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Firm-specific Risk Factor Analysis of Renewable Energy Stocks

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Abstract

This thesis investigates the relationship between firm-specific factors and renewable energy stock returns. For the period 2011-2015, we study 34 international renewable energy companies, operating in five renewable sectors (solar, wind, bio-energy, energy technology and geothermal) by applying panel data method. Inspired by Fama and French (1992) research, we added two new firm-specific variables to the existing variables, to examine the nature of the cross-section relation between firm-specific factors and renewable energy stock returns. Our main finding is that only one (firm size) out of five firm-specific variables used in our regression model is significant and positively associated with the cross-section average returns of the renewable energy companies.

Keywords: Renewable Energy, Risk factors, Panel Data method, Firm-specific variables, Firm size, Leverage, Price per Earnings, Book-to-Market, Cash flow per Sales, Beta

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This thesis was written as part of our Master of Science in Economics and Business Administration degrees at NMBU – Norwegian University of Life Sciences. Writing this thesis has been a challenging, yet fun and rewarding experience. Throughout the research process we have gained valuable insight into the renewable energy industry and the structural forces driving their market within it.

The choice of topic was derived from the authors' strong interest in clean energy and their markets. We have contributed equally to the thesis, but in a complementary manner, which we believe has strengthened the result.

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Ås, May 10, 2017

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1. Introduction

The renewable energy industry has grown considerably over the past decade and is growing into the preferred power source for many countries. Technology improvements, cost reductions and new financing structures, have turned the sector into a driver of economic growth all over the world. Based on Renewable Energy Policy Network for the 21st Century (2016), renewables contributed 19.2% to global energy consumption and 23.7% to their generation of electricity in 2014 and 2015, respectively. As a response to the growing demand for energy, investments in renewable energy have increased relative to investing in other more conventional types of energy. According to the International Energy Agency (IEA) (2016), not only renewables will remain the fastest-growing source of electricity generation, with their shares growing from 21% in 2015 to 28% in 2021, they are expected to cover more than 60% of all new power generation capacity by 2040. The International Renewable Energy Agency (IRENA) (2016) estimates that global annual investment in renewable energy needs to double from the current levels in the period up to 2020, to achieve the emissions-reducing potential of renewable energies by 2030. The increase in investments in renewable energy markets, leads to an increase in need of research into these markets in order to identify structural factors that drive risks and returns of renewable energy stock. Our study attempts to assist the research in renewable energy market by studying the nature of the relationship between firm-specific factors and renewable energy stock returns.

Developing markets with fast growing energy demand will require the largest increase in investment in renewable energy. Even though the falling renewable energy technology costs have significantly lowered the capital needed to invest in new systems, financing renewable energy projects are still difficult in many parts of the world. This is due to the high cost of capital, elevated by risks to underlying market barriers. The private sector will have to provide most of the investment needed in renewables, based on IRENA (2015) and with public funding in renewables not likely to increase above its current level of 15%. The Organisation for Economic Co-operation and Development (OECD) estimates that around USD 2.80 trillion per annum is potentially available from pension funds and insurance companies for new clean energy investment (Kaminker and Stewart, 2012). This is while there is a great uncertainty among investors relating to risk and return of investing in renewable sector.

Although the risks associated with a specific renewable energy investment arise from the nature of the underlying asset itself and the environment in which it operates. Investors distinguish renewable energy companies among the riskiest types of companies to invest in. It has been revealed that investors often have no good understanding of what they can expect in terms of risk and returns from investing in renewable energy companies and projects (Huisman, 2010). A recent study (Huisman and Kilic, 2016), reveals that renewable energy stocks presents "normal" risk and return potential once the extreme companies from the investment portfolio is eliminated. This confirms the need for more knowledge about the risk and return characteristics of renewable energy investments is to increase the appeal of investing in renewable energy.

To assist the investor to comprehend what to expect from investing in renewable energy stocks, identifying structural factors (micro and macro) that drive risks and returns of renewable energy stocks is crucial. Having a better understanding of the systematic risk factors, not only will aid investors what to expect from investing in renewable energy and help them understand how to combine renewable energy stocks in a portfolio with traditional assets, it will assist the entrepreneur to determine the appropriate financially approach to meet investor demands.

The focus in this study will be to find whether there are firm-specific systematic risk components for renewable energy companies. Thus, we examine whether there is a relationship between the financial performance of renewable energy companies and different firm-specific variables. Understanding the impact from these factors, reveals the firm's specific drivers of returns on renewable energy stocks, providing the transparency of such stocks and the awareness of investing in such stocks. Companies chosen for this study are assessed individually, allowing to find characteristics for companies with good or poor performance rather than a weighted average of both when assessing an index.

The rest of this thesis is organized as follows. Chapter 2 will give a review of the literature. In Chapter 3 the characteristics of the data sample used in this study are presented. The methodology applied in the analysis is described in Chapter 4. The results are presented in Chapter 5. Chapter 6 includes concluding remarks, limitations and recommendations for further research.

2. Literature Review

There is an accepted norm in finance that macroeconomic factors and firm-specific variables explain the behaviour of expected stock returns. Although Gordon (1959), Friend & Puckett (1964), Bower and Bower (1969) and Malkiel and Cragg (1970) found that expected stock returns is highly sensitive to macroeconomic factors, there is a number of firm-specific factors, such as book-to-market value, growth, dividend yield, earnings yield, leverage and momentum, that explain the behaviour of expected stock returns.

Different models have been developed to explain the relationship between risk and returns. Capital Asset Pricing Model (CAPM), that was developed by Sharpe (1964), Lintner (1965) and Mossin (1966) or Sharpe (1964), Lintner (1965) and Black (1972), is the first model to explain the relationship between risk and return. The model found a positive linear relation between expected returns on securities and their market betas, but it did not take the macro and firm-specific factors in consideration, when explaining the behaviour of expected stock returns, and while employing market beta as risk factor. Merton (1973) was one of the first to imply multiple sources of systematic risk. The ad-hoc three-factor model of Fama and French (1993) and the four-factor model of Carhart (1997) are successful examples of multifactor models.

Fama and French (1992) investigated the US stock market, by using book-to-market value of equity to capture the relative distress factor on expected returns, earnings-price ratio to capture any undefined and priced risk factor, leverage and market value of firm equity to capture companies financial risk and the size effect on expected returns. They found that for the 1963–1990 period, firm size and book-to-market value, capture the cross-sectional variation in average stock returns associated with the other factors. They also found that if firm size and book-to-market were included as explanatory variables, the beta will have no marginal contribution in explaining the cross-sectional difference among average stock returns.

Studies that Fama and French (2006), (2008) performed, favour the hypothesis that for expected profitability and investment, firms with higher book-to-market equity have higher expected stock returns. The components of book-to-market help managing the information in the ratio about expected cashflows and expected returns, thus enhancing estimates of expected returns. Anderson and Garcia-Feijóo (2006) using Fama and French (1992) (1993) methods studied the relationship between growth in capital and stock returns. Their findings are consistent with

Berk et al. (1999) in which variations in investment-growth options results in alterations in both valuation and expected stock returns.

Foerster et al. (2017) examine the ability of cash flows to explain average returns relative to earnings-based profitability measures, finding that direct cash flow measures are generally better stock return predictors than indirect cash flow measures, which in turn tend to be better than various income statement profitability measures that focus on gross profits, operating profits or net income. Furthermore, Fama and French (2006) found that more profitable companies have higher expected returns. Novy-Marx (2013) showed that profitability, measured by the ratio of gross profits to assets, predicts the cross section of average returns just as well as the book-to-market ratio does. Fama and French (2015) captured profitability as well as size, value and investment patterns in average stock returns in a five-factor model, which performs better than the Fama and French (1993) three-factor model.

There are other groups of study that have implied multiple sources of systematic risk for more than one country. Fama and French (2012) find that in the four regions (North America, Europe, Japan, and Asia Pacific) that were examined, expect for Japan, there are value premiums in average stock returns decrease with size. Maroney and Protopapadakis (2002) conducted Fama and French (1993) three-factor model on stock markets of Australia, Canada, Germany, France, UK and US, finding that the size effect and the value premium survive for all the countries examined and concluding that the size and BE/ME effects are international in character.

Bali et al. (2013), based on Fama and French (2008) study, focused on international stock markets and re-examines whether the origins of the book-to-market ratio, in terms of past changes in book equity and price enhance the estimates of expected returns provided by book-to-market ratio alone. The study examined all stocks trading in the United Kingdom, Germany, France, Italy, Canada, and Japan, finding that recent changes in book equity and price are more relevant than more distant changes in enhancing estimates of expected future cash flows and expected future returns. Their tests also show that changes in book equity say much more about expected stock returns than price changes do.

During the last decade, there has been a growing body of research on returns of renewable energy companies, and some of these studies aims at classifying the possible factors of these returns. Henriques and Sadorsky (2008), Kumar et al. (2012), Sadorsky (2012a), Bohl et al.

(2013) and Managi and Okimoto (2013) focus on the relationship between renewable energy stocks, changes in the oil price, other equity indices and carbon prices. Henriques and Sadorsky (2008) developed and estimated a four-variable vector auto regression model in order to investigate the empirical relationship between alternative energy stock prices, technology stock prices, oil prices and interest rates. Kumar et al. (2012) investigate the relationship between oil prices and the prices of alternate energy stocks, and also consider the relationship between technology stock prices and the prices of alternative energy products. Sadorsky (2012a) use four different multivariate GARCH models (BEKK, diagonal, constant conditional correlation, and dynamic conditional correlation) to analyse the volatility spill overs between oil prices and the stock prices of clean energy companies and technology companies compared and contrasted. Bohl et al. (2013) employ Carhart (1997) four-factor model to adjust monthly excess returns for exposures to the market, size, book-to-market and momentum factors, to investigate the return behaviour of renewable energy stocks. Managi and Okimoto (2013) apply Markov-switching vector autoregressive models to the economic system consisting of oil prices, clean energy and technology stock prices, and interest rates to analyse the relationships among oil prices, clean energy stock prices, and technology stock prices, endogenously controlling for structural changes in the market. The authors find evidence for the impact of several variables on renewable energy stock prices. Specifically, returns of high technology and renewable energy stocks seem to be highly correlated. On the other hand, results are not that clear for the effect of variations in the oil price. While Henriques and Sadorsky (2008) suggest that changes in oil prices have only limited impact on returns from investment in renewable energy stocks, Kumar et al. (2012), Sadorsky (2012a), Bohl et al. (2013) and Managi and Okimoto (2013) find some evidence for a significant relationship between these variables.

Using a variable beta model, Sadorsky (2012b) investigates the macro- and microeconomic factors' (size of the firm, the debt to equity ratio, the research and development expenditure to sales ratio, sales growth and oil price returns) of renewable energy company risk. The empirical results show that company sales growth has a negative impact on company risk while oil price increases have a positive impact on company risk. When oil price returns are positive and moderate, increases in sales growth can offset the impact of oil price returns and this leads to lower systematic risk.

Inchauspe et al. (2015) examined the dynamics of excess returns for the WilderHill New Energy Global Innovation Index, by proposing a multi-factor asset pricing model with time-varying coefficients to study the role of energy prices and stock market indices as explanatory factors. Their results suggest a strong influence of the MSCI World index and technology stocks throughout the sample period 2004-2011. The influence of changes in the oil price is significantly lower, although oil has become more influential from 2007 onwards. They also found evidence for underperformance of the renewable energy sector relative to the considered pricing factors after the financial crisis.

Kazemilari et al. (2017) by applying the minimum spanning trees approach, present a research analysis on renewable energy companies in stock exchange. Using the daily closure prices of 70 stocks of renewable energy companies from October 2010 to march 2015, they find that companies as First Solar Inc., General Cable Corporation and Trina Solar are the most important within network, and these stocks play a significant role in renewable energy development in terms of market capitals.

This paper contributes to the growing list of literatures by studying the behaviour of renewable energy stock prices, in relation to firm-specific factors. The study is inspired by Fama and French (1992), engaging firm-specific variables firms size, leverage, price-earnings ratio, cashflow to sales ratio, book- to- market value and market beta, combined. By using panel data method, we capture the cross-section variation in average renewable energy stock returns. Our analysis is run for all the renewable sectors involved in this study, comparing the behaviour of renewable energy stock prices, in relation to firm-specific factors across the sectors.

3. Data

The sample used in this study is selected from 34 renewable energy companies (Appendix A-1). The chosen companies are either listed as producer and distributer (e.g. renewable energy developers and independent power producers), as manufacturing and technology companies (e.g. equipment and components for the renewable energy industry) or as energy efficiency company (e.g. industrial automation and controls; and energy-efficient equipment). The chosen sample ranges over the period January 2011 to December 2015. All the companies appear at least once in eight different Global Alternative Energy Indices of RENIXX World, ALTEX Global, Ardour Global Alternative Energy Index, Credit Suisse Global Alternative Energy Index, DAX Global Alternative Energy Index, S&P Global Clean Energy Index, Wilderhill New Energy Global Innovation Index and World Alternative Energy Index. This is presented in Appendix A-2.

The source of the historical stock prices of the renewable energy companies and the firm specific variables is Morningstar. The historical stock prices to the companies are downloaded in daily, weekly, monthly and annual frequency. The firm specific variables are annual data. To calculate the renewable energy companies' beta, S&P Global 1200 was chosen as benchmark. The S&P Global 1200 provides efficient exposure to the global equity market. Capturing approximately 70% of global market capitalization, it is constructed as a composite of 7 headline indices, many of which are accepted leaders in their regions. These include the S&P500 (US), S&P Europe 350, S&P TOPIX 150 (Japan), S&P/TSX 60 (Canada), S&P/ASX All Australian 50, S&P Asia 50 and S&P Latin America 40[1].

The companies in the sample are located in North America, Europe, Asia and South America. The distribution of the companies within continents is shown in Appendix A-3.1. The sample used in this study consists of companies operating in the solar, energy technology, wind, bioenergy and geothermal sector. Of all the companies in the sample, 35 % operate in solar power sector, 26 % in energy technology sector, 24 % in the wind power sector, 12 % in bioenergy sector and 3% in geothermal sector. The distribution of the companies in the sample is illustrated in Appendix A-3.2

[1] https://us.spindices.com/indices/equity/sp-global-1200

Companies' price trend graphs for the period of 2011-2015 are shown in Appendix A-4. We have chosen to show the graphs in sectored manner, since later in our study, we have investigated the relationship between the firm-specific variables and cross-section average stock returns of the renewable energy companies, in their operative sectors.

3.1 Variables

As presented under literature review, several papers show that certain factors contribute to explain stock returns more than others. In deciding which variables to include, attention was given to those variables that had been found to be important in prior studies. Since this study is inspired by Fama and French (1992) research, we included the firm-specific variables that are used in that study and added two new variables.

The dependent variable in our model is the average annual stock returns of the renewable companies. The returns are calculated based on monthly data and log returns then annualized by multiplying by 12.

$$r_t = \ln\left(\frac{P_t}{P_{t-1}}\right) \quad 3.1$$

The explanatory variables (beta, leverage, price-earnings ratio, cash flow per sales, book-to-market value) in the model are firm- and time variant. However, the firm-specific variable, firm size, is almost invariant over time.

Beta

Beta captures the market risk that cannot be explained by variation in the global market for equities. The systematic risk (the only risk source in CAPM) is calculated for the renewable energy companies using the common expression for beta:

$$\beta = \frac{Cov\,(r_a\, r_{S\&P\ Global\ 1200})}{Var(r_{S\&P\ Global\ 1200})} \quad 3.2$$

Where r_a is the daily logarithmic stock returns (for each year) for the renewable company, and $r_{S\&P\ Global\ 1200}$ is the daily logarithmic stock returns of S&P Global 1200. All the observations of the companies are included in calculating the beta. An overview of the company's annual beta is presented in Appendix A-5.

Size

The presence of the size effect has been first documented by Banz (1981) for US equity markets and has later been confirmed by many other researchers in equity markets around the world. Van Dijk (2011) provides a review on the size effect around the world. The firm size is measured by market value of the company. Since the size effect is not linear in the market value, we have used the logarithmic firm size in our model.

Leverage

Fama and French (1992) were initially interested in analysing the impact of leverage on security returns, but in the end firm size and book-to-market ratios emerge as the strongest predictors of security returns. We include leverage to examine this result. There is different composition of liabilities, we choose debt to total equity as the measure of financial leverage for this study. Debt/Equity ratio is calculated by dividing a company's total liabilities by its stockholders' equity.

Price-earnings ratio

Fama and French (1992) (1998) chose E/P (Earning per share/Price per share) ratio, the inverse of the price multiplier ratio as a value factor in their research. To investigate the value effect on stock returns on renewable energy companies, we have chosen price per earnings ratio. It is the ratio for valuing a company that measures its current share price relative to its per-share earnings.

The price-earnings ratio is calculated as follows:

$$\text{Price-earnings ratio} = \frac{Market\ value\ \ of\ the\ company\ per\ share}{Earnings\ \ per\ share} \qquad 3.3$$

Cash flow per sales ratio

Fama and French (2015) captured profitability as well as size, value and investment patterns in average common stock returns in a five-factor model, which performs better than the Fama and French (1993) three-factor model. We added this factor as a profitability factor to investigate the relationship between profitability and renewable energy companies stock returns. This factor provides investors an idea of the company's capability to turn sales into cash.

Book-to-market value

The book-to-market value is a ratio used to find the value of a company by comparing the book value of a firm to its market value .The use of the book-to-market value is driven by the findings of Fama and French (1992), who show that the book-to-market value of individual stocks has the ability to explain cross-sectional variation in stock returns. Book-to-market value is calculated by the following formula:

$$\text{Book-to-Market value} = \frac{\text{Book value of the company per share} \times \text{Number of shares of the company}}{\text{Market value of the company}} \qquad 3.4$$

4. Methodology

According to empirical studies conducted previously, there is evidence that there is a relationship between firm-specific factors and average stock returns. In this study, we combine a selection of firm-specific variables with an overall market factor, to investigate the impact these firm-specific factors have on renewable energy companies' financial performance. Since the study dataset is characterized by time, cross-section and country specific dimensions, a panel data analysis is conducted. Panel data is used to analyse the impact of firm-specific factors on renewable energy companies' cross-section stock returns, in the period 2011-2015.

Panel data, also called longitudinal data, refers to a combination of time series data and cross-sectional data that examines one or more variables for the same objects over several periods. Therefore, observations in panel data involve at least two dimensions; a cross-section dimension, indicated by subscript *i*, and a time series dimension, indicated by subscript *t*. However, panel data could have a more complicated clustering or hierarchical structure. For instance, variable y may be the measurement of the level of returns of renewable companies *i* at time *t*.

