2010) and 149 TWh (2016) (appendix 9).

Another major trend in the ten-year period is declining interest rates. Lower interest rates increases debt capacity, but will affect the utilities differently depending on their capital structure. The Norwegian Interbank Offered Rate (NIBOR) is a common benchmark interest rate and is a good indicator of the current interest rate in Norway. From the top in 2008 we have experienced lower interest rates all the way down to 0.85 % in 2016 (appendix 10). Norway and Sweden have a common market for green certificates to support new projects for renewable power production. The common program started January 1 2012, and to get a green certificate your investment needs to produce renewable energy by the end of 2021 (Regjeringen, 2014), which may have along with declining interest rates contributed to pushing forward investments and incentivized higher leveraging.

The utilities in the sample are quite different in terms of size, age, location or position in the economic lifecycle. As mentioned, investments in hydro power production have been very profitable due to high prices of electricity and the durability of the investment. The owners are stable partners with a permanent strategy for ownership due to regulations. In theory, size can be an explanatory variable why some utilities outperform others due to economies of scale and economies of scope. Since investments in hydro power on average have a lower break even than other electric production investments such as wind, solar, coal and gas (Sidelnikova et al., 2015), high production also implies that a utility has a large advantage with high electricity prices. The majority of hydro power production is flexible and production is adjusted to price levels. Hydro power production is said to be a unending resource because the need for renewable electricity is perpetual in today's situation. Since younger companies have a higher probability of default compared to old companies, age could be an explanation why some utilities perform better than others. Common stages in the life cycle of industries are birth, growth, maturity, decline and death. It is usually in the maturity stage the companies generate the highest profit, which it seems many of the utilities find themselves due to their mostly stable payout. Location can influence economic performance since bottlenecks in the grid can influence prices.

One of the main trends for the utilities in the period is a declining equity ratio, except for a few exceptions. Debt capacity has increased due to lower interest rates, the electricity price has declined and reduced EBIT-margin and return on equity. Lower return on equity reduces the ability to increase retained earnings. The time limited governmental green certificate policy has worked as a push factor for new investments which have required capital from both equity and debt. It seems that in a historically very profitable industry, the margins are now lower, and the utilities may need to cut costs and spending. The average Zmijewski-score has improved slightly the last few years, which may be a sign that the utilities have initiated measures to improve the creditworthiness.

From the Wilcoxon ranked-sum test, the results indicate as we may have expected that the metrics that may matter when it comes to being assigned a good credit rating or ACS are the metrics that cover solidity and liquidity. It is not crucial to categorize the ratios, but it is interesting to investigate whether the ratings emphasize any other ratios than those covering if the utilities have enough cash. The ratings are supposed to be forward-looking as well as being a relative measure of the current credibility. Our findings may indicate that the ratings are mainly a measure of the current situation, and that future profitability and earnings may be left with less weight. The overall assigned official rating is not solely based on key ratios, it is also based on qualitative considerations as for example business cycles and the overall profitability of the industry.

Ultimately, credit ratings are opinions about credit risk, and it is not to be considered as a sole measure of default profitability or a measure of whether an investment is reasonable or not. Although the electricity price and profitability margins vary, the electric utility industry is considered to be a stable and profitable industry due to regulation and through public ownership. In 2015 when the prices were at their lowest in the sample period, 20 of 25 utilities delivered positive net results after tax. The average equity ratio has decreased in the ten-year period but was still 36.9 % in 2016. The Norwegian electric utility industry is a business with high complexity. However, if the utilities in the industry want to improve the credit ratings in the short term, it seems that the utilities should focus on controlling costs, getting a more solid equity ratio and improving the liquidity rather than carry out large investments.

7. Conclusion

Of the five models implemented, Zmijewski's model seems to be the most fitting to measure the relationship between short-term probability of default and official credit ratings and automatically generated credit scores (ACS). We find these models better for relative ranking across the industry than for measuring a default probability for the utilities. All the three Altman Z-scores result in noticeably low scores for the majority of the utilities, which may suggest that Altman Z-scores are unsuitable to measure creditworthiness for Norwegian electric utilities. Ohlson O-score and Zmijewski's model seem to give a more probable score according to the official credit ratings and the ACS.