The simplest econometric setup for panel data is as follows:

$$y_{it} = \alpha + \beta x_{it} + u_{it} \qquad 4.1$$

Where y_{it} is the dependent variable, α is the interception, β is a k×1 vector of parameters to be estimated on the explanatory variables, x_{it} is a 1×k vector of observations on the explanatory variables, t =1, ..., T; i =1..., N, and u_{it} is a 1×k vector of error term, t =1, ..., T; i =1..., N[2]

Panel data increases on the degrees of freedom, deals with the collinearity issue among the explanatory variables (decreases it), and consequently allows for more efficient estimates, allowing more sample variability than cross-sectional data which may be viewed as a panel with T = 1, or time series data which is a panel with N = 1, improving the efficiency of econometric estimates and providing more accurate inference of model parameters. Providing a higher number of observations (data points) by combining the number of several companies over several periods, panel data offers us more information, variability, less collinearity between the variables and multiple degrees of freedom that strengthens the survey. Panel data is better than cross-section data where one can often encounter problems with omitted variables due to unobserved effects. Through time company's datasets lapses due to bankruptcy, merger or dissolution. Dataset that contains all elements observed in all time frame is called balanced data, whereas unbalanced data is a set of data where not all elements are observed.

Panel data includes both cross-sectional and time series data, leading to a more complex customization of the data into a regression model. Furthermore, utilizing panel data can lead to problems with heteroscedasticity and autocorrelation in the regression analysis. There are essentially two different estimator methods to estimate coefficients of panel data: fixed effects models and random effects model (Brooks, 2014b).

Pooled OLS regression as the simplest approach to deal with panel data, merges all observations disregarding that the data set and estimates the usual OLS regression model. This leads to a common coefficient for all variables, assuming there is no difference between the companies, that company number one is equal to company number two. Pooled OLS ignores heterogeneity of the companies, which can lead to heteroscedasticity, correlation between the error term and the explanatory variables in the model. However, this is a naive presumption since the random events affecting the dependent variable are likely to influence the explanatory variables as well. An equation with *m* explanatory variables a pooled model can be written as follows:

[2] k represents the number of slope parameters to be estimated, which is equal to the number of explanatory variables in the regression model.

$$y_{it} = \alpha + \sum_{n=1}^{m} \beta_n x_{nit} + u_{it} \qquad 4.2$$

Where y_{it} is the dependent variable (average returns of company i at time t), α is the intersection term, β_n is the coefficients of the explanatory variable , n=1,…….6, x_{it} is a 1×k vector of observations on the explanatory variables, t =1, ..., T; i =1,...,N, and u_{it} is a 1×k vector of error term, t =1, ..., T; i =1,...,N. These notations are used throughout this chapter. Pooled estimators are consistent, assuming the coefficients are constant across firms and there is no correlation between the error term and variables. But even if there is no correlation between the error term and variables, residuals will most likely be correlated over time for a given company.

Following the setup, we let the average stock returns for renewable company i=1…,34, at time t=2011…,2015, be denoted as y_{it} . In this model (4.3), not only the average stock returns vary across firms and over time, the firm-specific variables vary across time and company as well.

The model is specified as follows:

$$y_{it} = \alpha + \beta_1 Beta_{it} + \beta_2 Ln\ size_{it} + \beta_3 Leverage_{it} + \beta_4 PE_{it} + \beta_5 xCFS_{it} + \beta_6 BM_{it} + u_{it} \qquad 4.3$$

The average stock returns of any renewable energy company in this study is measured in terms of its annual beta (non-linear), firm size (logarithmic), leverage (debt-to-equity), price per earnings ratio (PE), cash flow per sales (CFS) and book-to-market value (BM). The beta captures the market risk that cannot be explained by variation in the global market for equities, firm size refers the total dollar market value of a company's outstanding shares. The debt-to equity ratio is a financial ratio which describes the amount of debt, the price per earning is the ratio for valuing a company that measures its current share price relative to its per-share earnings, the cash flow per sales compares a company's operating cash flow to its net sales or revenues, which gives investors an idea of the company's ability to turn sales into cash and the book-to-market value is to the value of a company by comparing the book value of a firm to its market value.

4.1 The Fixed Effects Models

The heterogeneity, that is being ignored by pooled OLS, in panel data is called, fixed effects or unobserved effects. In general, these effects are not directly observable and therefore cannot be measured in a standard regression model like pooled OLS. Unobserved effects could be the different governances in the companies, where one could be better than another. To capture these unobserved effects, in the regression equation (4.2), the disturbance term u_{it}could be decomposed in an individual entity-specific effect μ_i, and a remainder disturbance v_{it}. The residual u_{it} contains the effects of all the unobserved variables that are not included in the regression, and varies over time and across entities. Consequently, the disturbance term u_{it} may be defined as:

$$u_{it} = \mu_i + v_{it} \qquad 4.4$$

So, equation 4.2 can be rewritten as followed:

$$y_{it} = \alpha + \sum_{n=1}^{m} \beta_n x_{nit} + \mu_i + v_{it} \qquad 4.5$$

Since unobserved effects are now included in the expression for the error term, assumptions for the regression analysis of correlation between the error term and variables are broken. In this case one can use the fixed effects model (Dougherty, 2011). There are three available strategies for estimating the fixed effects: within-groups fixed effects, first differences fixed effects and least squares dummy variable (LSDV) fixed effects.

Within-groups Fixed Effects

In order to eliminate the unobserved effect within-group model, we calculate the first average of all observations within firms, as in equation:

$$\bar{y}_i = \alpha + \sum_{n=1}^{m} \beta_n \bar{x}_{ni} + \mu_i + \bar{v}_i \qquad 4.6$$

The data set is manipulated to appear as cross-section data by taking the average of all the observations over time within each company. This eliminates the time series element in panel data and gives the companies an average value. Since the time series element is constant over time, its value is equal to the average value. Equation (4.6) is subtracted from equation (4.5):

$$(y_{it} - \bar{y}_i) = \sum_{n=1}^{m} \beta_n \ (x_{nit} - \bar{x}_{ni}) + (v_{it} - \bar{v}_i) \qquad 4.7$$

This transformation which is called within transformation, eliminates the unobserved effect μ_i. Equation (4.7) can be simplified and expressed as followed:

$$\ddot{y}_{it} = \sum_{n=1}^{m} \beta_n \ \ddot{x}_{nit} + \ddot{v}_{it} \qquad 4.8$$

Where $\ddot{y}_{it} = (y_{it} - \bar{y}_i)$, $\ddot{x}_{nit} = (x_{nit} - \bar{x}_{ni})$, and $\ddot{v}_{it} = (v_{it} - \bar{v})_i$ estimates are known as average estimates, because the data set is manipulated to use average values. For this study equation (4.8) is as followed:

$$\ddot{y}_{it} = \beta_1 B\ddot{e}ta_{it} + \beta_2 Ln\ddot{s}ize_{it} + \beta_3 Leve\ddot{r}age_{it} + \beta_4 \ddot{PE}_{it} + \beta_5 \ddot{CFS}_{it} + \beta_6 \ddot{BM}_{,it} + \ddot{v}_{it} \qquad 4.9$$

Where $\ddot{y}_{it}$ is the demeaned cross-sectional value of average stock returns of company *i*, and year *t* (i = 1, ..., 34; t = 2011, ..., 2015). This would apply to the explanatory variables as well, where the double dots over the variables are the demeaned cross-section value of the respected variable. Using fixed effects estimation, the correlation between the error term and variables that violate assumptions of OLS dissolves, since unobserved effect is modified, but at the same time the unobserved effects are removed and we therefore do not have coefficients for the company-specific effects that are time independent.

First differences Fixed Effects

In the second variation of the fixed effects model the unobserved effect is eliminated by subtracting observations from a previous period from the observations in the present period. This is done for all time periods in the dataset. The regression model for the previous period is expressed as followed:

$$y_{it-1} = \alpha + \sum_{n=1}^{m} \beta_n \ \bar{x}_{n,it-1} + \mu_i + v_{it-1} \qquad 4.10$$

By subtracting equation (4.10) from equation (4.5), equation that expresses first differences fixed effects regression model is achieved.

$$\Delta y_{it} = \sum_{n=1}^{m} \beta_{n\Delta x_{n,it}} + v_{it} - v_{it-1} \qquad 4.11$$

In this model like fixed effects within-groups model, the time series unobserved effect is eliminated. Loss of important information is the inconvenience of fixed effects within-group model and first differences model. By manipulating the variables, lagging or average adjustment, important information about a variable's influence on the dependent variable can be missed. First differences method is more suited for investing dynamic changes, while within groups fixed effects matches better to investigations of contexts (Dougherty, 2011).

Least Squares Dummy Variable (LSDV) Fixed Effects

The first two models solved the heterogeneity problem by eliminating the unobserved effect. The LSDV model solves the problem by adding dummy variables to a firm's unobserved effects.

$$y_{it} = \sum_{n=1}^{m} \beta_n x_{n,it} + \sum_{i=1}^{n} \mu_i D_i + u_{it} \qquad 4.12$$

Equation (4.12) represents the regression model where the dummy variables are included. μ_i is the unobserved effect that affects y_{it} (the average stock returns for renewable company i=1…,34, at time t=2011…,2015) cross-section, but is constant over time, like the sector that a company operates in. The dummy variable D_i takes the value 1 for all observations on the *i* company, and zero elsewhere. The intercept is removed here to avoid the dummy trap, where there is perfect multicollinearity between the dummy variables and the intercept.

$$y_{it} = \sum_{n=1}^{m} \beta_{nx_{n,it}} + \sum_{i=1}^{n} \delta_i D_t + u_{it} \qquad 4.13$$

Equation 4.13 represents a time-fixed model that can be used rather than an object-fixed model shown in equation (4.12). δ_i is a time-varying intercept that captures all the variables that affect y_{it} and that vary overtime but are constant cross-section, like environment regulatory, tax rate changes. D_t takes the value 1 for all observations in period t and zero elsewhere.

The advantage of fixed effects specification is that it can allow the individual-and/or time specific effect to be correlated with explanatory variables x_{it}. The weakness of the fixed effects specification is that the number of unknown parameters increases with the number of sample observations. Furthermore, the fixed effects estimator does not allow the estimation of coefficients that are time-invariant.

4.2 The Random Effects Model

Another way to account for heterogeneity is to run the random effects model. The random effects model, which is equivalent to the Generalized Least Square (GLS), needs to follow some severe restrictions in order to be applied. In this method, the subtraction of the necessary mean value seems to be a better and more advanced solution than subtracting the whole mean value over all the cross-section units. Therefore, using the random effect model, we do not lose any degrees of freedom, since we do not use more variables, we just make transformations, and it allows the derivation of efficient estimators to make use of both within and between (group) variation. Equation (4.14) expresses the regression model for a random effect model:

$$y_{it} = \alpha + \beta\, x_{it} + \omega_{it} \qquad 4.14$$

$$\omega_{it} = \varepsilon_i + v_{it} \qquad 4.15$$

Where α is a common intercept that the intercepts for each cross-sectional unit are assumed to arise from (which is the same for all cross-sectional units and over time), and ε_i is a random variable that varies cross-sectional but is constant over time. ε_i measures the random deviation of each entity's intercept term from the global intercept term α. x_{it} which is still a 1×k vector of explanatory variables, but unlike the fixed effects model, there are no dummy variables to capture the heterogeneity (variation) in the cross-sectional dimension. This is captured via the ε_i terms. With random effects model follows the assumptions that the new cross-sectional error term, ε_i, has zero mean, is independent of the individual observation error term v_{it}, has constant variance σ_ε^2, and is independent of the explanatory variables (x_{it}).

The random effects model of this study is as followed:

$$y_{it}=\alpha+\beta_1 Beta_{it} + \beta_2 Ln\ size_{it} + \beta_3 Leverage_{it} + \beta_4 PE_{it} + \beta_5 CFS_{it} + \beta_6 BM_{it} + (\varepsilon_i + v_{it}) \quad 4.16$$

Where y_{it} is the average annual stock returns of renewable energy company i, and year t. (i = 1, ..., 34; t = 2011, ..., 2015) The explanatory variables are the same that have been defined earlier. α and the βs are vectors of parameters, $\varepsilon_i \sim$ IID (0, σ_ε^2) is the unobserved random effect that varies across companies but not over time, and $v_{it} \sim$ IID (0, σ_v^2) is an idiosyncratic error term, i =1, ..., 34; t = 2011, ..., 2015.

According to Brooks (2014b), the transformation involved in this GLS procedure is to subtract a weighted mean of the y_{it} , over time (i.e. part of the mean and not the whole mean, as was the case for fixed effects estimation). The 'quasi-demeaned' data is defined
$y^* = y_{it} - \theta\bar{y}_i$ and $x^* = x_{it} - \theta\bar{x}_i$ where $\bar{y}$ and $\bar{x}$ are the means over time of the observations on $y_{it}$and, x_{it}respectively. θ is a function of the variance of the observation error term, σ_v^2, and of the variance of the entity-specific error term, σ_ε^2.

$$\theta = 1 - \frac{\sigma_v}{\sqrt{T\sigma_\varepsilon^2+\sigma_v^2}} \quad 4.16$$

This transformation will ensure that there are no cross-correlations in the error terms. The standard error-components models assume that there is heterogeneity between entities in the cross-sectional dimension, causing errors to be correlated within cross-sectional units like companies in our data. In a similar way, we could also have "heterogeneity" in the time dimension. We can easily allow for time variation, as for cross-sectional variation, in the random effects model.

Cases where the unobserved effect is correlated with some of the explanatory variables, fixed effects model should be used. Whereas unobserved effects and the explanatory variables are not correlated or have an expected value equal to zero, the random effects model is used. Pooled OLS is used in cases where no there is no evidence of unobserved effects (Wooldridge, 2009).

5. Results

In this chapter we present the dataset further using descriptive statistics, as well as explaining the results from the regression analysis. With the help of statistical tests, we have chosen the model that is most adequate to our study and reviewed the results of the model in chapter 5.4.

5.1 Descriptive statistics

Appendix B-1 gives an overview of the descriptive statistics of all the companies. The lowest annual average return is -60.6%, with an annual standard deviation of 83.5%, which belongs to Yingli Green Energy company. Tesla motors has the highest annual average return of 43.3% with a standard deviation of 50.1%.

Before investigating the firm-specific factors as risk sources, we must analyse the explanatory power of the systematic risk on renewable energy company stock returns. Companies betas were estimated with simple linear regressions, using monthly logarithmic asset returns as the dependent variable and monthly logarithmic return of S&P Global 1200 as the independent variable. The following linear regression is run:

$$R_{it} = \alpha_{it} + \beta_{it} R_{S\&P\ Global\ 1200} + \varepsilon_{it} \qquad 5.1$$

Where t refers to month t in the period 2011-2015, and *i* refers to company *i* (1-34) in our dataset. Daily and weekly beta are calculated in the same way, with simple linear regression. An overview of the companies' betas is presented in Appendix B-2. Even though we have significant betas, the low adjusted R-square is a reminder that a model with market beta alone fails to explain the stock returns on renewable energy companies, and further investigation with multi-variables is needed to explain the nature of risk and returns on renewable stock returns. Figure 5.1 illustrates the companies average monthly beta and the respected adjusted R-square.

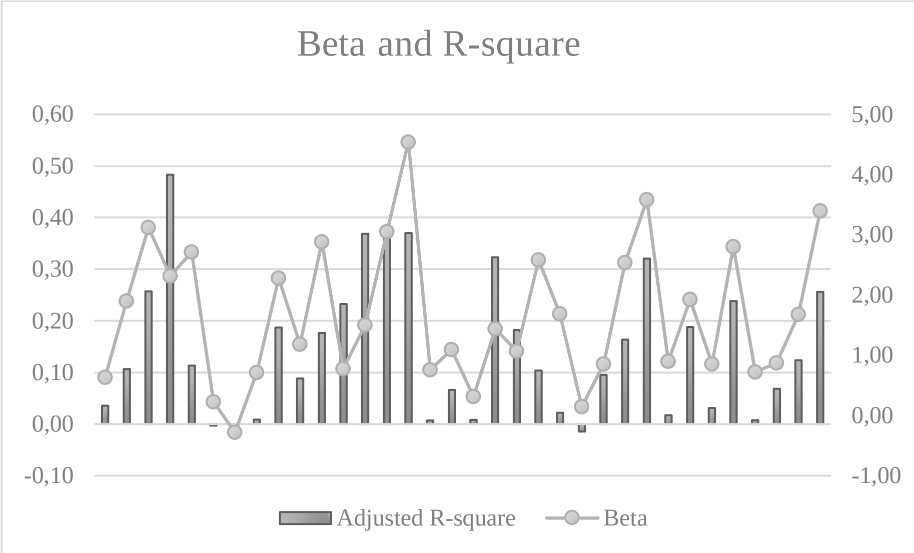

FIGURE 5.1: ADJUSTED R-SQUARE AND MARKET BETA OF THE 34 RENEWABLE ENERGY COMPANIES.
Adjusted R-square and market beta are concatenated using historical monthly data from Morningstar, with S&P Global 1200 as benchmark, for the period January 2011- December 2015.

Table 5.1 reviews the descriptive statistics of the explanatory variables, from 170 observations of 34 companies and in a period of 5 years. In panel data, descriptive statistics are described in three categories: overall, between and within. Overall contains description of the entire dataset by merging all observations. Between and within shows descriptive statistics for observations by treating the cross-sectional and time series data. It is shown that the annual average beta is 1.38 for all companies in the data set, where the lowest beta is -0.618 and the highest is 3.760. It shows that the spread of beta is rather high with a standard deviation 0.795. Firm size was estimated in logarithmic form with an average value of 5.509 and a standard deviation of 2.373. Leverage had an average value of 0.620 and its standard deviation is 5.780. Growth prospects is measured by book-to-market and price per earnings ratio. Their average value is 43.687 and 5.808, with standard deviations of 201.913 and 49.350, respectively.

Profitability which is measured by cash flow per sales has an average value of -12.161 with a standard deviation of 40.706.

TABLE 5.1: DESCRIPTIVE STATISTIC FOR THE EXPLANATORY VARIABLES.

The table shows the average value, standard deviation, minimum and maximum value for annual data of explanatory variables, from January 2011 - December 2015. The descriptive statistic is concatenated using data from Morningstar.

		Average	Standard Deviation	Min	Max	Observations
Beta	Overall	1,382	0,795	-0,618	3,761	N =170
	between		0,670	-0,313	2,528	n=34
	Within		0,440	0,174	2,945	T=5
Firm size	Overall	5,509	2,373	-1,177	9,581	N =170
	between		2,305	-0,789	9,337	n=34
	Within		0,665	3,600	8,294	T=5
Leverage	Overall	0,620	5,780	-68,060	22,530	N =170
	between		2,370	-9,950	7,180	n=34
	Within		5,285	-57,485	26,361	T=5
Book to market value	Overall	43,687	201,913	-11,005	1871,362	N =170
	between		155,393	-1,696	855,152	n=34
	Within		131,124	-608,488	1059,898	T=5
Price -earnings ratio	Overall	5,808	49,350	-391,147	326,350	N =170
	between		28,664	-127,566	68,203	n=34
	Within		40,413	-257,773	263,955	T=5
Cash flow per sales	Overall	-12,161	40,706	-210,540	56,800	N =170
	between		27,457	-83,850	17,964	n=34
	Within		30,347	-151,471	64,909	T=5

The between standard deviation, of beta (0.670), firm size (2.305), and book-to-market (155,393) value are larger than the within standard deviation, indicating that these variables vary more between the companies than throughout the study period of five years. Leverage, price earnings ratio and cash flow per sales between and within standard deviation, show that these variables are more variant over time than between the companies. The min and max values for the between shows the minimum and maximum average of the variables for each company through the period 2011-2015. Among the firm-specific variables firm size has the minimum spread, while book to market value fluctuates most. The within min and max values show the minimum and maximum change in the respected variable for individual company, when we take away the overall mean.

The results show that beta increases by a minimum of 0.174 and a maximum of 2.945 for each company, when the overall mean is subtracted. Firm size is the firm-specific variable that has the least changes among the firm specific variables for each company, when the overall mean is subtracted.

5.2 Results of the Regressions

First, a pooled OLS regression is estimated, results are viewed in table 5.2. The ***C*** is the intercept, that as it can be seen it is not statistically significant. It is observable that price per earnings ratio is the only statistically significant explanatory variable, at a 5% significance level, with a risk premium of 0.3 % per year for all the companies.

TABLE 5.2: THE TABLE SHOWS PANEL LEAST SQUARES (OLS) REGRESSION OUTPUT.
Total panel (balanced) observations: 170 of 34 cross-sections for annual returns of renewable energy companies as dependent variable, and data of explanatory variables, from January 2011 - December 2015. The regression output is concatenated using data from Morningstar.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0,1061	0,1860	-0,5702	0,5693
Beta	0,0287	0,0702	0,4092	0,6829
Firm size	0,0075	0,0258	0,2914	0,7711
Leverage	0,0112	0,0094	1,1896	0,2359
Price per earnings ratio	**0,0026**	**0,0011**	**2,3273**	**0,0212**
Cash flow per sales	0,0015	0,0014	1,1105	0,2684
Book to market	-0,0002	0,0003	-0,7143	0,4760
R-squared				0,0564
F-statistic				1,6240
Durbin-Watson stat				1,8911

The other variables do not have any impact on the financial performance of renewable energy companies, since they are not significant by this estimation. The R-squared value of this estimation, shows only 5% of the variation among renewable energy companies' financial performance is explained by the independent variables in the model. The high value for Durbin-Watson statistic (1.891) which tests for autocorrelation in the residuals, imply little to no autocorrelation in the sample. The graph of residuals from the pooled regression (Appendix B-3) shows some tendency in the residuals (variation below and above zero is in a systematically way), which indicates possible heterogeneity.

A pooled regression is characterized by the assumptions of no cross-sectional (companies) heterogeneity and no period effects. Mainly, a pooled regression assumes that the estimated coefficients are the same for each cross-section and over the years. One of the assumptions of the OLS specification is the exogeneity of the explanatory variables. However, this could be a naive presumption since the random events affecting the dependent variable are likely to influence the explanatory variables as well. This means that it is necessary to account for heterogeneity in the data, because everything that is not explained in a pooled regression is transferred to error terms.

5.2.1 The Fixed Effects Model

Results from the cross-section fixed effects model is illustrated in table 5.3. The ***C*** represents the intercept. Based on the P-values of the results, it can be detected that only beta and firm size

TABLE 5.3: THE TABLE SHOWS PANEL LEAST SQUARES (CROSS-SECTION FIXED EFFECTS) REGRESSION OUTPUT
Total panel (balanced) observations: 170 of 34 cross-sections for annual returns of renewable energy companies as dependent variable, and data of explanatory variables, from January 2011 - December 2015. The regression output is concatenated using data from Morningstar.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1,565	0,486	-3,220	0,002
Beta	**0,243**	**0,122**	**1,997**	**0,048**
Firm size	**0,226**	**0,087**	**2,581**	**0,011**
Leverage	0,006	0,010	0,619	0,537
Price per earnings ratio	0,002	0,001	1,655	0,100
Cash flow per sales	0,003	0,002	1,657	0,100
Book to market	-0,001	0,000	-1,363	0,175
R-squared				0,294
F-statistic				1,388
Prob(F-statistic)				0,089

are statistically significant explanatory variables at 5% significance level (beta at 0. 048 and firm size at 0.011), with 24.3% and 22.6% risk premium per year. Cash flow per sales ratio and book-to-market ratio are not significant at 5% significance level. Price per earnings is insignificant as compared to the results of pooled regression.

The R-squared value of this estimation shows that almost 30% of the variation among renewable energy companies' financial performance is explained by the independent variables in the model.

The necessity of fixed effects model, is determined by the Redundant fixed effects test, which tests the significant of the unobserved effects. The null hypothesis in this test is that the effects are redundant. The result of the test is presented in Appendix B-4. The test estimates three restricted specifications i.e. with period fixed effects only, with cross-section fixed effects only and one with all the effects. Table B4.1 (Appendix B-4) consists of three sets of tests: the significance of the cross-section fixed effects, period effects only and the remaining is the significance of all the effects. According to the results, the sum of squares (F-test) and likelihood ratio (chi square test) and P-value (prob.) the null hypothesis is strongly rejected. In other words, all the results indicate that the effects are statistically significant and pooled OLS regression could not be employed.

5.2.2 The Random Effects Model

The results of the random effects model regression are shown in table 5.4. The coefficients estimates are different compared with fixed effects regression, but similar to the pooled regression.

TABLE 5.4: THE TABLE SHOWS PANEL EGLS (CROSS-SECTION RANDOM EFFECTS) REGRESSION OUTPUT
Total panel (balanced) observations: 170 of 34 cross-sections for annual returns of renewable energy companies as dependent variable, and data of explanatory variables, from January 2011 - December 2015. The regression output is concatenated using data from Morningstar.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0,079	0,152	-0,521	0,603
Beta	0,029	0,068	0,423	0,673
Firm size	0,009	0,020	0,469	0,640
Leverage	0,011	0,009	1,228	0,221
Price per earnings ratio	**0,002**	**0,001**	**2,333**	**0,021**
Cash flow per sales	0,002	0,001	1,146	0,253
Book to market	0,000	0,000	-0,737	0,462
R-squared				0,053
F-statistic				1,852
Prob(F-statistic)				0,106

According to the results, only price per earnings ratio is statistically significant at 5% significance level, with a 0.2% annual risk premium. None of the other explanatory variables seem to have any effect on the company's stock returns with this model. The R-squared value of this estimation is 0.053, indicating that only 5.3% of the variation among renewable energy companies' financial performance is explained by the independent variables in the model. This is much lower than the fixed effects model R-squared value (0.293), which could be an indication that fixed effects model is more adequate for our model.

To test whether cross-section random effects model is well specified, we run Hausman test. The Hausman test in panel data is used to differentiate between fixed effects model and random effects model. Random effects model is preferred under the null hypothesis due to higher efficiency, while under the alternative fixed effects is at least consistent and thus preferred. If P-value is below the threshold ($P<0.05$), indicating that tests estimator is significant, random effects estimators should not be used. Table B4.2 (Appendix B-4), shows the results of the test, and according to the P-value (0.0001) of chi-square test, the null hypothesis is rejected, demonstrating that the Fixed Effects model is more appropriate for our data sample.

5.2.3 Multicollinearity and Heteroscedasticity

Correlation matrix in table 5.5 show no perfect correlation between the explanatory variables in the regression model. Perfect correlation implies correlation between two variables with correlation value of ± 1.

TABLE 5.5: CORRELATION MATRIX FOR ANNUAL DATA OF EXPLANATORY VARIABLES.
For the period, January 2011 - December 2015. correlation matrix is concatenated using data from Morningstar.

	Beta	Firm size	Leverage	Price per earnings	Cash flow per sales ratio	Book to market ratio
Beta	**1,0000**					
p-value						
Firm size	**0,0005**	**1,0000**				
p-value	*0,9951*					
Leverage	**-0,1342**	**-0,0147**	**1,0000**			
p-value	*0,0809*	*0,8490*				
Price per earnings	**-0,1459**	**0,1437**	**0,0297**	**1,0000**		
p-value	*0,0576*	*0,0616*	*0,7010*			
Cash flow per sales ratio	**0,1940**	**0,1815**	**-0,1618**	**0,0475**	**1,0000**	
p-value	*0,0113*	*0,0178*	*0,0351*	*0,5385*		
Book to market ratio	**0,1341**	**-0,4323**	**-0,0038**	**-0,0260**	**0,0446**	**1,0000**
p-value	*0,0813*	*0,0000*	*0,9610*	*0,7365*	*0,5640*	

Leverage, and price per earnings have negative correlation with beta, but none of them are significant at a 5% significance level, only cashflow is significantly correlated with beta. Cash flow per sales and book to market are significantly correlated with firm size at a 5% significance level. Cash flow per sales and book-to-market have negative correlation with leverage, but only cash flow per sales is significant at a 5% significance level.

Testing for multicollinearity and heteroskedasticity are two important points to consider in our panel data. According to the table 5.5, it can be observed that there is no sign of multicollinearity between the explanatory variables, as none of the correlation coefficients is equal or bigger than ± 0.8.

In order to see if the variances of the residual values are constant, and to check for the problem of heteroskedasticity, we choose to run the Breusch-Pagan (BP) test, which is a Lagrange multiplier test of the null hypothesis of no heteroskedasticity. The results (Appendix B-4.3) show high observatory (small P-value), the null hypothesis is rejected and we have heteroskedasticity. As heteroskedasticity is detected, robust covariance matrix estimation (Sandwich Estimator) was used as modification tool.

5.3 Choice of Model

To analyse our results further a model must be chosen. Generally, the random effects model is preferred to the fixed effects model since it is more efficient and it corrects the model only by the necessary amount that is needed to remove the within-cross section (or within-period) correlation between the residuals. Based on the results of Redundant and Hausman tests, the cross-section fixed effects are the most appropriate model for our data set. However, as mentioned earlier, the fixed effects model removes the unobserved effects and we therefore do not have coefficients for the company-specific effects that are time independent. To estimate the company-specific effects, we have also employed a LSDV model.

To choose between LSDV entity-(company) fixed effects model, and LSDV time-fixed effects model, we run a F-test for individual effects. The F-test (Appendix B-4.4) which the null is that no time-fixed effects needed, examines for the necessity of time-fixed effects. Even though the P-value (0.0000) of F-test indicates that the time-fixed effects is more suited in our study, we choose to analysis the results of both entity fixed effects and time-fixed effects. This is because we have the cross-sectional (companies) dimension, that is more significant than the period dimension in our sample since there are 34 companies (cross-section units) and only five years (periods). Our model, a two way least square dummy variable is shown as followed:

$$y_{it} = \beta_1 Beta_{it} + \beta_2 Ln\ size_{it} + \beta_3 Leverage_{it} + \beta_4 PE_{it} + \beta_5 CFS_{it} + \beta_6 BM_{it} + \delta_1 D_{2011} + D_{2012} + \delta_3 D_{2013} + \delta_4 D_{2014} + \delta_5 D_{2015} + \mu_1 D_{company1} + \ldots + \mu_{34} D_{company34} + u_{it} \quad 5.2$$

Where y_{it} is the average annual stock returns of renewable energy company i, and year t. (i = 1, ..., 34; t = 2011, ..., 2015). The explanatory variables are the same as discussed earlier. δ_t is a time-varying intercept that captures all the variables that affect $y_{it}$and that vary over time but are constant cross-sectional. D_t, denotes a dummy variable that takes the value 1 for the first period and zero elsewhere, and so on. μ_i individual specific effects of company *i*, that capture all the variables that affect $y_{it}$and vary cross-sectional but are constant over time. D_i, denotes a dummy variable that takes the value 1 for the first company and zero elsewhere, and so on. The intercept term (α) is removed from this equation to avoid the dummy variable trap, where we have perfect multicollinearity between the dummy variables and the intercept.

Considering the above we continue our analysis by examining how the firm-specific variables affect the financial performance of renewable energy companies based on the sector they operate in. This is to get a better idea on how different variables affect different renewable energy sector.

5.4 Analysis of the LSDV Model

The division of our sample companies into sectors are shown in Appendix C-1. The companies as mentioned earlier are divided into companies operating in the solar, energy technology, wind, bioenergy and geothermal sector. The LSDV results that are illustrated in Appendices C-2 to C-6, represent the coefficients that are significant at 5% level of significance. This choice was made to avoid clutter in the tables representing the results. Our results show that, while there is some relation between firm-specific factors that we included in our model and renewable energy companies' financial performance, not all of the firm-specific factors show continuous impact on renewable energy companies' financial performance.

According to the results in Appendix C-2, the cross-section average returns of renewable energy companies operating in the solar sector, appear to be effected mainly by beta (systematic risk) and firm-specific factor, firm size. The other firm-specific factors do not show significant coefficients during the whole period of 2011-2015, to assume they have any role in explaining the cross-sectional average return of the companies in solar sector.

Table C2.1 (Appendix C-2) shows the results from LSDV estimation for beta in the solar sector. The coefficients in the table refer to the effect of each individual company's beta on the company's financial performance, compared to the average impact beta has had that year. The average effect of beta in the solar sector companies' financial performance, in 2011 was 0.2820, but is not significant with 5% level of significance, and one can see from the table C2.1, that not so many companies have had significant coefficient that year, even though the R-squared value (0.3575) that year is higher than the fixed effects model R-squared value. The average beta coefficients in 2012 -2015 are all significant at 5% level of significance. All the companies' beta has a minor influence (the negative coefficients) than the average impact beta has shown in the respective year. R-squared values vary through the period with 2013 having the highest value (0.3934) which is relatively higher than R-squared in fixed effects model. The higher R-squared is caused by the included dummy variables in the model, which explain more of the variation in the financial performance of the renewable energy companies in the solar sector. Although beta shows a continuous effect on most of the companies' financial performance, it shows no influence on Solartron Pcl. financial performance. Table C2.2 (Appendix C-2) illustrates the LSDV results for firm size in the solar sector. The average coefficients of firm size are all significant with 5% level of significance, vary from 0.2557 to 0.3384. The R-squared values have a spread of 0.2328- 0.4272, indicating that 23.28 % to 42.72% of the variation among renewable energy companies' financial performance is explained by the firm size variable in the model, during the period of 2011-2015. Furthermore, the results in table C2.2 show that the company's firm size effect each year, has a negative relation with the average firm size effect of the same year. In 2011, firm size shows an average cross-section risk premium of 25.57% in renewable energy companies, for Advanced Energy Industries Inc, this modification would have been 1.3977 points minor than the average financial performance modification. Tables C2.3 and C2.4 (Appendix C-2) show the results from LSDV estimation for leverage and price to earnings ratio, variable in the solar sector. None of the average coefficients are significantly different from zero with 5% level of significance. Furthermore, these firm-specific variables affect the financial performance of a few of the companies in this sector. While the R-squared values vary during the period, one cannot explain the variation among renewable energy companies' (solar sector) financial performance with firm-specific variables, leverage and price per earnings ratio. Tables C2.5 and C2.6 (Appendix C-2), reflect LSDV results for cash flow per sales and book to market value, variables in the solar sector. Although they show some significant average coefficients with 5% level of significance, and R-squared values that spread from 0.1628 to 0.3863, yet these firm-specific variables have very few significant coefficients and fail to explain the variation among renewable energy companies' (solar sector) financial performance.

The cross-section average returns of renewable energy companies operating in the wind sector (Appendix C-3), appear to be affected mainly by one firm-specific factor, size. It seems that the other firm-specific factors have even a minor role in explaining the cross-sectional average return of the companies in the wind sector than they had in the solar sector.

Table C3.1 (Appendix C-3) shows that the wind sector companies' beta has no significant coefficient, to support their role in explaining the company's financial performance. Table C3.2 (Appendix C-3) illustrates the LSDV results for firm size in the wind sector. The results show that company's firm size effect each year, mostly has a negative relation with the average firm size effect of the same year. EDP Renewables in 2012 has a positive relation with the average firm size effect of 2012. The average cross-section firm size risk premium in 2012 is shown to be 33.56%, and regarding EDP Renewables, this modification would have been 2.73 points more than the average financial performance modification. Vestas Wind, a Danish company stands out in this sector. While firm size shows a continuous effect on the companies' financial performance, it shows no influence on Vestas Wind financial performance. Tables C3.3 to C3.6 (Appendix C-3) show the results from LSDV estimation for leverage, price to earnings ratio, cash flow per sales and book-to-market value variables in wind sector. Common for all these variables are that they only effect the financial performance of one company (Nordex SE) in this sector, and only in 2011.

As shown in Appendix C-4 the cross-section average returns of renewable energy companies operating in the bio-energy sector, are affected mainly by one firm-specific factor, firm size. For two companies, beta has an effect as well. The other firm-specific factors have almost no effect in explaining the cross-sectional average return of the companies in the bio-energy sector. Table C4.1 (Appendix C-4) show that only two companies (Cosan Ltd and Pacific Ethanol) in bio-energy sector have significant beta coefficient. Table C4.2 (Appendix C-4) views the LSDV results for firm size in the bio-energy sector. The results show that company's firm size effect each year, has a negative relation with the average firm size effect of the same year. This is an image that has been repeating itself through the different sectors. Tables C4.3 to C4.6 (Appendix C-4) show the results from LSDV estimation for leverage, price per earnings ratio, cash flow per sales and book-to-market value variables in the bio-energy sector. Common for these variables are, they only effect the financial performance of one company (Pacific Ethanol) in this sector. This is while the significant coefficients, have a negative relation with the average firm-specific variable effect of the same year.

We can see the pattern repeating itself for the energy technology sector (Appendix C-5). While the firm-specific factor, firm size (table C5.2) has the main effect in explaining the cross-section average returns of renewable energy companies operating in the energy technology sector, firm's systematic risk, beta in table C5.1 shows a minor effect as well. However, neither the firm-specific factor, firm size, nor beta explains the cross-section average returns of Tesla Motors and Universal Display corporation. While the other firm-specific factors in tables C5.3 to C5.6 have no effect on the cross-sectional average return of the companies in the energy technology sector, it appears they have some minor role in explaining the cross-sectional average return of Tesla motors.

In our sample, we had only one company that operates in the geothermal power sector. As shown in Appendix C-6, the firm-specific factor firm size is the only factor that explains the cross-sectional average return of the company.