The results based on the economic development of the electric utilities in the ten-year period indicate that there has been a weakening in all the financial ratios covered in this thesis, and quite evidently in the equity ratio, financial coverage, and EBITDA/total debt. The economic development seems to be driven by pressure from lower electricity prices. Green certificates and lower interest rates incentivize leveraging for historically favourable hydro investments. It seems that in a historically profitable industry, the margins are now lower, and the utilities may need to cut costs and spending. The average Zmijewski-score has on average increased (meaning declining creditworthiness) in the ten-year period, with a slight decrease (improvement) in the last few years, which may be a sign that the utilities have initiated measures to improve their creditworthiness. There are also apparent differences in creditworthiness across utilities as shown especially in the solidity and profitability measures.

The results from the part 3 indicate that the equity ratio, financial coverage, and EBITDA/total debt are the statistically significant different ratios between the defined groups. The ratings are supposed to be forward-looking as well as being a relative measure of the current credibility. Our findings may indicate that the ratings are mainly a measure of the current situation, and that future profitability and earnings may be left with less weight. Ultimately, credit ratings are opinions about credit risk, and it is not to be considered as a sole measure of default profitability or a measure of whether an investment is reasonable or not.

8. Further research

The sample of electric utilities in this thesis consists of 25 of the largest electric utilities in Norway. The analyses do not adjust utilities according to size nor diversification. Some business units are more profitable than others and further research where financial ratios is adjusted for these differences would be interesting topics. A deeper qualitative study of creditworthiness of some of the utilities would be of interest or larger quantitative research with a larger sample of utilities. A broader study on the relative performance in the industry and probability of default for smaller enterprises are both potential topics for further research. It could also be interesting to investigate a similar case on electric utilities in other countries.

9. References

Altman, E. I. (1968). Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy. *The Journal of Finance, 23*(4), 589-609. Retrieved from http://www.jstor.org/stable/pdf/2978933.pdf

Altman, E. I. (2000). Prediciting Financial Distress of Companies: Revisiting the Z-score and ZETA Models, 54. Retrieved from http://lemeunier.gilbert.free.fr/Investissement/DOCS/PDF/Zscores.pdf

Altman, E. I. (2002). Revisiting Credit Scoring Models In a Basel 2 Environment. Retrieved from https://archive.nyu.edu/bitstream/2451/26767/2/S-CDM-02-06.pdf

Altman, E. I. (2003). The use of credit scoring models and the importance of credit culture. Retrieved from http://pages.stern.nyu.edu/~ealtman/3-%20CopCrScoringModels.pdf

Arendals Fossekompani. (2017). *Annual report 2016*. Retrieved from https://www.arendalsfoss.no/wp-content/uploads/2017/05/AFK-A%CC%8Arsrapport-2016-web.pdf.

Beaver, W. H. (1967). Financial Ratios As Predictors of Failure. *Journal of Accounting Research, 4*, 71-111. Retrieved from http://www.jstor.org/stable/pdf/2490171.pdf?refreqid=excelsior:cf40a2df8a8e9b81e06e75dbfdc4033a

Berk, J., & DeMarzo, P. (2017). *Corporate Finance* (Fourth edition ed.). Harlow, England: Pearson Education.

Blacconiere, W. G., Johnson, M. F., & Johnson, M. S. (2000). Market valuation and deregulation of electric utilities. *Journal of Accounting and Economics, 29*, 231-260. Retrieved from doi:https://ac.els-cdn.com/S0165410100000215/1-s2.0-S0165410100000215-main.pdf?_tid=a9d5f354-dad3-43d1-91f2-de67f95706e8&acdnat=1524126786_7b6618c4faa73ca2013b5b6d3908f81c

Bye, T., Bergh, M., & Holstad, M. (2010). Lønnsomhetsutvikling i norsk kraftsektor etter dereguleringen i 1991. *Økonomisk analyser, 5/2010*, 27-31. Retrieved from https://www.ssb.no/a/publikasjoner/pdf/oa_201005/oa2010-5.pdf

Bøhnsdalen, E. T., Västermark, K. L., Døskeland, I. H., Holmefjord, V., Aarstad, J., & Kringstad, A. (2016). *Langsiktig markedsanalyse - Norden og Europa 2016-2040*. Statnett Retrieved from http://www.statnett.no/Global/Dokumenter/Nyheter%20-%20vedlegg/Nyheter%202016/Langsiktig%20markedsanalyse%20Norden%20og%20Europa%202016%E2%80%932040.pdf.