Based on the LSDV results (Appendix C-2 to C-6), the significant beta coefficients are mostly negatively associated with the average significant firm beta of the respected year. As mentioned earlier, the negative sign refers to the minor movements of firm's beta, relative to the average beta of their respective year. From the same results, while firm size is the only firm-specific factor that helps to explain the cross-section of average stock returns throughout the different sectors and during the whole period (2011-2015) of our data set, it generally affects less than the average size effect, of the respected year, through the period. There is no visible pattern between the other firm-specific factors (leverage, price per earnings ratio, cash flow per sales ratio and book to market ratio) in our model and the cross-sectional average returns of renewable energy companies in our sample.

5.5 Limitations

Even though the analysis in general and the model have been constructed as comprehensive as possible, there are some limitations, causing suggestions for further research and improvements to the existing research that has been done in this study.

Primarily, the analysis presented in this paper only covers 34 international renewable companies, for which there was sufficient data on their stocks returns and firm-specific variables. Thus, the results reveal the relation between renewable energy stock returns and chosen firm-specific variables for a fraction of the total operative renewable energy companies in the world. A second limitation experienced in this paper is the short time-span. The five years analysed by the regressions of this paper perhaps could be insufficient to explore the full effect of firm-specific factors on renewable energy stocks. There is a chance that with data set that covers 10 years or more, we would have more findings than we do have in this study.

Both these limitations are results of the young renewable energy industry. Even though the renewable energy resources have always existed over wide geographical areas, the lack of renewable energy technology and information about climate change mitigation, has detained renewable energy deployment. However, this seems to be changing, as renewables are deploying rapidly and are going to play a major role in the energy market in many countries around the world. To encourage investors to invest in renewable energy stocks, and to be able to identify and explain the risks and expectations from investing in renewable energy stocks, more research is needed to identify the factors that drive the risks and return of renewable energy stocks. Identifying these factors and understanding their behaviour would increase the transparency of investing in renewable energy stocks, enhancing the renewable industry and reacting to the needed modification that energy sector demands due to climate change mitigation.

6. Conclusions and Further Research

Renewable energy is clearly becoming a significant part of the world financial portfolio and therefore more research on the behaviour of these markets is needed. Numerous studies have identified important facts about firm-specific factors' effects in different common equity markets, but these facts are a lot less explored for renewable energy markets. This study presents results to fill this gap by considering stock returns for 34 international renewable energy companies, divided in to five sectors of solar, wind, bioenergy, energy technology and geothermal. Using a fixed effects model on a balanced panel data, we examine the relation of the firm-specific variables, firm size, leverage, price per earnings ratio, cash flow per sales ratio, book-to-market value, associated with market beta, within 2011-2015 period sample.

We find that during our sample period only one (firm size) out of five firm-specific variables used in our regression model is significant and positively associated with the cross-sectional average returns of the renewable energy companies. This is confirmed when we use the LSDV model, including the dummy variables to explain more of the unobserved variations of the renewable companies' financial performance. Furthermore, our findings show that market beta, has little explanatory power on the cross-section renewable energy stock returns, both when used as the only explanatory variable, and when included in a model with the chosen firm-specific variables, it fails to explain the stock returns of renewable energy.

We trace that financial leverage has no systematic impact on renewable energy company stock returns. Moreover, our results are not in range with the findings of other empirical studies performed on common stocks, regarding valuation factors (book-to-market value ratio, price per earnings ratio) and profitability factor (cash flow per sales). This could indicate that the renewable energy company stocks, have distinct characteristics, leading them to react differently than common stocks.

While investors care about many factors (macroeconomic and firm-specific), and make their investment decisions accordingly, it seems that renewable energy stocks dependency drivers, go beyond just macro - and micro factors. Due to the young age of this market, any future research would be supportive to provide more information on the risk and rewards of investments on renewable energy stocks. For further research, it would be interesting to concentrate on one country and one sector, to exploit the information embedded in the cross-sectional variation in the firm size factor across different companies and understand, how the size effect is on average more pronounced in developed markets than in renewable energy markets. Another interesting angle for future research could be to concentrate on one country and incorporate variables that reflect the legal and taxation traditions of that country, in the regression model. This would be a valuable contribution to the literature, since it seems that renewable energy stocks are reliant on more than macro- and micro factors.

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Appendix A

In this section, all companies included in this study are represented. Appendix A-1 lists the company's name, and is followed by Appendix A-2 which gives an overview over the renewable energy companies in the Global Alternative Energy Indices. A short company description for each company can be found in Appendix A-3. The tables and figures are concatenated using information from Morningstar and company's webpage.

Appendix A-1 List of all the companies

TABLE A1.1: LIST OF ALL THE COMPANIES IN OUR DATA SAMPLE, WITH THEIR OPERATIVE SECTOR AND COUNTRY OF ORIGIN.

Companies	Sectors	Ticker	Country
Advanced Energy Industries Inc	Solar Power	AEIS(NASDAQ)	USA
Ballard Power Systems Inc	Energy technology	BLD/TSX) BLDP(NASDAQ)	Canada
Canadian Solar Inc	Solar power	CSIQ(NASDAQ)	Canada
Cosan Ltd	Bioenergy	CZZ (NYSE)	Brazil
Daqo New Energy Corporation	Solar power	DQ(NYSE)	China
EDP Renewables	Solar power/ Wind Power	EDPR(ELI)	Spain
EnergieKontor	WindPower	EKT(ETR)	Germany
EnerNoc	Energy Intelligence Software	ENOC(NASDAQ)	USA
First Solar	Solar Power	FSLR(NASDAQ)	USA
Green Plains Renewable Energy	Bioenergy	GPRE(NASDAQ)	USA
Hanwha Q Cells Co. Ltd.	Solar Power	00880(KRX)	South Korea
Hexcel	WindPower	HXL(NYSE)	USA
Itron	Hydropower	ITRI(NASDAQ)	USA
JA Solar Holdings Corporation Ltd	Solar Power	JASO(NASDAQ)	China
JinkoSolar	Solar Power	JKS (NYSE)	China
Maxwell Tehnologies	Energy technology	MXWL(NASDAQ)	USA
Nordex SE	Windpower	NDX1(ETR)	Germany
Novozymes A/S	Bioenergy	NZYM-B(CPH)	Denmark
ON Semiconductor	Energy technology	ON(NASDAQ)	USA
Ormat Technologies Inc.	Geothermal power	ORA(NYSE)	USA
Pacific Ethanol	Bioenergy	PEIX (NASDAQ)	USA
Plug Power	Energy technology	PLUG(NASDAQ)	USA
PNE wind AG	WindPower	PNE3(ETR)	Germany
Power Integration	Energy technology	POWI(NASDAQ)	USA
REC Silicon ASA	Solar Power	RNWEF(OTCMKTS)	Norway
Renesola	Solar Power	VQKA(FRA)	China
Solartron Pcl.	Solar Power	SOLAR(BKK)	Thailand
Terna Energy	Windpower	TENERGY(ATHEX)	Greek
Tesla Motors	Energy technology	TSLA(NASDAQ)	USA
Trina Solar	Solar Power	TSL(NYSE)	China
Universal Display Corporation	Energy technology	OLED(NASDAQ)	USA
Veeco Instruments	Energy technology	VECO(NASDAQ)	USA
Vestas Wind	WindPower	VWS(NASDAQ COPENHAGEN)	Denmark
Yingli Green Energy Holding Company Ltd	Solar Power	YGE(NYSE)	China

Appendix A-2 Companies distribution in Global Alternative Energy Indices

TABLE A2.1: COMPANIES DISTRIBUTION IN GLOBAL ALTERNATIVE ENERGY INDICES

	RENIXX	ALTEX	AGIGL	CSAE	DAX	ICLN	NEX	WAEX
Advanced Energy			x				x	
Ballard Power	x		x				x	
Canadian Solar	x		x				x	
Cosan			x					
Daqo New Energy Corporation			x					
EDP Renewables	x		x	x			x	
EnergieKontor			x					
EnerNoc			x				x	
First Solar	x	x	x	x	x	x	x	x
Green Plains Inc.			x				x	
HANWHA			x					
Hexcel								
Itron		x	x				x	
JA Solar	x		x				x	
JinkoSolar	x		x					
Maxwell Tehnologies			x				x	
Nordex SE	x		x				x	
Novozymes					x		x	
ON Semiconductor								x
Ormat Technologies Inc.	x		x				x	
Pacific Ethanol			x					
Plug Power	x		x				x	
PNE Wind AG			x					
Power Integration		x	x				x	
REC Silicon ASA	x		x					
Renesola			x					
Solartron Pcl.			x					
Terna Energy			x					
Tesla Motors	x	x	x				x	
Trina Solar			x					
Universal Display Corporation							x	
Veeco			x				x	x
Vestas Wind	x	x	x		x	x	x	
Yingli Green Energy	x		x					

Overview over the renewable energy companies in the Global Alternative Energy Indices. The eight indices: RENIXX World (RENIXX), ALTEX Global (ALTEX), Ardour Global Alternative Energy Index (AGIGL), Credit Suisse Global Alternative Energy Index(CSAE), DAX Global Alternative Energy Index (DAX), S&P Global Clean Energy Index (ICLN), Wilderhill New Energy Global Innovation Index (NEX) and World Alternative Energy Index (WAEX).[3]

[3] Information about the different indices: http://www.ialtenergy.com/alternative-energy-index.html

Appendix A-3 Company descriptions[4]

Advanced Energy Industries Inc.

An American company, established in 1981, develops power and control technologies for the manufacture of semiconductors, flat panel displays, data storage products, solar cells and architectural glass.

Ballard Power Systems Inc.

Is recognized as a world leader in proton exchange membrane ("PEM") fuel cell development and commercialization. Protonex is a leading provider of advanced fuel cell power solutions for portable, remote and mobile applications in the 100 to 1,000-watt range. Based on patented proton exchange membrane (PEM) and solid oxide fuel cell (SOFC) technologies, these power systems are among the industry's smallest, lightest and highest performing fuel cell systems for portable applications.

Canadian Solar Inc

Operates as a global energy provider with business subsidiaries in 20 countries on 6 continents. Besides serving as a manufacturer of solar PV modules and provider of solar energy solutions, Canadian Solar has a geographically diversified pipeline of utility-scale power projects. With the company's recent acquisition of Recurrent Energy, Canadian Solar's total project pipeline is now 9 GW, including an increase in the late-stage project pipeline to 2.4 GW. Including two state-of-the-art manufacturing facilities in Ontario, Canadian Solar employs over 7,500 workers worldwide. This translates into more than 12 GW of panel shipments, or 30 million PV modules, in the past 14 years.

Cosan Ltd.

A public listed company, a Brazilian conglomerate producer of bioethanol, sugar, energy and foods. The company operates in Brazil, Uruguay, Paraguay, Bolivia and United Kingdom.

[4] The descriptions are taken from the companies' websites.

Daqo New Energy Corporation

Founded in 2008, Daqo New Energy Corporation, is a leading manufacturer of high-purtiy polysilicon for the global solar industry. As one of the world's lowest cost producers of high-purity polysilicon and solar wafers, the company primarily sells its products to solar cell and solar module manufacturers.

EDP Renewables

A leading renewable energy company registered in Oviedo and headquartered in Madrid that designs, develops, manages and operates power plants that generate electricity using renewable energy sources.

Energie Kontor

A German company that develops, operates and manages wind farms and solar parks.

EnorNoc

Among the largest providers of energy intelligence software and services for commercial, institutional, and industrial customers, as well as electric power grid operators and utilities. It chiefly provides energy intelligence software and services.

First Solar

An American photovoltaic (PV) manufacturer of rigid thin film modules, or solar panels, and a provider of utility-scale PV power plants and supporting services that include finance, construction, maintenance and life panel recycling. Designs and manufactures solar modules using a proprietary thin film semiconductor technology that is one of the lowest cost in the world.

Green Plains Renewable Energy

An American company based in Omaha, Nebraska that was founded in 2004 The company claims to be the fourth largest ethanol fuel producer in North America.

Hanwha Q Cells Co. Ltd.

The world's largest solar cell manufacturer as well as one of the largest photovoltaic module manufacturers. Hanwha Q Cells offers the full spectrum of photovoltaic products, applications and solutions, from modules to kits to systems to large scale solar power plants.

Hexcel

An American company which is a global supplier of advanced materials - Carbon Fibre, Epoxy resins and adhesives, glass, aramid and carbon fabrics, aircraft flooring. A world leader in prepregs and composites for wind turbine blades, Hexcel is also a specialist in fibre reinforcements, laminates, PU foam cores and gel coats for wind energy applications

Itron

An American technology company that offers products and services on energy and water resource management. Its products and services include technology solutions related to smart grid, smart gas and smart water that measure and analyses electricity, gas and water consumption, its products include electricity, gas, water and thermal energy measurement devices and control technology; communications systems; software; as well as managed and consulting services.

JA Solar Holdings Corporation Ltd

A solar development company based in Shanghai. They design, develop, manufacture and sell solar cell and solar module products and are based in the People's Republic of China. The Company is also engaged in the manufacturing and sales of monocrystalline and multi-crystalline solar cells. JA Solar Holdings also sells its products to customers in Germany, Sweden, Spain, South Korea and United States.

Jinko Solar

A Chinese manufacturer of photovoltaics and a developer of solar projects. The company started out as a wafer manufacturer in 2006 and had its IPO in 2010. Jinko Solar has a vertically integrated business model manufacturing wafers, cells and modules. At the end of 2015, the capacities were 3 GW, 2.5 GW and 4.3 GW, respectively.

Maxwell Technologies

Focuses on developing and manufacturing energy storage and power delivery solution-related products for automotive, heavy transportation, renewable energy, backup power, wireless communications and industrial and consumer electronics applications.

Nordex SE

A German company that designs, sells and manufactures wind-turbines. The company's headquarters is in the German city of Rostock while management is situated in Hamburg. Production takes place in Rostock as well as in China and for a brief time in Jonesboro, Arkansas. The company was founded in 1985 in Give, Denmark. Since then the company steadily grew. In 1995 Nordex was the first company to mass-produce a 1 MW turbine.

Novozymes A/S

A global biotechnology company headquartered in Bagsværd outside of Copenhagen. The company has operations in several countries around the world, including China, India, Brazil, Argentina, United Kingdom, the United States and Canada. The company's focus is the research, development and production of industrial enzymes, microorganisms, and biopharmaceutical ingredients. As of 2013, the company holds an estimated 48% of the global enzyme market, making it the world's largest producer of industrial enzymes.

ON semiconductor

A semiconductor supplier company Products include power and signal management, logic, discrete, and custom devices for automotive, communications, computing, consumer, industrial, LED lighting, medical, military/aerospace and power applications.

Ormat Technologies

A provider of alternative and renewable energy technology based in Reno, Nevada. The company built over 150 power plants and installed over 2,000 MW. As of February 2016, Ormat owns and operates 697 MW of geothermal and recovered energy based power plants.

Pacific Ethanol

The leading producer and marketer of low-carbon renewable fuels in the Western United States.

Plug Power

Produces cost-effective hydrogen and fuel cell power solutions that increase productivity, lower operating costs and reduce carbon footprints. Is squarely focused on customer productivity – and providing the power to move businesses into the future with cost-effective hydrogen and fuel cell power solutions that increase productivity, lower operating costs and reduce carbon footprints.

PNE wind AG

A German company based in Cuxhaven. It is developing wind farms on land and at sea (offshore). The business model of PNE Wind AG includes planning, building, financing, operating and selling of wind farms. The company is active in Germany as well as in countries such as Hungary, France, Turkey and USA.

Power Integrations

A Silicon Valley-based supplier of high-performance electronic components used in high-voltage power-conversion systems.

REC Silicon ASA

Former Renewable Energy Corporation ASA, is a Norwegian public renewable energy with headquarters in Sandvika in Bærum. REC Silicon produces solar-grade silicon.

Rene Sola

A leading international manufacturer and supplier of green energy products. Rene sola has offices and warehouses in more than 16 countries, and is well positioned to provide the highest quality green energy products and on-time services for EPC, installers and green energy projects around the world. The company's segments include wafer sales, cell and module sales, and solar power projects.

Solartron Pcl.

Solartron PCL deals with the assembly, installation, selling, and distribution of solar cell systems and associated equipment. The company provides solar power service, equipment and support to nearly all areas of life, whether it be business related or home related.

Terna Energy

The company is a subsidiary of Greek conglomerate GEK Terna, which through its subsidiary Heron S.A. is as well involved in the construction and operation of thermoelectric power generation fuelled with natural gas. Terna Energy however exclusively produces energy from renewable energy sources, including wind farms and small hydroelectric plants. It also constructs renewable energy plants and integrated process units for the overall management and energy utilization of wastes and biomass.

Tesla Motors

An American automaker and energy storage company co-founded based in Palo Alto, California. The company specializes in electric cars and their powertrain components and produces battery charging equipment as well.

Trina Solar

A Chinese company located in the province of Jiangsu, with numerous branches in the USA, Europe and Asia, which is listed on the PPVX solar share index and on the NYSE. Founded in 1997 by Jifan Gao the company develops and produces ingots, wafers, solar cells and solar modules.

Universal Display Corporation

A developer and manufacturer of organic light emitting diodes (OLED) technologies and materials as well as provider of services to the display and lighting industries. It is also an OLED research company.

Veeco Instruments

An American company that process equipment solutions enable the manufacture of LEDs, power electronics, hard drives, MEMS and wireless chips. Veeco is the market leader in MOCVD, MBE, Ion Beam and other advanced thin film process technologies.

Vestas Wind System A/S

A Danish manufacturer, seller, installer, and servicer of wind turbines. It was founded in 1945, and as of 2013, it is the largest wind turbine company in the world. The company operates manufacturing plants in Denmark, Germany, India, Italy, Romania, the United Kingdom, Spain, Sweden, Norway, Australia, China, and the United States

Yingli Green Energy Holding Company Ltd

One of the world's leading solar panel manufacturers. Yingli Green Energy's manufacturing covers the photovoltaic value chain from ingot casting and wayfaring through solar cell production and solar panel assembly. Yingli's photovoltaic module capacity is 4 GW.

Appendix A-3.1 Continent distribution for all companies

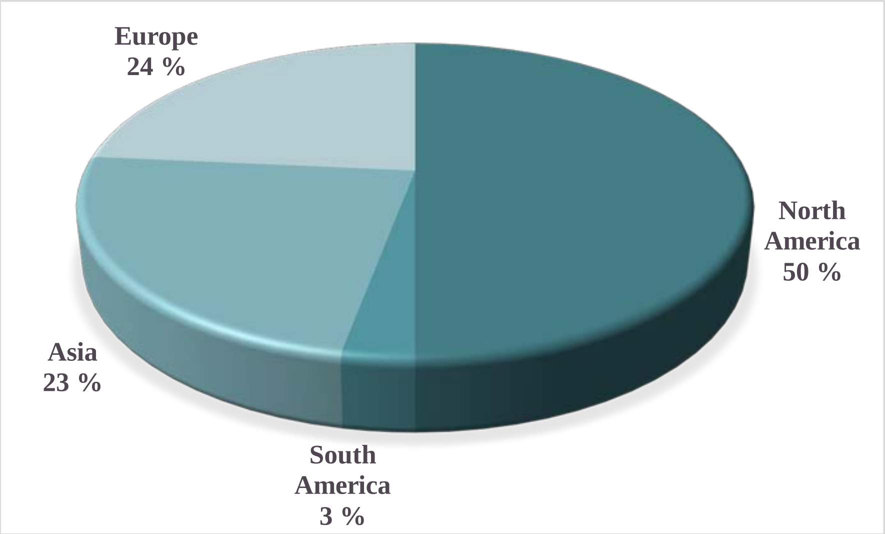


FIGURE A3.1: CONTINENT DISTRIBUTION FOR ALL COMPANIES

The figure illustrates the 34 companies' spread relative to their operative location. Of all the companies in the sample, 50% are in North America, 24% in Europe, 23% is Asia and 3% in South America.