Chudson, W. A. (1945). The Pattern of Corporate Financial Structure: A Cross-Section View of Manufacturing, Mining, Trade, and Construction, 1937. *National Bureau of Economic Research*. Retrieved from http://www.jstor.org/stable/pdf/2325350.pdf

Damodaran, A. (2012). *Investment Valuation, 3rd edition*. New Jersey: John Wiley & Sons, Inc.

ESMA. (2017). *Report on CRA Market Share Calculation*. Retrieved from https://www.esma.europa.eu/sites/default/files/library/esma33-5-209_-_cra_market_share_calculation_2017.pdf.

ESMA. (2018). *Credit rating agencies*. Retrieved from https://www.esma.europa.eu/supervision/credit-rating-agencies/supervision

Fantoft, S. (2014). Retrieved from http://www.statnett.no/Samfunnsoppdrag/Neste-generasjon-kraftsystem-magasin/Slik-bestemmes-stromprisen/

Fitzpatrick, P. (1932). A comparison of ratios of sucessful industrial enterprises with those of failed companies. *The Certified Public Accountant*.

Fornybar.no. (2016). Kraftmarkedet Retrieved from http://www.fornybar.no/kraftmarkedet

Greaker, M. (2016). Kapitalavkastning og ressursrente i kraftsektoren*2016/34*. Retrieved from https://www.ssb.no/energi-og-industri/artikler-og-publikasjoner/_attachment/285550?_ts=15890b57180

Grice, J. S., & Dugan, M. T. (2001). The Limitations of Bankruptcy Prediction Models: Some Cautions for the Researcher*17*, 151-166. Retrieved from https://link.springer.com/content/pdf/10.1023/A:1017973604789.pdf

Hagen, P. C. (2014). *Innføring i sannsynlighetsregning og statistikk* (Vol. 7): Cappelen Damm.
Hillegeist, S. A., Keating, E. K., Cram, D. P., & Lundstedt, K. G. (2004). Assessing the Proability of Bankruptcy*9*, 5-34. Retrieved from https://link.springer.com/content/pdf/10.1023/B:RAST.0000013627.90884.b7.pdf
Johnson, R. A., & Bhattacharyya, G. K. (2011). *Statistics, Principles and Methods*
. USA: John Wiley & Sons.
Lie, E., & Lie, H. J. (2002). Multiples Used to Estimate Corporate Value. *Financial Analysts Journal, 58*(2), 44-54. Retrieved from http://www.jstor.org/stable/pdf/4480377.pdf?refreqid=excelsior%3A2b18a5254214b3a6dd667e3162926843
Mansi, S. A., Maxwell, W. F., & Zhang, A. (2010). Bankruptcy Prediction Models and the Cost of Debt. *Journal of Fixed Income*. Retrieved from https://poseidon01.ssrn.com/delivery.php?ID=563006110027086023086081109106064110102013067092070087126002110100017080077078127113099122116002019025028001084107114030091065126032013032039094001251260200720700210471150830910641210641270171040731231100720080150061060980760211210940280250311 05&EXT=pdf
Merwin, C. L. (1942). Financing Small Corporations in Five Manufacturing Industries, 1926-1936. *National Bureau of Economic Research*.
Moody's Investor Service. (2017). *Unregulated Utilities and Unregulated Power Companies*. Retrieved from https://www.moodys.com/researchdocumentcontentpage.aspx?docid=PBC_1066389.
Moody's Investor Service. (2018). Ratings Definitions. Retrieved from https://www.moodys.com/Pages/amr002002.aspx
Norges Bank. (2018). *Statsobligasjoner daglige noteringer*. Retrieved from https://www.norges-bank.no/Statistikk/Rentestatistikk/Statsobligasjoner-Rente-Daglige-noteringer/
Norsk Hydro. (2017). *Annual Report 2016*. Retrieved from https://www.hydro.com/globalassets/1-english/investor-relations/annual-report/2016/downloads/annual-report-2016.pdf.
Norton, S. W. (1985). Regulation and Systematic Risk: The Case of Electric Utilities. *The Journal of Law & Economics, 28*, 671-686. Retrieved from doi:http://www.jstor.org/stable/725350
Ohlson, J. A. (1980). Financial Ratios and Probabilistic Prediction of Bankruptcy. *Journal of Accounting Research, 18*(1), 109-131. Retrieved from https://www.jstor.org/stable/pdf/2490395.pdf
Oslo Stock Exchange. (2018). Equity Capital Instruments. In 2017_Indekser (Ed.), (2017 ed.): Oslo Stock Exchange.
Palepu, K. G., Healy, P. M., & Peek, E. (2016). *Business Analysis and Valuation: IRFS edition, 4th edition*. Hampshire, United Kingdom: Annabel Ainscow.
Partnoy, F. (2001). The Paradox of Credit Rating. *U San Diego Law & Econ Research Paper No. 20*. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=285162
Petitt, B. S., Pinto, J. E., & Pirie, W. L. (2015). *Fixed Income Analysis* New Jersey John Wiley & Sons Inc. .
Porter, M. E. (2008). The Five Competitive Forces That Shape Strategy. *Harvard Business Review, 86*(1), 78-93. Retrieved from https://s3.amazonaws.com/academia.edu.documents/32580687/HBR_on_Strategy.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1526238827&Signature=fgAnyWlLQS26XOoijyWgxt0MHgw%3D&response-content-disposition=inline%3B%20filename%3DHBR_on_Strategy.pdf#page=25
Regjeringen. (2014). *Elsertifikatordningen*. Retrieved from https://www.regjeringen.no/no/tema/energi/fornybar-energi/elsertifikater1/id517462/
Regjeringen.no. (2014). Norsk vannkrafthistorie på 5 minutter. Retrieved from https://www.regjeringen.no/no/tema/energi/fornybar-energi/norsk-vannkrafthistorie-pa-fem-minutter/id2346106/
Regjeringen.no. (2016). *Skattesatser 2016*. Retrieved from https://www.regjeringen.no/no/tema/okonomi-og-budsjett/skatter-og-avgifter/skattesatser-fradrag-og-belopsgrenser-i-2016/id2457143/

Regjeringen.no. (2017). *Skattesatser 2018*. Retrieved from https://www.regjeringen.no/no/tema/okonomi-og-budsjett/skatter-og-avgifter/skattesatser-2018/id2575161/
Schulman, I. G. D. J. M. (1988). A Primary Rule for Detecting Bankruptcy: Watch the Cash. *Financial Analysts Journal, 44*(5), 74-78. Retrieved from http://www.jstor.org/stable/pdf/4479150.pdf
Servigny, A. D., & Renault, O. (2004). *Measuring and Managing Credit Risk*. New York: McGraw Hill.
Shumway, T. (2001). Forecasting Bankruptcy More Accurately: A Simple Hazard Model*74*, 101-124. Retrieved from http://www.jstor.org/stable/pdf/10.1086/209665.pdf?refreqid=excelsior:d8118cd9f56e5fbbcd473f7325868594
Sidelnikova, M., Weir, D. E., Groth, L. H., Nybakke, K., Stensby, K. E., Langseth, B., . . . Qureishy, T. H. (2015). *Kostnader i energisektoren*. (2/2015). Retrieved from http://publikasjoner.nve.no/rapport/2015/rapport2015_02a.pdf.
Skatteloven. (1999). *Lov om skatt av formue og inntekt (skatteloven). LOV-1999-03-26-14*. Retrieved from https://lovdata.no/dokument/NL/lov/1999-03-26-14/KAPITTEL_19#%C2%A718-2.
Skogsvik, K. (1990). Current Cost Accounting Ratios as Predictors of Business Failure: The Swedish Case. *Journal of Business Finance & Accounting, 17*(1), 137-160.
Statistics Norway. (2017a). *Electricity balance (GWh)*. Retrieved from https://www.ssb.no/en/energi-og-industri/statistikker/elektrisitet/aar
Statistics Norway. (2017b). Mer enn en fjerdedel av foretakene overlevde i fem år. *Nyetablerte foretaks overlevelse og vekst*. Retrieved from https://www.ssb.no/virksomheter-foretak-og-regnskap/artikler-og-publikasjoner/mer-enn-en-fjerdedel-av-foretakene-overlevde-i-fem-ar
Statistics Norway. (2018). Konsumprisindeks. Retrieved from https://www.ssb.no/kpi
Westgaard, S., & Wijst, N. v. d. (2001). Default probabilities in a corporate bank portfolio: A logistic model approach. *European Journal of Operational Research, 135*, 338-349. Retrieved from https://ac.els-cdn.com/S0377221701000455/1-s2.0-S0377221701000455-main.pdf?_tid=702f4385-5c99-45f9-8b9c-f807a099f842&acdnat=1526234952_d9f6087960f371daeddb3618a03653b1
Zmijewski, M. E. (1984). Methodological Issues Related to the Estimation of Financial Distress Prediction Models*22*, 59-82. Retrieved from http://www.jstor.org/stable/pdf/2490859.pdf?refreqid=excelsior%3Ad5b4cb60de754ca13373c434027a1771