Appendix A-3.2 Sector distribution for all companies

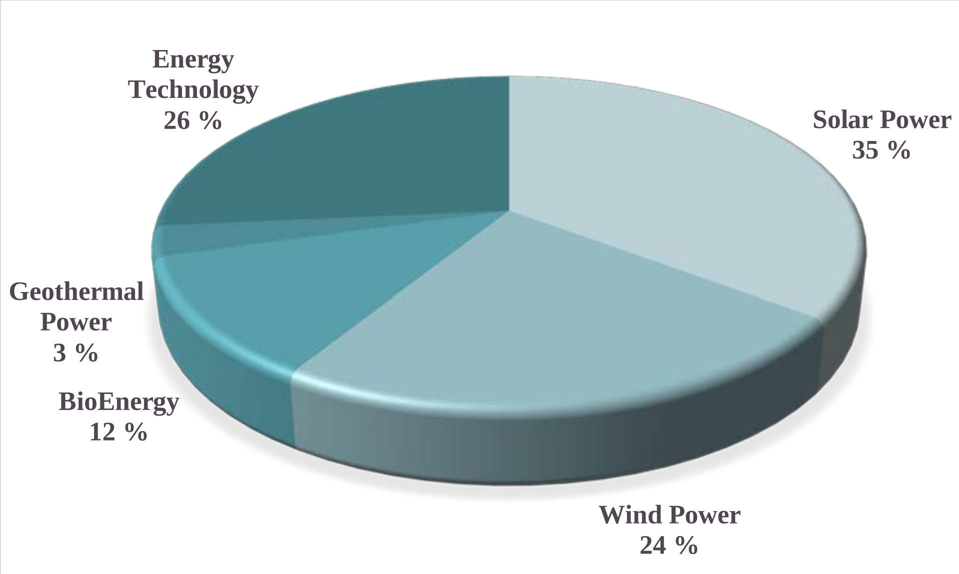


FIGURE A3.1: SECTOR DISTRIBUTION FOR ALL COMPANIES

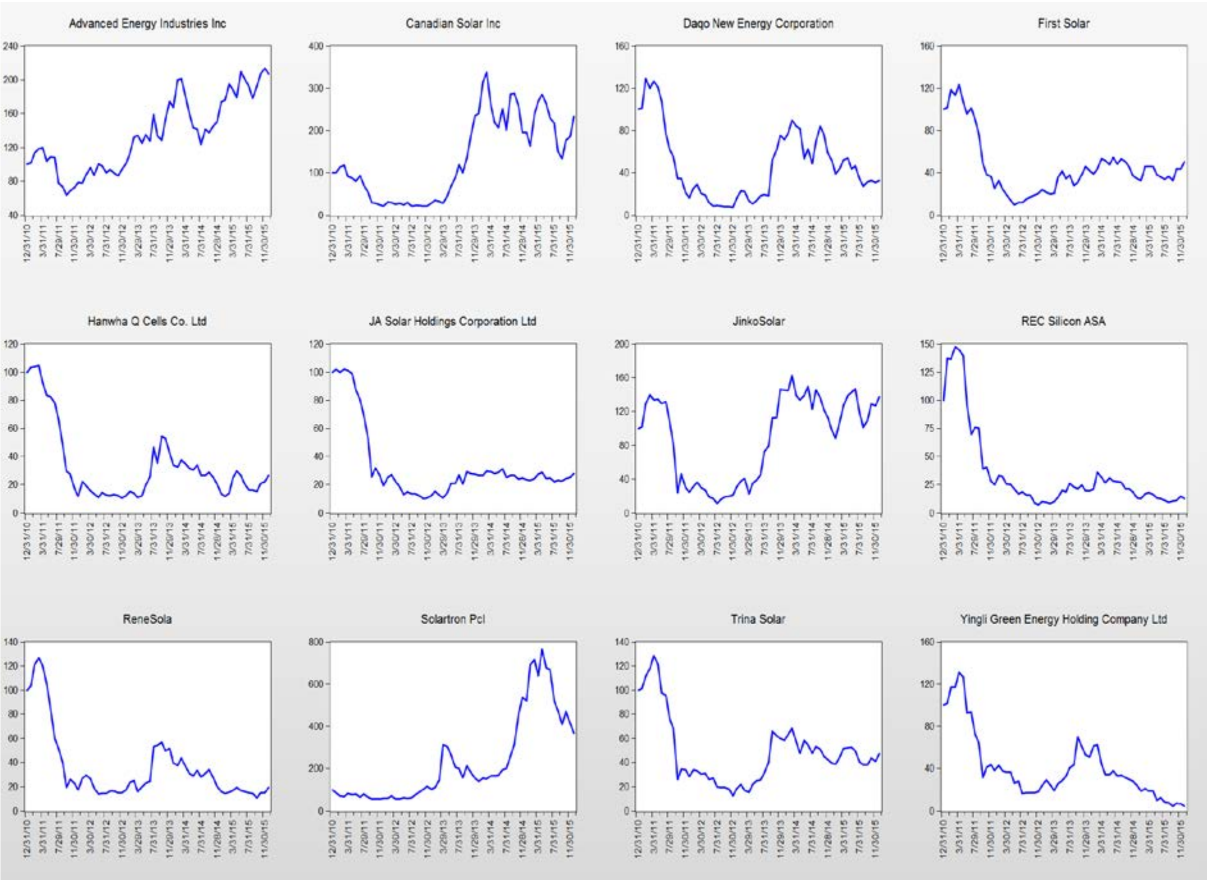
The sample used in this study consists of companies operating in the solar, wind, bioenergy, energy technology and geothermal sector. Of all the companies in the sample, 35 % operate in solar power sector, 26 % in energy technology sector, 24 % in the wind power sector, 12 % in bioenergy sector and 3% in geothermal sector.

Appendix A-4 Price trend graphs

In this section, we view the monthly price trend graphs for the 34 renewable companies in our sample, within the sample period of January 2011- December 2015. We have chosen to show them in their respected operative sector, since the analysis of the study is focused on each sector. The monthly price trends graphs are concatenated using monthly data from Morningstar.

Appendix A-4.1 Solar sector price trend graphs

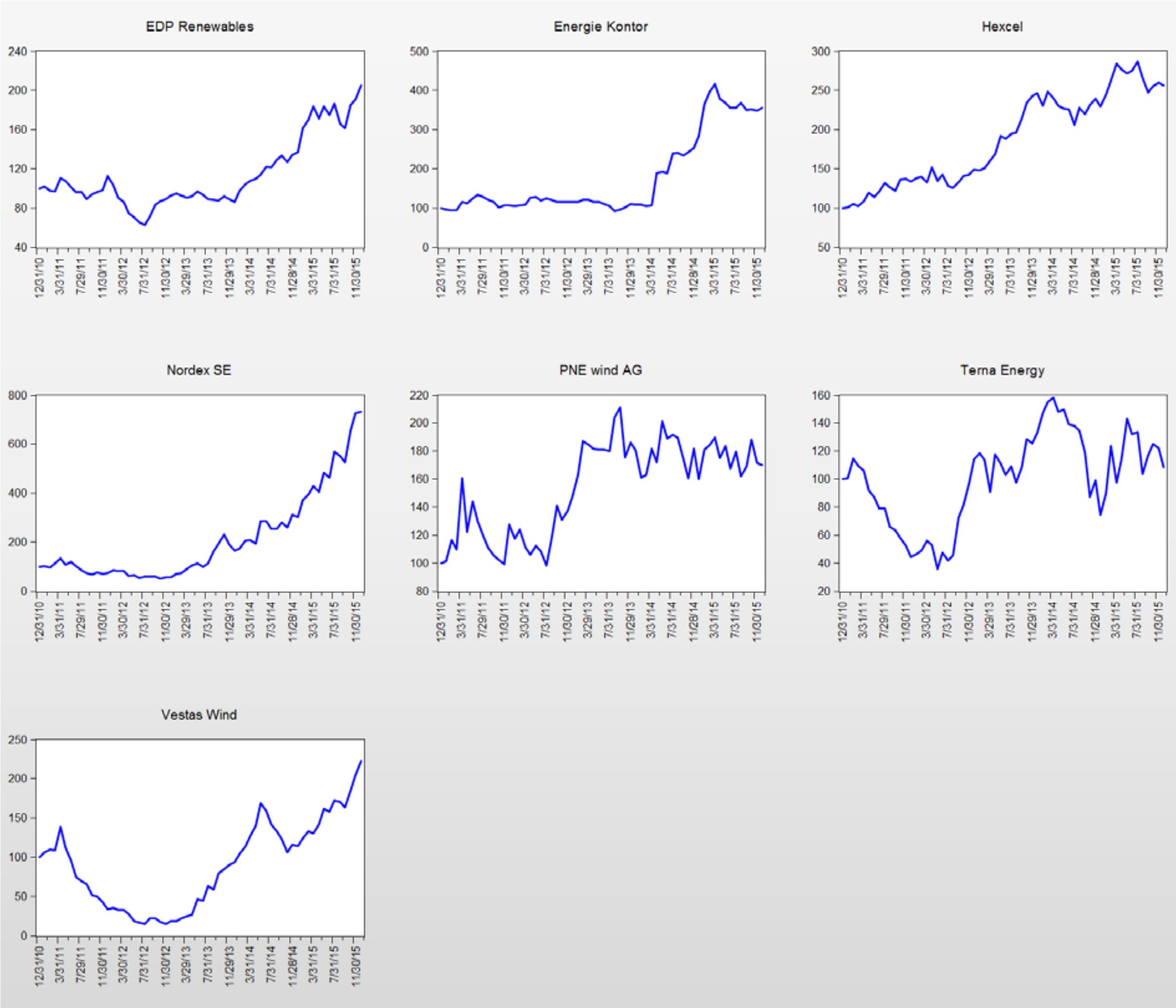
FIGURE A4.1: THE FIGURE SHOWS MONTHLY PRICE TREND GRAPHS FOR COMPANIES OPERATING IN SOLAR SECTOR. For the period of January 2011- December 2015, were the graphs are concatenated using monthly data from Morningstar.



The graphs illustrate the historical monthly price trend of companies (in our data sample) that operate in solar sector, in the period of 2011-2015. All of the price trend begin at US$ 100. The companies origin in USA (Advanced energy industries Inc., First Solar), Canada (Canadian Solar), China (Daqo New Energy Corporation, Ja solar Holdings Corporation Ltd., Jinko Solar, Renesola, RenaSola, Yingli Green Energy Holding Company Ltd.), South Korea (Hanwha Q Cells Co. Ltd.), Thailand (Solatron Pcl) and Norway (Rec Silicon ASA). Advanced energy industries Inc. seems to be the one company that stands out in the solar sector, other seem to have almost the similar trends. The rise and fall of many companies seem to correlate, even though they operate in different contents.

Appendix A-4.2 Wind sector price trend graphs

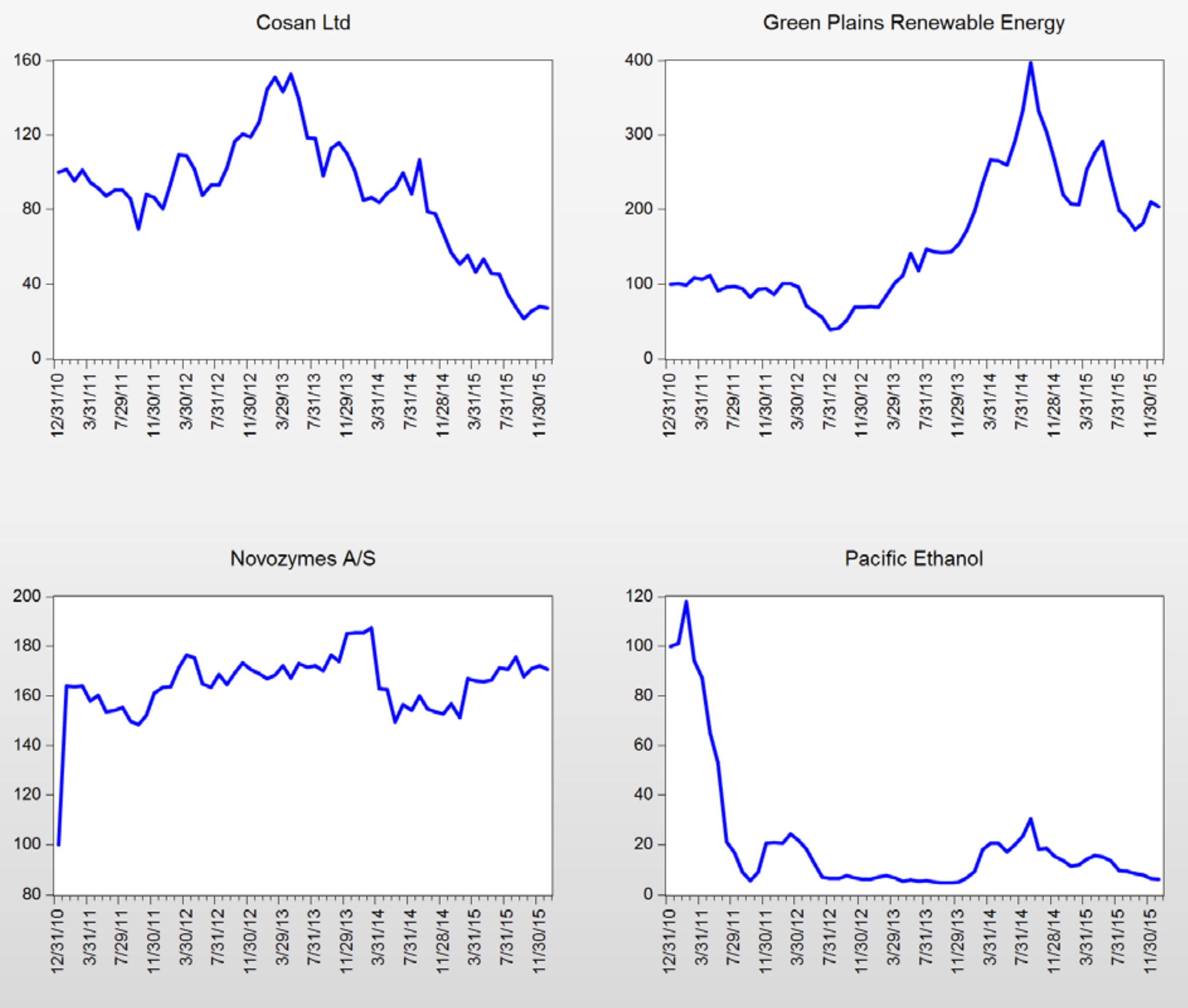
FIGURE A4.2: THE FIGURE SHOWS MONTHLY PRICE TREND GRAPHS FOR COMPANIES OPERATING IN WIND SECTOR. For the period of January 2011- December 2015, were the graphs are concatenated using monthly data from Morningstar.



The figure shows the historical monthly price trend of companies (in our data sample) that operate in wind sector, in the period of 2011-2015. All of the price trend begin at US$ 100. The companies origin in Denmark (Vestas wind), Greek (Terna energy), Spain (EDP renewables), Germany (Energie Kontor, Nordex SE, PNE wind AG) and USA (Hexcel). There is no obvious correlation between the price trends in this sector, other than all of the stock prices have raised above starting price, even after the fall during 2012.

Appendix A-4.3 Bio-energy sector price graphs

FIGURE A4.3: THE FIGURE SHOWS MONTHLY PRICE TREND GRAPHS FOR COMPANIES OPERATING IN BIOENERGY SECTOR
For the period of January 2011- December 2015, were the graphs are concatenated using monthly data from Morningstar.

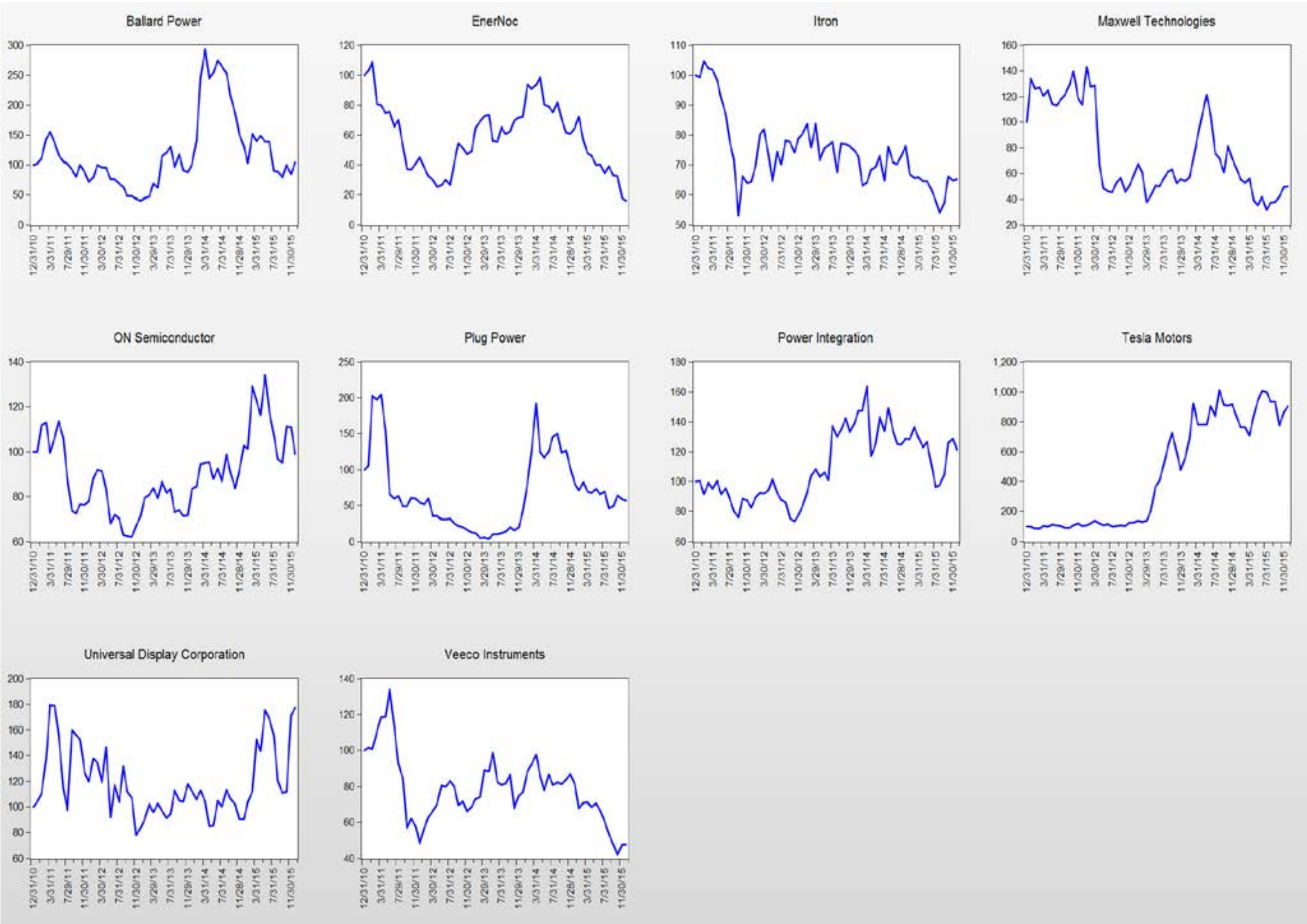


The graphs view the historical monthly price trend of companies (in our data sample) that operate in Bio energy sector, in the period of 2011-2015. All of the price trend begin at US$ 100. The companies origin in Brasil (Cosan Ltd.) Denmark (Novozymes A/S), USA (Green Plains renewable energy, Pacific ethanol). No correlation between the historical price trends can be spotted in this sector.