10. Appendices

Appendix 1: Market value to book value of equity (numbers in 1000 NOK)

Utilities	Market Value of Equity	Book Value of Equity	Market/Book-ratio
Agder Energi AS	23,279,725	4,626,155	5.03
Akershus Energi AS	5,543,186	2,320,000	2.39
BKK AS	27,282,285	7,535,000	3.62
E-CO Energi Holding AS	35,072,487	5,890,533	5.95
Eidsiva Energi AS	16,793,730	5,636,000	2.98
Fredrikstad Energi AS	1,183,456	737,827	1.60
Glitre Energi AS	8,145,366	3,956,538	2.06
Hafslund AS	17,924,899	9,571,000	1.87
Helgeland Kraft AS	2,787,421	1,893,000	1.47
Lyse AS	13,531,725	7,063,463	1.92
Nord-Salten Kraft AS	821,550	293,902	2.80
Nord-Trøndelag Elektrisitetsverk Holding AS	6,308,315	4,025,408	1.57
Ringeriks-Kraft AS	1,406,091	452,994	3.10
Sogn og Fjordane Energi AS	5,544,613	2,503,207	2.22
Sognekraft AS	1,668,303	432,421	3.86
Statkraft AS	205,533,898	83,519,000	2.46
Sunnfjord Energi AS	944,600	831,951	1.14
Sunnhordland Kraftlag AS	7,302,721	2,156,952	3.39
Tafjord Kraft AS	2,800,016	1,226,717	2.28
Troms Kraft AS	1,450,733	899,058	1.61
Trønderenergi AS	5,361,509	3,839,773	1.40
Tussa Kraft AS	1,750,768	831,441	2.11
Valdres Energiverk AS	182,589	141,205	1.29
Vardar AS	5,841,861	1,593,375	3.67
Østfold Energi	6,304,471	1,968,698	3.20

Appendix 2: Annual hydro production in a normal year

Utilities	Production normal (TWh)
Agder Energi AS	8.10
Akershus Energi AS	2.40
BKK AS	6.80
E-CO Energi Holding AS	10.00
Eidsiva Energi AS	3.40
Fredrikstad Energi AS	-
Glitre Energi AS	2.50
Hafslund AS	3.10
Helgeland Kraft AS	1.00
Lyse AS	5.70
Nord-Salten Kraft AS	0.26
Nord-Trøndelag Elektrisitetsverk Holding AS	3.90
Ringeriks-Kraft AS	0.44
Sogn og Fjordane Energi AS	1.90
Sognekraft AS	0.60
Statkraft AS	52.10
Sunnfjord Energi AS	0.50
Sunnhordland Kraftlag AS	2.20
Tafjord Kraft AS	1.60
Troms Kraft AS	0.90
Trønderenergi AS	1.80
Tussa Kraft AS	0.70
Valdres Energiverk AS	0.01
Vardar AS	0.60
Østfold Energi AS	2.20

Appendix 3: Average central metrics from 2007-2016

Average	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Equity ratio (in %)	44.75	42.67	41.02	36.29	34.82	35.17	36.05	35.16	36.47	36.89
EBITDA/debt (in %)	27.60	24.04	24.72	21.96	20.84	15.16	17.68	15.12	13.52	14.72
Financial coverage	7.42	3.25	7.15	5.32	6.76	3.80	4.28	3.46	3.77	4.46
Liquidity rate	1.36	1.06	1.12	1.02	0.83	0.85	1.03	1.14	1.23	1.10

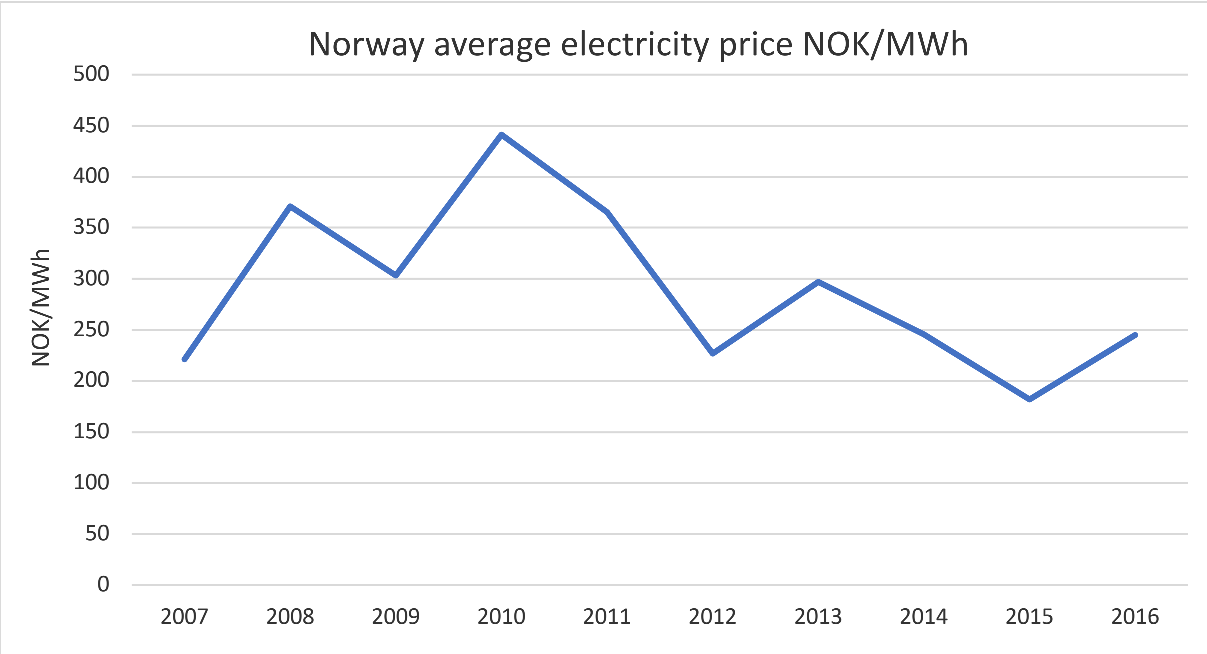
Appendix 4: Average EBIT-measures from 2007-2016

Average	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
EBIT-margin (in %)	35.58	35.82	32.35	31.10	30.72	24.21	27.08	24.89	21.16	25.59
EBIDTA-margin (in %)	46.36	49.92	42.80	40.16	42.36	36.74	37.87	37.32	35.67	37.37
EBIT/total assets (in %)	9.92	7.80	9.25	8.83	9.14	6.24	7.79	6.64	5.12	6.26