Appendix A-4.4 Energy Technology sector price trend graphs

FIGURE A4.4: THE FIGURE SHOWS MONTHLY PRICE TREND GRAPHS FOR COMPANIES OPERATING IN ENERGY TECHNOLOGY SECTOR.

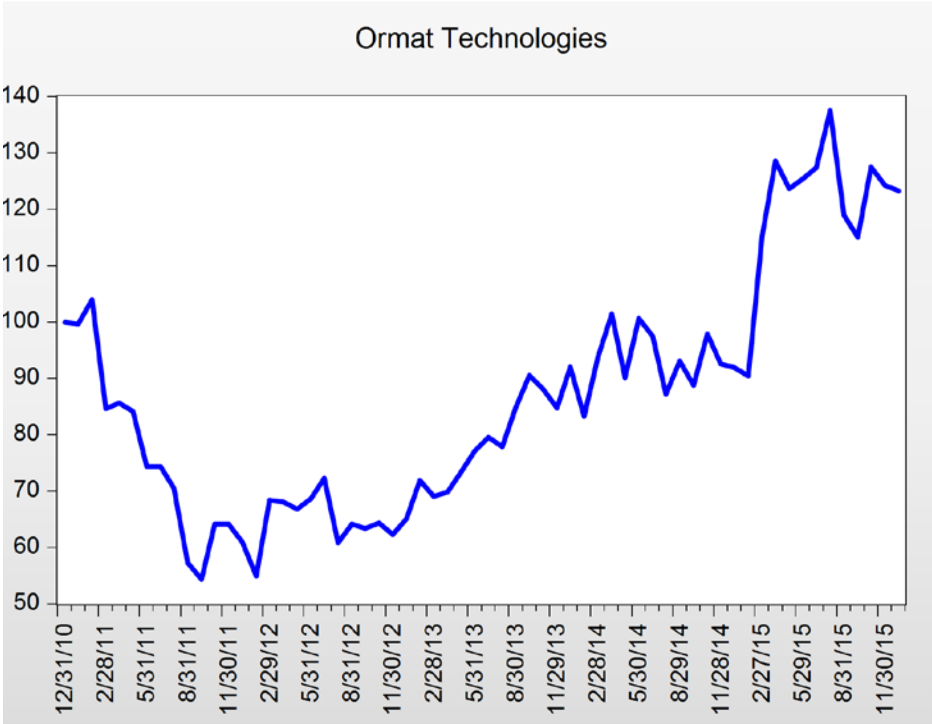
For the period of January 2011- December 2015, were the graphs are concatenated using monthly data from Morningstar.



The graphs show the historical monthly price trend of companies (in our data sample) that operate in energy technology sector, in the period of 2011-2015. All of the price trends begin at USD 100. The companies origin in Canada (Ballard Power) and USA. It seems that most of the histrical prices movments are correlated.

Appendix A-4.5 Geothermal Power sector price trend graph

FIGURE A4.5: THE FIGURE SHOWS MONTHLY PRICE TREND GRAPHS FOR COMPANIES OPERATING IN ENERGY TECHNOLOGY SECTOR.
For the period of January 2011- December 2015, were the graphs are concatenated using monthly data from Morningstar.



The graph show the historical monthly price trend of the company (in our data sample) that operate in geothermal power sector, in the period of 2011-2015. Ormat Technologies is an American company.

Appendix A-5 Overview of the annual beta (explanatory variable)

TABLE A5.1: OVERVIEW OF THE ANNUAL MARKET BETA (EXPLANATORY VARIABLE).

For the period from January 2011 - December 2015, the market betas are calculated using daily logarithmic stock returns (for each year) of the renewable company, and the daily logarithmic stock returns of S&P 1200 global. The source of data for the daily stock prices is Morningstar.

Company/Year	2011	t-stat	2012	t-stat	2013	t-stat	2014	t-stat	2015	t-stat
Advanced Energy Industries Inc	1,56	13,65	1,31	9,17	1,44	5,80	1,86	6,77	1,25	10,79
Ballard Power Systems Inc	1,10	7,33	0,86	3,34	1,94	3,31	2,33	3,50	1,42	3,99
Canadian Solar Inc	2,22	11,42	1,65	4,88	2,41	4,64	3,05	7,05	2,29	9,37
Cosan Ltd	1,29	14,71	1,05	8,60	1,34	8,70	1,98	7,83	2,07	10,47
Daqo New Energy Corporation	1,85	8,95	0,66	1,56	2,95	3,76	2,61	5,23	2,05	6,03
EDP Renewables	0,24	2,85	0,55	3,29	0,61	4,15	1,05	6,55	0,99	7,34
EnergieKontor	-0,42	-3,34	-0,42	-2,70	0,09	0,55	0,18	0,50	0,42	2,41
EnerNoc	1,33	6,51	1,43	5,43	1,56	5,29	1,69	6,26	0,87	2,23
First Solar	1,61	9,69	2,09	6,02	1,78	4,35	2,09	7,16	1,67	9,35
Green Plains Renewable Energy	1,25	13,62	1,39	5,42	1,32	4,77	1,92	6,66	1,58	7,00
Hanwha Q Cells Co. Ltd.	2,42	11,16	1,29	3,39	1,82	3,10	2,06	4,48	1,91	4,73
Hexcel	1,56	20,08	1,25	11,75	1,27	10,77	1,41	11,37	1,10	11,95
Itron	1,30	13,57	1,19	7,42	1,12	7,69	1,15	5,40	1,01	9,31
JA Solar Holdings Corporation Ltd	1,88	9,10	1,74	4,60	2,96	5,41	2,28	6,35	1,35	7,44
JinkoSolar	1,93	8,51	1,53	3,66	2,68	4,68	3,76	9,40	2,74	11,74
Maxwell Tehnologies	1,31	10,82	1,59	4,87	1,80	5,29	2,72	6,10	1,54	6,19
Nordex SE	0,17	0,93	0,19	0,82	0,79	2,05	2,13	6,31	1,28	7,19
Novozymes A/S	0,01	0,06	0,09	0,71	-0,07	-0,47	0,53	3,52	0,99	8,22
ON Semiconductor	1,50	13,24	1,46	10,30	1,16	6,85	1,85	10,45	1,33	8,13
Ormat Technologies Inc.	1,37	13,70	1,00	7,07	1,17	7,87	0,83	4,96	0,87	7,19
Pacific Ethanol	0,75	2,20	1,21	2,20	1,50	3,38	3,30	5,73	1,91	6,13
Plug Power	1,60	6,79	0,12	0,43	0,65	0,61	1,46	1,64	1,47	5,23
PNE wind AG	0,51	3,03	-0,62	-2,85	0,21	0,70	0,70	2,54	0,24	1,43
Power Integration	1,25	13,39	1,08	7,21	1,36	6,95	1,86	7,30	0,95	7,74
REC Silicon ASA	-0,19	-0,81	-0,03	-0,07	0,39	0,70	1,08	2,40	1,17	3,63
Renesola	2,09	10,03	1,66	4,05	2,12	3,70	2,81	6,35	1,66	5,73
Solartron Pcl.	-0,01	-0,04	0,17	0,34	0,29	0,50	0,32	0,69	0,46	1,46
Terna Energy	0,02	0,16	0,01	0,02	0,32	0,88	0,46	1,34	0,77	2,89
Tesla Motors	1,29	10,38	1,53	6,32	0,94	2,25	1,98	6,61	1,29	7,98
Trina Solar	2,01	9,80	1,79	4,61	2,52	5,06	2,83	6,44	1,90	9,17
Universal Display Corporation	1,86	8,83	2,02	7,56	1,91	5,55	1,68	6,02	1,11	5,57
Veeco Instruments	1,37	10,87	1,88	9,14	1,40	5,90	1,65	6,93	0,99	7,13
Vestas Wind	1,73	11,44	1,82	5,23	2,26	7,25	2,42	9,05	1,04	7,54
Yingli Green Energy Holding Company	1,92	10,36	2,00	5,57	2,69	5,29	2,32	5,25	2,07	4,33

Annual beta was included in our model as the factor that captures the market risk, which cannot be explained by variation in the global market for the equities in our data set. The annual Beta of the companies which are calculated from the daily logarithmic stock returns, have a spread from -0,62 to 3.76. The negative betas of EnergieKontor and REC Silicon ASA are not significantly different from zero, at a 5% significance level, due to their t-stat. This means that in the period that these company show negative/ zero betas, their stocks moved in the opposite direction to the overall market (here S& P 1200 Global), or the stocks had no volatility at all (like cash). Beta behaves differently across different industries, sectors and all from firm-specific announcements, different financial management activities and strategies as well as changes in the overall market can influence beta variations.

Appendix B

Appendix B-1 Descriptive statistics for companies

In this section, daily, weekly and monthly descriptive statistics on returns for each company in our data sample is presented in an alphabetical order. The daily, weekly and monthly descriptive statistics are for the period of January 2011- December 2015, and concatenated using daily, weekly and monthly data, respectively from Morningstar. The daily average returns have a spread of -0.24% to 0.17%, with an average standard deviation of 4%. The weekly average returns vary from -1.12 % to 0.83% with an average standard deviation of 8%. The monthly average returns fluctuate between -5.50% to 3.60% with an average standard deviation of 17%.

Advanced Energy Industries Inc.

	Daily	Weekly	Monthly
Average	0,06 %	0,28 %	1,19 %
Median	0,00 %	0,07 %	1,42 %
Min.	-23,74 %	-20,35 %	-33,22 %
Max.	22,92 %	18,20 %	21,84 %
Number of obs.	1284	260	61
Std. Dev.	2,56 %	5,31 %	10,24 %
Excess kurtosis	12,28	2,19	0,84
Skewness	-0,02	-0,12	-0,50

Ballard Power Systems Inc

	Daily	Weekly	Monthly
Average	0,00 %	-0,04 %	0,06 %
Median	0,00 %	-1,06 %	-3,46 %
Min.	-29,94 %	-27,85 %	-43,71 %
Max.	47,22 %	49,64 %	60,91 %
Number of obs.	1284	260	61
Std. Dev.	4,94 %	10,35 %	20,03 %
Excess kurtosis	17,28	4,39	1,16
Skewness	1,79	1,19	0,86

Canadian Solar Inc

	Daily	Weekly	Monthly
Average	0,07 %	0,33 %	1,39 %
Median	0,00 %	0,67 %	0,00 %
Min.	-20,07 %	-35,20 %	-60,51 %
Max.	28,88 %	28,89 %	48,68 %
Number of obs.	1284	260	61
Std. Dev.	4,68 %	9,74 %	22,16 %
Excess kurtosis	3,33	0,66	-0,20
Skewness	0,28	-0,18	-0,01

Cosan Ltd

	Daily	Weekly	Monthly
Average	-0,10 %	-0,51 %	-2,14 %
Median	0,00 %	-0,12 %	-1,29 %
Min.	-14,38 %	-19,78 %	-29,83 %
Max.	8,59 %	18,44 %	23,68 %
Number of obs.	1284	260	61
Std. Dev.	2,43 %	5,41 %	12,15 %
Excess kurtosis	2,62	0,90	-0,39
Skewness	-0,50	-0,27	-0,21

Daqo New Energy Corporation

	Daily	Weekly	Monthly
Average	-0,09 %	-0,41 %	-1,83 %
Median	0,00 %	-0,65 %	-3,40 %
Min.	-26,46 %	-47,50 %	-49,78 %
Max.	47,70 %	56,98 %	104,24 %
Number of obs.	1284	260	61
Std. Dev.	5,76 %	12,89 %	27,88 %
Excess kurtosis	6,01	1,99	2,89
Skewness	0,76	0,27	1,01

EDP Renewables

	Daily	Weekly	Monthly
Average	0,05 %	0,26 %	1,18 %
Median	0,01 %	0,33 %	1,99 %
Min.	-7,24 %	-16,66 %	-13,93 %
Max.	7,42 %	9,41 %	16,29 %
Number of obs.	1284	260	61
Std. Dev.	1,84 %	4,13 %	6,92 %
Excess kurtosis	1,44	0,78	-0,20
Skewness	-0,11	-0,38	0,12

EnergieKontor

	Daily	Weekly	Monthly
Average	0,10 %	0,51 %	2,08 %
Median	0,03 %	0,10 %	0,30 %
Min.	-11,44 %	-14,22 %	-13,53 %
Max.	34,36 %	44,00 %	57,57 %
Number of obs.	1284	260	61
Std. Dev.	2,49 %	4,93 %	10,25 %
Excess kurtosis	31,51	24,19	14,03
Skewness	2,21	2,99	3,04

EnerNoc

	Daily	Weekly	Monthly
Average	-0,14 %	-0,69 %	-2,99 %
Median	-0,09 %	-0,25 %	-0,90 %
Min.	-48,81 %	-51,17 %	-61,00 %
Max.	22,70 %	33,13 %	44,26 %
Number of obs.	1284	260	61
Std. Dev.	3,98 %	8,41 %	16,54 %
Excess kurtosis	27,07	6,92	2,25
Skewness	-1,63	-1,10	-0,35

First Solar

	Daily	Weekly	Monthly
Average	-0,05 %	-0,26 %	-1,11 %
Median	0,00 %	-0,34 %	-3,35 %
Min.	-29,21 %	-35,85 %	-45,85 %
Max.	37,52 %	33,90 %	54,64 %
Number of obs.	1284	260	61
Std. Dev.	3,84 %	8,53 %	18,70 %
Excess kurtosis	13,18	2,54	0,49
Skewness	0,38	-0,01	0,11

Green Plains Renewable Energy

	Daily	Weekly	Monthly
Average	0,05 %	0,26 %	1,16 %
Median	0,00 %	0,63 %	0,44 %
Min.	-13,94 %	-25,90 %	-34,03 %
Max.	24,84 %	27,89 %	27,70 %
Number of obs.	1284	260	61
Std. Dev.	3,03 %	6,52 %	13,52 %
Excess kurtosis	5,74	2,10	-0,13
Skewness	0,26	-0,28	-0,29

Hanwha Q Cells Co. Ltd.

	Daily	Weekly	Monthly
Average	-0,11 %	-0,29 %	-2,16 %
Median	-0,15 %	-0,92 %	-5,34 %
Min.	-25,37 %	-28,51 %	-48,65 %
Max.	31,33 %	41,44 %	61,05 %
Number of obs.	1284	260	61
Std. Dev.	5,35 %	10,84 %	24,30 %
Excess kurtosis	4,08	1,63	0,72
Skewness	0,59	0,57	0,76

Hexcel

	Daily	Weekly	Monthly
Average	0,07 %	0,37 %	1,55 %
Median	0,05 %	0,45 %	1,65 %
Min.	-13,64 %	-14,49 %	-11,60 %
Max.	9,13 %	11,51 %	13,13 %
Number of obs.	1284	260	61
Std. Dev.	1,81 %	3,91 %	5,76 %
Excess kurtosis	5,64	1,08	-0,52
Skewness	-0,30	-0,28	-0,14

Itron

	Daily	Weekly	Monthly
Average	-0,03 %	-0,16 %	-0,70 %
Median	0,00 %	-0,13 %	-0,53 %
Min.	-15,27 %	-18,23 %	-30,00 %
Max.	18,44 %	16,75 %	22,08 %
Number of obs.	1284	260	61
Std. Dev.	2,10 %	4,54 %	8,95 %
Excess kurtosis	11,18	1,79	1,23
Skewness	-0,06	-0,17	-0,22

JA Solar Holdings Corporation Ltd

	Daily	Weekly	Monthly
Average	-0,10 %	-0,49 %	-2,08 %
Median	0,00 %	-0,46 %	-0,88 %
Min.	-18,73 %	-37,89 %	-72,08 %
Max.	53,30 %	35,86 %	37,59 %
Number of obs.	1284	260	61
Std. Dev.	4,56 %	8,81 %	18,21 %
Excess kurtosis	17,36	2,52	2,88
Skewness	1,60	0,08	-0,65

JinkoSolar

	Daily	Weekly	Monthly
Average	0,02 %	0,14 %	0,52 %
Median	0,00 %	0,41 %	2,57 %
Min.	-32,99 %	-40,16 %	-121,69 %
Max.	27,80 %	37,70 %	64,36 %
Number of obs.	1284	260	61
Std. Dev.	5,07 %	11,30 %	27,10 %
Excess kurtosis	2,99	0,77	6,25
Skewness	0,08	0,04	-1,42

Maxwell Technologies

	Daily	Weekly	Monthly
Average	-0,08 %	-0,37 %	-1,14 %
Median	0,00 %	-0,50 %	1,13 %
Min.	-49,82 %	-53,73 %	-65,62 %
Max.	20,55 %	38,77 %	29,26 %
Number of obs.	1284	260	61
Std. Dev.	3,83 %	8,44 %	18,09 %
Excess kurtosis	25,32	7,21	2,04
Skewness	-1,51	-0,47	-1,09

Nordex SE

	Daily	Weekly	Monthly
Average	0,15 %	0,76 %	3,27 %
Median	0,01 %	0,47 %	1,55 %
Min.	-25,67 %	-18,43 %	-24,23 %
Max.	22,08 %	21,19 %	39,55 %
Number of obs.	1284	260	61
Std. Dev.	3,40 %	6,88 %	14,02 %
Excess kurtosis	6,33	0,16	-0,25
Skewness	0,06	-0,05	0,22

Novozymes A/S

	Daily	Weekly	Monthly
Average	0,04 %	0,21 %	0,88 %
Median	0,00 %	0,14 %	0,12 %
Min.	-13,46 %	-14,01 %	-14,01 %
Max.	9,08 %	11,86 %	49,42 %
Number of obs.	1284	260	61
Std. Dev.	1,77 %	3,41 %	7,24 %
Excess kurtosis	5,11	1,89	34,57
Skewness	0,06	-0,11	5,01

ON Semiconductor

	Daily	Weekly	Monthly
Average	0,00 %	0,01 %	-0,01 %
Median	0,00 %	-0,10 %	-0,10 %
Min.	-16,85 %	-21,64 %	-20,34 %
Max.	10,35 %	17,26 %	24,19 %
Number of obs.	1284	260	61
Std. Dev.	2,35 %	5,39 %	9,15 %
Excess kurtosis	4,44	1,83	-0,07
Skewness	-0,39	-0,37	0,05

Ormat Technologies Inc.