Appendix 5: Return on assets and equity from 2007-2016

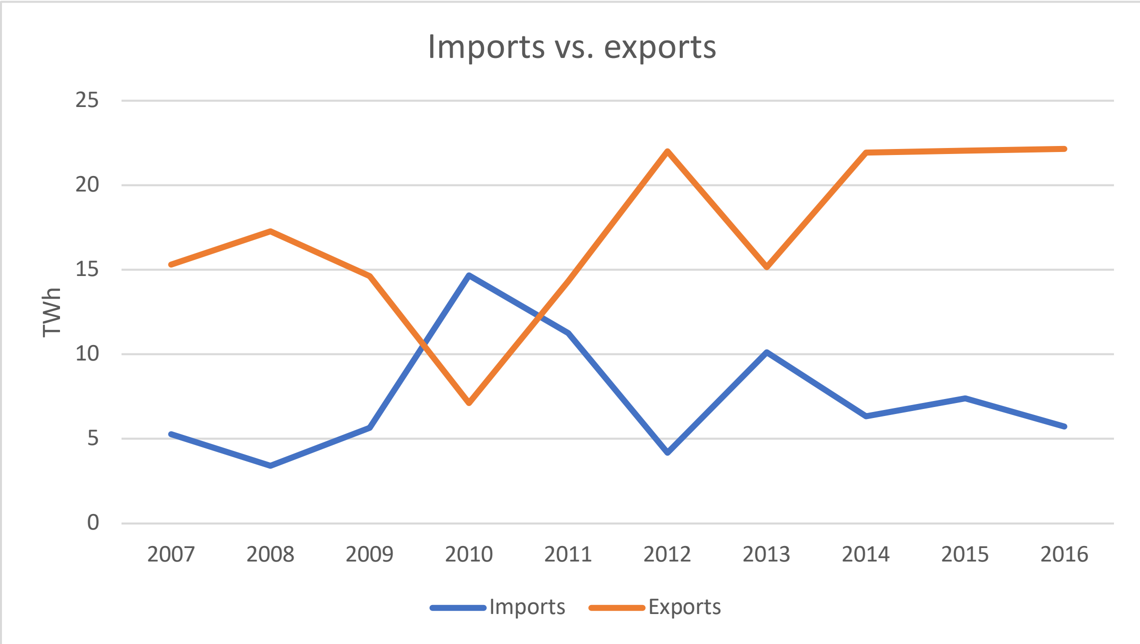
Average	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
ROA	4.66 %	4.02 %	5.31 %	3.58 %	3.21 %	2.70 %	2.82 %	2.97 %	1.85 %	2.74 %
ROA2	6.67 %	7.99 %	7.38 %	5.72 %	5.86 %	5.07 %	5.70 %	5.42 %	3.81 %	4.72 %
ROE	10.92 %	10.34 %	13.11 %	10.33 %	9.37 %	7.01 %	7.59 %	8.81 %	5.61 %	8.51 %

Appendix 6: Average electricity price between price areas



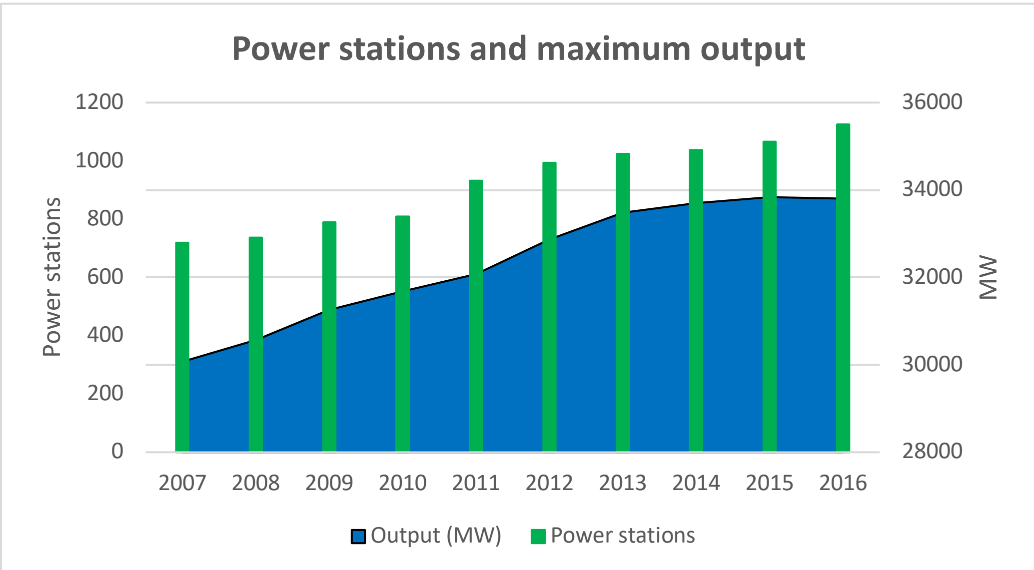
Reference: Nordpool

Appendix 7: Trade balance



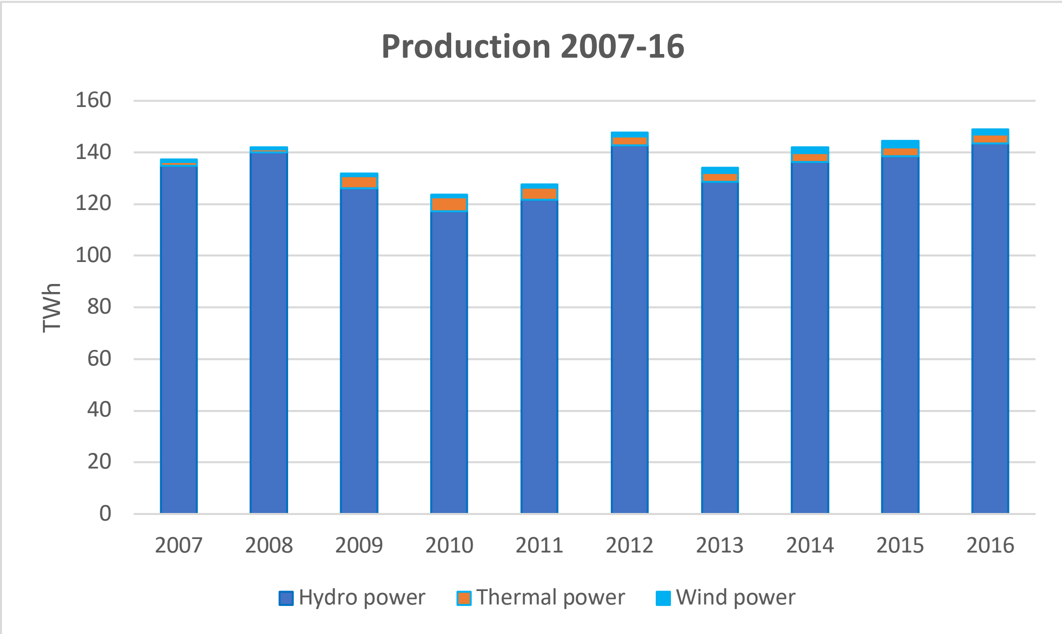
Reference: Statistics Norway

Appendix 8: Production and output (capacity)



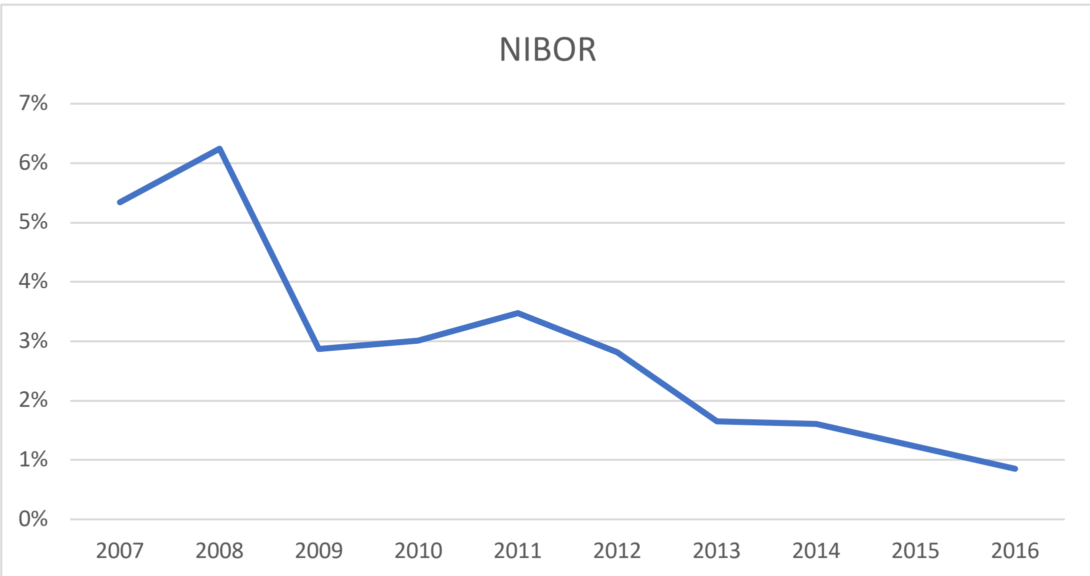
Reference: Statistics Norway

Appendix 9: Power production by type



Reference: Statistics Norway

Appendix 10: NIBOR



References: Norges Bank 2018, Oslo Stock Exchange 2018

Norges miljø- og biovitenskapelige universitet
Noregs miljø- og biovitskapelege universitet
Norwegian University of Life Sciences

Postboks 5003
NO-1432 Ås
Norway