	Daily	Weekly	Monthly
Average	0,02 %	0,09 %	0,34 %
Median	0,00 %	-0,05 %	-0,37 %
Min.	-15,19 %	-20,70 %	-20,70 %
Max.	11,16 %	12,74 %	24,28 %
Number of obs.	1284	260	61
Std. Dev.	2,02 %	4,22 %	8,90 %
Excess kurtosis	6,39	2,51	0,75
Skewness	-0,14	-0,38	0,04

Pacific Ethanol

	Daily	Weekly	Monthly
Average	-0,22 %	-1,07 %	-4,53 %
Median	-0,11 %	-1,15 %	-4,30 %
Min.	-41,49 %	-52,88 %	-90,94 %
Max.	50,35 %	49,80 %	82,53 %
Number of obs.	1284	260	61
Std. Dev.	5,94 %	12,52 %	27,55 %
Excess kurtosis	10,34	2,96	2,61
Skewness	0,70	-0,02	0,05

Plug Power

	Daily	Weekly	Monthly
Average	-0,05 %	-0,20 %	-0,93 %
Median	0,00 %	-0,75 %	-1,34 %
Min.	-73,40 %	-104,98 %	-97,34 %
Max.	47,47 %	102,38 %	86,50 %
Number of obs.	1284	260	61
Std. Dev.	6,90 %	15,53 %	31,77 %
Excess kurtosis	19,50	15,87	2,13
Skewness	-0,37	0,20	0,05

PNE wind AG

	Daily	Weekly	Monthly
Average	0,04 %	0,20 %	0,87 %
Median	-0,01 %	-0,03 %	-0,71 %
Min.	-24,25 %	-33,01 %	-27,18 %
Max.	20,40 %	26,71 %	38,00 %
Number of obs.	1284	260	61
Std. Dev.	2,88 %	6,12 %	11,01 %
Excess kurtosis	9,43	5,44	1,37
Skewness	-0,31	-0,09	0,61

Power Integration

	Daily	Weekly	Monthly
Average	0,01 %	0,08 %	0,31 %
Median	0,00 %	0,04 %	0,62 %
Min.	-21,26 %	-22,50 %	-33,13 %
Max.	15,49 %	17,30 %	30,73 %
Number of obs.	1284	260	61
Std. Dev.	2,27 %	5,06 %	9,42 %
Excess kurtosis	10,97	2,68	2,78
Skewness	0,05	-0,27	-0,13

REC Silicon ASA

	Daily	Weekly	Monthly
Average	-0,17 %	-0,86 %	-3,41 %
Median	-0,32 %	-1,61 %	-2,71 %
Min.	-31,79 %	-32,23 %	-66,32 %
Max.	25,33 %	44,14 %	51,87 %
Number of obs.	1284	260	61
Std. Dev.	4,90 %	10,80 %	22,18 %
Excess kurtosis	3,81	1,09	0,71
Skewness	-0,11	0,54	-0,08

ReneSola

	Daily	Weekly	Monthly
Average	-0,13 %	-0,60 %	-2,68 %
Median	0,00 %	-0,74 %	-2,30 %
Min.	-23,97 %	-40,33 %	-70,18 %
Max.	27,76 %	35,82 %	78,25 %
Number of obs.	1284	260	61
Std. Dev.	5,05 %	11,27 %	22,87 %
Excess kurtosis	3,26	0,86	2,36
Skewness	0,34	-0,02	0,35

Solartron Pcl.

	Daily	Weekly	Monthly
Average	0,10 %	0,50 %	2,14 %
Median	0,00 %	0,00 %	-0,69 %
Min.	-28,38 %	-38,30 %	-25,21 %
Max.	29,04 %	47,00 %	76,10 %
Number of obs.	1284	260	61
Std. Dev.	5,53 %	10,26 %	18,08 %
Excess kurtosis	6,84	2,93	3,23
Skewness	0,05	0,21	1,17

Terna Energy

	Daily	Weekly	Monthly
Average	0,01 %	0,02 %	0,13 %
Median	-0,03 %	-0,17 %	-0,57 %
Min.	-22,88 %	-25,19 %	-39,28 %
Max.	20,61 %	37,98 %	46,70 %
Number of obs.	1284	260	61
Std. Dev.	3,48 %	7,46 %	15,76 %
Excess kurtosis	4,42	3,32	0,69
Skewness	-0,09	0,57	0,17

Tesla Motors

	Daily	Weekly	Monthly
Average	0,17 %	0,83 %	3,60 %
Median	0,03 %	0,71 %	0,15 %
Min.	-21,48 %	-16,62 %	-22,84 %
Max.	21,83 %	34,16 %	59,37 %
Number of obs.	1284	260	61
Std. Dev.	3,26 %	6,58 %	14,46 %
Excess kurtosis	6,18	2,14	2,52
Skewness	0,32	0,30	1,01

Trina Solar

	Daily	Weekly	Monthly
Average	-0,06 %	-0,29 %	-1,24 %
Median	0,00 %	-0,47 %	-2,34 %
Min.	-29,43 %	-45,32 %	-96,01 %
Max.	26,92 %	34,61 %	49,86 %
Number of obs.	1284	260	61
Std. Dev.	4,68 %	10,08 %	20,60 %
Excess kurtosis	3,93	1,98	6,87
Skewness	0,16	-0,09	-1,24

Universal Display Corporation

	Daily	Weekly	Monthly
Average	0,04 %	0,19 %	0,94 %
Median	0,00 %	0,29 %	-1,92 %
Min.	-20,10 %	-24,96 %	-46,87 %
Max.	22,79 %	61,63 %	49,49 %
Number of obs.	1284	260	61
Std. Dev.	3,72 %	8,62 %	17,13 %
Excess kurtosis	6,25	9,73	1,08
Skewness	0,36	1,21	0,22

Veeco Instruments

	Daily	Weekly	Monthly
Average	-0,06 %	-0,27 %	-1,21 %
Median	0,00 %	0,03 %	1,03 %
Min.	-13,12 %	-16,49 %	-39,89 %
Max.	15,17 %	16,32 %	18,54 %
Number of obs.	1284	260	61
Std. Dev.	2,68 %	5,44 %	11,05 %
Excess kurtosis	3,79	0,74	1,27
Skewness	0,15	-0,04	-0,87

Vestas Wind

	Daily	Weekly	Monthly
Average	0,06 %	0,28 %	1,31 %
Median	0,00 %	1,08 %	0,88 %
Min.	-27,63 %	-33,88 %	-38,85 %
Max.	20,62 %	24,95 %	54,90 %
Number of obs.	1284	260	61
Std. Dev.	3,53 %	8,21 %	16,63 %
Excess kurtosis	6,71	1,42	1,33
Skewness	-0,10	-0,50	0,51

Yingli Green Energy Holding Company Ltd

	Daily	Weekly	Monthly
Average	-0,24 %	-1,12 %	-5,05 %
Median	-0,12 %	-1,07 %	-1,18 %
Min.	-46,07 %	-41,73 %	-72,18 %
Max.	24,63 %	50,11 %	54,69 %
Number of obs.	1284	260	61
Std. Dev.	5,22 %	11,49 %	24,11 %
Excess kurtosis	7,03	2,08	1,02
Skewness	-0,32	0,37	-0,46

Appendix B-2 Overview of companies' beta and adjusted R-square

TABLE B2.1: COMPANIES' BETA AND ADJUSTED R-SQUARE.

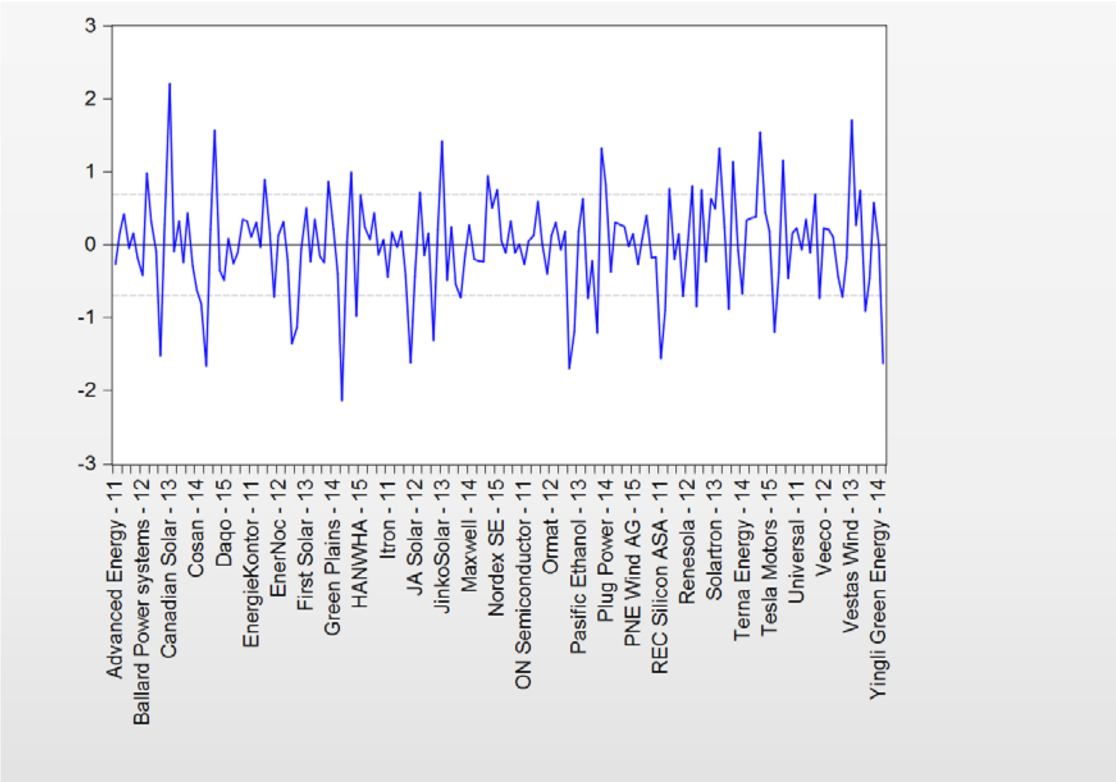
For the period, January 2011 - December 2015. The betas coefficients are concatenated using regression on daily, weekly, monthly logarithmic stock returns (for the whole sample period) of the renewable company, and the daily, weekly, monthly logarithmic stock returns of S&P 1200 global respectively. The source of data for the daily stock prices is Morningstar.

	Daily			Weekly			Monthly		
Companies	Beta coefficient	t-stat	Adjusted R-square	Beta coefficient	t-stat	Adjusted R-square	Beta coefficient	t-stat	Adjusted R-square
Advanced Energy Industries Inc	1,48	21,315	0,26	1,24	8,9900	0,24	0,63	1,7932	0,04
Ballard Power Systems Inc	1,31	8,621	0,05	1,26	4,2368	0,06	1,90	2,8558	0,11
Canadian Solar Inc	2,24	16,802	0,18	1,89	7,1596	0,16	3,13	4,6653	0,26
Cosan Ltd	1,45	22,326	0,28	1,22	8,6071	0,22	2,32	7,5550	0,48
Daqo New Energy Corporation	1,88	10,804	0,08	1,93	5,3006	0,09	2,71	2,9446	0,11
EDP Renewables	0,52	9,320	0,06	0,64	5,5120	0,10	0,22	0,9090	0,00
EnergieKontor	-0,18	-2,246	0,00	0,15	1,0080	0,00	-0,28	-0,7786	-0,01
EnerNoc	1,33	11,055	0,09	1,17	4,8743	0,08	0,71	1,2371	0,01
First Solar	1,76	15,851	0,16	1,68	7,2958	0,17	2,28	3,8479	0,19
Green Plains Renewable Energy	1,40	15,955	0,17	1,17	6,5115	0,14	1,18	2,6117	0,09
Hanwha Q Cells Co. Ltd.	2,07	13,035	0,12	-0,49	-1,5221	0,01	2,88	3,7233	0,18
Hexcel	1,39	32,905	0,46	1,19	13,2920	0,40	0,78	4,3803	0,23
Itron	1,20	20,973	0,25	0,92	7,5450	0,18	1,50	6,0022	0,37
JA Solar Holdings Corporation Ltd	1,91	14,282	0,14	1,23	4,9120	0,08	3,05	6,0283	0,37
JinkoSolar	2,25	15,256	0,15	2,35	7,7834	0,19	4,54	6,0216	0,37
Maxwell Tehnologies	1,56	13,806	0,13	1,34	5,6534	0,11	0,76	1,1961	0,01
Nordex SE	0,60	5,661	0,02	1,11	5,7894	0,11	1,09	2,2917	0,07
Novozymes A/S	0,23	4,203	0,01	0,83	9,5272	0,26	0,31	1,2238	0,01
ON Semiconductor	1,46	23,425	0,30	1,49	11,3492	0,33	1,44	5,4448	0,32
Ormat Technologies Inc.	1,16	21,037	0,26	0,96	8,7055	0,22	1,07	3,7898	0,18
Pacific Ethanol	1,32	7,196	0,04	1,18	3,2354	0,04	2,58	2,8199	0,10
Plug Power	1,24	5,771	0,02	1,29	2,8488	0,03	1,69	1,5322	0,02
PNE wind AG	0,27	2,945	0,01	0,71	4,0055	0,05	0,15	0,3834	-0,01
Power Integration	1,23	19,687	0,23	1,12	8,4163	0,21	0,85	2,7050	0,10
REC Silicon ASA	0,25	1,625	0,00	1,88	6,2952	0,13	2,54	3,5686	0,16
Renesola	2,02	13,537	0,12	1,88	6,0099	0,12	3,58	5,4139	0,32
Solartron Pcl.	0,17	0,950	0,00	0,60	1,9955	0,01	0,90	1,4325	0,02
Terna Energy	0,22	2,053	0,00	0,74	3,3921	0,04	1,92	3,8591	0,19
Tesla Motors	1,36	14,174	0,13	0,81	4,2870	0,06	0,85	1,7127	0,03
Trina Solar	2,08	15,322	0,15	1,87	6,7741	0,15	2,80	4,4466	0,24
Universal Display Corporation	1,74	16,227	0,17	1,56	6,5998	0,14	0,72	1,2073	0,01
Veeco Instruments	1,41	18,882	0,22	0,90	5,9162	0,12	0,87	2,3238	0,07
Vestas Wind	1,74	17,382	0,19	1,60	7,1708	0,16	1,68	3,0776	0,12
Yingli Green Energy Holding Company Ltd	2,08	13,456	0,12	1,56	4,7755	0,08	3,39	4,6533	0,26

An overview of companies daily, weekly and monthly betas calculated with simple regression, with their R-squared values. Before investigating the power of firm specific variables as risk sources, we analysed we analyse the explanatory power of the systematic risk (the only risk source in the CAPM) on the renewable energy stock returns market. The daily beta spread from -0.18 to 2.24, the weekly beta varies from 0.49 to 2.35, the monthly beta spread from 0.28 to 4.54 and are mostly significantly different from zero, at a 5% significance level. The negative betas are not significantly different from zero, at a 5% significance level, due to their small t-stat values. The low adjusted R-squared values indicate that the model (with beta as the only explanatory variable) is not a suitable one to explain the financial performance of renewable energy companies.

Appendix B-3 Residuals of Pooled Regression

FIGURE B3.1: RESIDUALS OF POOLED REGRESSION (OLS)
Of total panel (balanced) observations: 170 of 34 cross-sections for annual returns of renewable energy companies as dependent variable, and data of explanatory variables, from January 2011 - December 2015. the graph output is concatenated using data from Morningstar.



The Graph of residuals from the pooled regression shows a noticeable pattern in the residuals. Variation below and above zero is in a systematically way, which indicates possible Heterogeneity.

Appendix B-4 A review of tests performed

TABLE B4.1: REDUNDANT TEST FOR CROSS-SECTION FIXED EFFECTS,
Testing the joint significance of the fixed effects estimates in least squares specifications, for the total panel (balanced) observations: 170 of 34 cross-sections for annual returns of renewable energy companies as dependent variable, and data of explanatory variables, from January 2011 - December 2015. the test output is concatenated using data from Morningstar.

	Statistic	d.f.	Prob.
Cross-section F	1.406004	-33,126	0.0000
Cross-section Chi-square	53.299189	33	0.0000
Period F	17.913950	-4,126	0.0000
Period Chi-square	76.541689	4	0.0000
Cross-Section/Period F	3.733947	-37,126	0.0000
Cross-Section/Period Chi-square	125.843873	37	0.0000

To determine whether the fixed effects are necessary or not, a redundant fixed effects test is run. The redundant fixed effects; which provided by EViews and test the significant of effects. Null hypothesis in this test is the effects are redundant. Three different redundant fixed effects tests are employed, each in both $\chi 2$ and F-test versions, for: 1) restricting the cross-section fixed effects to zero; 2) restricting the period fixed effects to zero; and 3) restricting both types of fixed effects to zero. According to the results, the sum of squares (F-test) and likelihood ratio (chi square test) and p-value (prob.) strongly reject the null hypothesis (Brooks, 2014a) In other words, all the results indicate that the effects are statistically significant.

TABLE B4.2: HAUSMAN TEST FOR CORRELATED RANDOM EFFECTS,
For total panel (balanced) observations: 170 of 34 cross-sections for annual returns of renewable energy companies as dependent variable, and data of explanatory variables, from January 2011 - December 2015. The test output is concatenated using data from Morningstar.

	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	28.013909	6	0.0001

To decide between fixed or random effects a Hausman test is used, to examine whether the difference between the random effects regression and the fixed effects regression is zero. The null hypothesis is that the preferred model is random effects vs. the alternative the fixed effects. Here the null was rejected(p-value=0.0001) which means the fixed effects model is preferred.

TABLE B4.3: BREUSCH-PAGAN TEST, PANEL CROSS-SECTION DEPENDENCE TEST.

For total panel (balanced) observations: 170 of 34 cross-sections for annual returns of renewable energy companies as dependent variable, and data of explanatory variables, from January 2011 - December 2015. The test output is concatenated using data from Morningstar.

Test	Statistic	d.f.	Prob.
Breusch-Pagan LM	837.4851	561	0.0000

Absence of heteroscedasticity is one of the assumptions of linear regression, which means that the variance of the residuals in the fitted model should not increase as the fitted value increases**.** The Breusch-Pagan test is a Lagrange multiplier test of the null hypothesis of no heteroskedasticity.

TABLE B4.4: F TEST FOR INDIVIDUAL EFFECTS.

For total panel (balanced) observations: 170 of 34 cross-sections for annual returns of renewable energy companies as dependent variable, and data of explanatory variables, from January 2011 - December 2015. The test output is concatenated using data from Morningstar.

Test	Statistic	d.f.	Prob.
F test for individual effects	17.914	4-126	0.0000

The dummies in Least square dummy variables (LSDV) model can be included as entity-fixed or time-fixed model. A F-test will help in choosing the write model regarding LSDV model. F-test indicates that the time-fixed effects is more suited in or not. If P-value is below the threshold (P<0.05), time-fixed effects are recommended.

Appendix C

In this section, the division of our sample companies into sectors are shown in Appendix C-1. The results from the LSDV regression are illustrated in Appendices C2-C6. Only the coefficients that are significant at 5% level of significance, are represented.

Appendix C-1 Companies in their operative sectors

Solar
Advanced Energy Industries Inc
Canadian Solar Inc
Daqo New Energy Corporation
First Solar
Hanwha Q Cells Co. Ltd.
JA Solar Holdings Corporation Ltd
JinkoSolar
REC Silicon ASA
Renesola
Solartron Pcl.
Trina Solar
Yingli Green Energy Holding Company Ltd

Wind
EDP Renewables
EnergieKontor
Hexcel
Nordex SE
PNE wind AG
Terna Energy
Vestas Wind

Bio-energy
Cosan Ltd
Green Plains Renewable Energy
Novozymes A/S
Pacific Ethanol

Energy Technology
Ballard Power Systems Inc
EnerNoc
Itron
Maxwell Tehnologies
ON Semiconductor
Plug Power
Power Integration
Tesla Motors
Universal Display Corporation
Veeco Instruments

Geothermal Power
Ormat Technologies Inc

Appendix C-2 Results from LSDV regression in Solar sector

TABLE C2.1: RESULTS FROM LSDV ESTIMATION FOR BETA IN SOLAR SECTOR.
For the period of January 2011 - December 2015. The LSDV coefficients are concatenated using annual data from Morningstar.

LSDV results for Beta in Solar sector

Company	Country		2011	2012	2013	2014	2015
		Average	***0,2028***	***0,3316***	***0,2839***	***0,4107***	***0,3279***
		t-stat	*1,81*	*2,49*	*2,64*	*2,83*	*2,62*
Advanced Energy Industries Inc	USA		-0,7592		-0,6532		
Canadian Solar Inc	Canada				-0,8149		
Daqo New Energy Corporation	China			-0,8977	-0,9614	-1,0186	-0,8943
First Solar	USA			-0,7426	0,8184	-0,8494	-0,7399
Hanwha Q Cells Co. Ltd.	South Korea			-0,8959	-0,9656	-1,0069	-0,8930
JA Solar Holdings Corporation Ltd	China			-0,9352	-0,9980	-1,0576	-0,9317
JinkoSolar	China				-0,8175	-0,9385	-0,7725
REC Silicon ASA	Norway			-0,5976	-0,7349	-0,5968	-0,6000
Renesola	China			-1,0174	-1,0789	-1,1420	-1,0139
Solartron Pcl.	Thailand						
Trina Solar	China			-0,8872	-0,9421	-1,0229	-0,8832
Yingli Green Energy Holding Company Ltd	China		-0,9106	-1,3492	-1,4045	-1,4839	-1,3451
	R-squared		0,3575	0,1749	0,3934	0,1826	0,1753

TABLE C2.2: RESULTS FROM LSDV ESTIMATION FOR FIRM SIZE VARIABLE IN SOLAR SECTOR.
For the period of January 2011 - December 2015. The LSDV coefficients are concatenated using annual data from Morningstar.

LSDV results for Firm size in Solar sector

Company	Country		2011	2012	2013	2014	2015
		Average	***0,25574***	***0,3356***	***0,2721***	***0,3349***	***0,3384***
		t-stat	*3,57*	*4,09*	*3,91*	*4,16*	*4,20*
Advanced Energy Industries Inc	USA		-1,3977	-2,0732	-1,8058	-2,0603	-2,0758
Canadian Solar Inc	Canada				-0,5754		
Daqo New Energy Corporation	China		-1,3176	-1,8530	-1,6970	-1,8414	-1,8508
First Solar	USA		-2,1149	-2,9293	-2,5514	-2,9151	-2,9367
Hanwha Q Cells Co. Ltd.	South Korea		-1,3764	-1,9177	-1,7571	-1,9061	-1,9157
JA Solar Holdings Corporation Ltd	China		-1,5806	-2,1884	-1,9749	-2,1761	-2,1887
JinkoSolar	China		-1,3022	1,9224	-1,6991	-1,9101	-1,9231
REC Silicon ASA	Norway		-0,0868				
Renesola	China		-1,5003	-2,0602	-1,8848	-2,0484	-2,0588
Solartron Pcl.	Thailand			-0,9265	-0,8394	-0,9157	-0,9213
Trina Solar	China		-1,6789	-2,3497	-2,0861	-2,3369	-2,3522
Yingli Green Energy Holding Company Ltd	China		-1,9773	-2,5959	-2,3738	-2,5836	-2,5966
	R-squared		0,3988	0,2328	0,4272	0,2329	0,2338

TABLE C2.3: RESULTS FROM LSDV ESTIMATION FOR LEVERAGE VARIABLE IN SOLAR SECTOR.
For the period of January 2011 - December 2015. The LSDV coefficients are concatenated using annual data from Morningstar.

LSDV results for Leverage in Solar sector

			2011	2012	2013	2014	2015
		Average	*0,0073*	*0,0038*	*-0,0004*	*0,0043*	*0,0035*
		t-stat	*0,78*	*0,36*	*-0,05*	*0,40*	*0,33*
Company	*Country*						
Advanced Energy Industries Inc	USA						
Canadian Solar Inc	Canada						
Daqo New Energy Corporation	China						
First Solar	USA						
Hanwha Q Cells Co. Ltd.	South Korea						
JA Solar Holdings Corporation Ltd	China						
JinkoSolar	China						
REC Silicon ASA	Norway				-0,6006		
Renesola	China				-0,4945		
Solartron Pcl.	Thailand		0,5000				
Trina Solar	China						
Yingli Green Energy Holding Company Ltd	China				-0,7879	-0,5859	-0,5861
	R-squared		0,3448	0,1377	0,3617	0,1348	0,1337

TABLE C2.4: RESULTS FROM LSDV ESTIMATION FOR PRICE TO EARNINGS RATIO VARIABLE IN SOLAR SECTOR.
For the period of January 2011 - December 2015. The LSDV coefficients are concatenated using annual data from Morningstar

LSDV results for Price to earnings ratio in Solar sector

			2011	2012	2013	2014	2015
		Average	*0,0020*	*0,0027*	*0,0022*	*0,0027*	*0,0027*
		t-stat	*1,64*	*1,97*	*1,87*	*1,98*	*1,97*
Company	*Country*						
Advanced Energy Industries Inc	USA						
Canadian Solar Inc	Canada						
Daqo New Energy Corporation	China						
First Solar	USA						
Hanwha Q Cells Co. Ltd.	South Korea						
JA Solar Holdings Corporation Ltd	China						
JinkoSolar	China						
REC Silicon ASA	Norway						
Renesola	China						
Solartron Pcl.	Thailand						
Trina Solar	China						
Yingli Green Energy Holding Company Ltd	China			-0,592	-0,778	-0,623	
	R-squared		0,355	0,161	0,378	0,158	0,157

TABLE C2.5: RESULTS FROM LSDV ESTIMATION FOR CASH FLOW PER SALES VARIABLE IN SOLAR SECTOR. For the period of January 2011 - December 2015. The LSDV coefficients are concatenated using annual data from Morningstar

LSDV results for Cash flow for sales in Solar sector

Company	Country		2011	2012	2013	2014	2015
		Average	*0,0022*	*0,0039*	*0,0022*	*0,0040*	*0,0034*
		t-stat	*1,34*	*2,07*	*1,37*	*2,16*	*2,19*
Advanced Energy Industries Inc	USA						
Canadian Solar Inc	Canada						
Daqo New Energy Corporation	China						
First Solar	USA						
Hanwha Q Cells Co. Ltd.	South Korea						
JA Solar Holdings Corporation Ltd	China						
JinkoSolar	China						
REC Silicon ASA	Norway				-0,6139		
Renesola	China				-0,4662		
Solartron Pcl.	Thailand		0,6025				
Trina Solar	China						
Yingli Green Energy Holding Company Ltd	China		-0,5531	-0,5531	-0,7474	-0,5601	-0,5618
	R-squared		0,3505	0,1635	0,3705	0,1628	0,1628

TABLE C2.6: RESULTS FROM LSDV ESTIMATION FOR BOOK-TO-MARKET VALUE VARIABLE IN SOLAR SECTOR. For the period of January 2011 - December 2015. The LSDV coefficients are concatenated using annual data from Morningstar.

LSDV results for Book to market value in Solar sector

Company	Country		2011	2012	2013	2014	2015
		Average	*-0,0009*	*-0,0010*	*-0,0008*	*-0,0010*	*-0,0010*
		t-stat	*-2,43*	*-2,41*	*-2,32*	*-2,46*	*-2,46*
Advanced Energy Industries Inc	USA						
Canadian Solar Inc	Canada		0,5480				
Daqo New Energy Corporation	China						
First Solar	USA						
Hanwha Q Cells Co. Ltd.	South Korea						
JA Solar Holdings Corporation Ltd	China						
JinkoSolar	China						
REC Silicon ASA	Norway				-0,5773		
Renesola	China				-0,4887		
Solartron Pcl.	Thailand		0,5220				
Trina Solar	China						
Yingli Green Energy Holding Company Ltd	China			-0,6021	-0,7808	-0,6275	-0,6188
	R-squared		0,3697	0,1726	0,3863	0,1712	0,1705

Appendix C-3 Results from LSDV regression in Wind sector

TABLE C3.1: RESULTS FROM LSDV ESTIMATION FOR BETA IN WIND SECTOR.
For the period of January 2011 - December 2015. The LSDV coefficients are concatenated using annual data from Morningstar.

LSDV results for Beta in Wind sector

			2011	2012	2013	2014	2015
		Average	***0,2028***	***0,3316***	***0,2839***	***0,4107***	***0,3279***
		t-stat	*1,81*	*2,49*	*2,64*	*2,83*	*2,62*
Company	***Country***						
EDP Renewables	Spania						
EnergieKontor	Germany						
Hexcel	USA						
Nordex SE	Germany						
PNE wind AG	Germany						
Terna Energy	Greek						
Vestas Wind	Denmark						
	R-squared		0,3575	0,1749	0,3934	0,1826	0,1753

TABLE C3.2: RESULTS FROM LSDV ESTIMATION FOR FIRM SIZE VARIABLE IN WIND SECTOR.
For the period of January 2011 - December 2015. The LSDV coefficients are concatenated using annual data from Morningstar.

LSDV results for Firm size in Wind sector

			2011	2012	2013	2014	2015
		Average	***0,25574***	***0,3356***	***0,2721***	***0,3349***	***0,3384***
		t-stat	*3,57*	*4,09*	*3,91*	*4,16*	*4,20*
Company	***Country***						
EDP Renewables	Spania		-1,9015	2,7354	-2,3421	-2,7210	-2,7434
EnergieKontor	Germany		-0,7690	-1,2847	-1,1444	-1,2734	-1,2818
Hexcel	USA		-1,7499	-2,5489	2,1833	-2,5349	-2,5558
Nordex SE	Germany		-1,0979	-1,7589	-1,5031	-1,7462	-1,7611
PNE wind AG	Germany		-0,9558	-1,4732	-1,3315	-1,4618	-1,4704
Terna Energy	Greek		-1,2767	-1,8660	1,6672	-1,8540	-1,8657
Vestas Wind	Denmark						
	R-squared		0,3988	0,2328	0,4272	0,2329	0,2338

TABLE C3.3: RESULTS FROM LSDV ESTIMATION FOR LEVERAGE VARIABLE IN WIND SECTOR.

For the period of January 2011 - December 2015. The LSDV coefficients are concatenated using annual data from Morningstar.

LSDV results for Leverage in Wind sector							
			2011	2012	2013	2014	2015
		Average	***0,0073***	***0,0038***	***-0,0004***	***0,0043***	***0,0035***
		t-stat	*0,78*	*0,36*	*-0,05*	*0,40*	*0,33*
Company	***Country***						
EDP Renewables	Spania						
EnergieKontor	Germany						
Hexcel	USA						
Nordex SE	Germany		0,5582				
PNE wind AG	Germany						
Terna Energy	Greek						
Vestas Wind	Denmark						
	R-squared		0,3448	0,1377	0,3617	0,1348	0,1337

TABLE C3.4: RESULTS FROM LSDV ESTIMATION FOR PRICE PER EARNINGS RATIO VARIABLE IN WIND SECTOR.

For the period of January 2011 - December 2015. The LSDV coefficients are concatenated using annual data from Morningstar.

LSDV results for Price per earnings ratio in Wind sector							
			2011	2012	2013	2014	2015
		Average	***0,0020***	***0,0027***	***0,0022***	***0,0027***	***0,0027***
		t-stat	*1,64*	*1,97*	*1,87*	*1,98*	*1,97*
Company	***Country***						
EDP Renewables	Spania						
EnergieKontor	Germany						
Hexcel	USA						
Nordex SE	Germany		0,4968				
PNE wind AG	Germany						
Terna Energy	Greek						
Vestas Wind	Denmark						
	R-squared		0,355	0,161	0,378	0,158	0,157

TABLE C3.5: RESULTS FROM LSDV ESTIMATION FOR CASH FLOW PER SALES VARIABLE IN WIND SECTOR.
For the period of January 2011 - December 2015. The LSDV coefficients are concatenated using annual data from Morningstar.

LSDV results for Cash flow per sales in Wind sector

			2011	2012	2013	2014	2015
		Average	***0,0022***	***0,0039***	***0,0022***	***0,0040***	***0,0034***
		t-stat	*1,34*	*2,07*	*1,37*	*2,16*	*2,19*
Company	***Country***						
EDP Renewables	Spania						
EnergieKontor	Germany						
Hexcel	USA						
Nordex SE	Germany		0,5491				
PNE wind AG	Germany						
Terna Energy	Greek						
Vestas Wind	Denmark						
	R-squared		0,3505	0,1635	0,3705	0,1628	0,1628

TABLE C3.6: RESULTS FROM LSDV ESTIMATION FOR BOOK-TO-MARKET VALUE VARIABLE IN WIND SECTOR.
For the period of January 2011 - December 2015. The LSDV coefficients are concatenated using annual data from Morningstar.

LSDV results for Book to market value in Wind sector

			2011	2012	2013	2014	2015
		Average	***-0,0009***	***-0,0010***	***-0,0008***	***-0,0010***	***-0,0010***
		t-stat	*-2,43*	*-2,41*	*-2,32*	*-2,46*	*-2,46*
Company	***Country***						
EDP Renewables	Spania						
EnergieKontor	Germany						
Hexcel	USA						
Nordex SE	Germany		0,5557				
PNE wind AG	Germany						
Terna Energy	Greek						
Vestas Wind	Denmark		1,0811	1,0443		1,0364	1,0469
	R-squared		0,3697	0,1726	0,3863	0,1712	0,1705

Appendix C-4 Results from LSDV regression in Bio-energy sector

TABLE C4.1: RESULTS FROM LSDV ESTIMATION FOR BETA IN BIOTECHNOLOGY SECTOR.
For the period of January 2011 - December 2015. The LSDV coefficients are concatenated using annual data from Morningstar.

LSDV results for Beta in Biotechnology sector

			2011	2012	2013	2014	2015
		Average	***0,2028***	***0,3316***	***0,2839***	***0,4107***	***0,3279***
		t-stat	*1,81*	*2,49*	*2,64*	*2,83*	*2,62*
Company	***Country***						
Cosan Ltd	Brazil			-0,7768	-0,8634	-0,8598	-0,7752
Green Plains Renewable Energy	USA						
Novozymes A/S	Denmark						
Pacific Ethanol	USA		-0,7522	-1,1306	-1,2082	-1,2284	-1,1283
	R-squared		0,3575	0,1749	0,3934	0,1826	0,1753

TABLE C4.2: RESULTS FROM LSDV ESTIMATION FOR FIRM SIZE VARIABLE IN BIOTECHNOLOGY SECTOR.
For the period of January 2011 - December 2015. The LSDV coefficients are concatenated using annual data from Morningstar.

LSDV results for Firm size in Biotechnology sector

			2011	2012	2013	2014	2015
		Average	***0,25574***	***0,3356***	***0,2721***	***0,3349***	***0,3384***
		t-stat	*3,57*	*4,09*	*3,91*	*4,16*	*4,20*
Company	***Country***						
Cosan Ltd	Brazil		-2,1207	-2,8950	-2,5490	-2,8812	-2,9010
Green Plains Renewable Energy	USA		-1,3099	-1,9570	-1,7122	-1,9444	-1,9586
Novozymes A/S	Denmark		-2,1352	-3,0291	-2,5880	-3,0142	-3,0392
Pacific Ethanol	USA		-1,6148	-2,1401	-1,9922	-2,1286	-2,1375
	R-squared		0,3988	0,2328	0,4272	0,2329	0,2338

TABLE C4.3: RESULTS FROM LSDV ESTIMATION FOR LEVERAGE VARIABLE IN BIOTECHNOLOGY SECTOR.
For the period of January 2011 - December 2015. The LSDV coefficients are concatenated using annual data from Morningstar.

LSDV results for Leverage in Biotechnology sector

			2011	2012	2013	2014	2015
		Average	***0,0073***	***0,0038***	***-0,0004***	***0,0043***	***0,0035***
		t-stat	*0,78*	*0,36*	*-0,05*	*0,40*	*0,33*
Company	***Country***						
Cosan Ltd	Brazil						
Green Plains Renewable Energy	USA						
Novozymes A/S	Denmark						
Pacific Ethanol	USA				-0,7195	-0,5704	-0,5611
	R-squared		0,3448	0,1377	0,3617	0,1348	0,1337

TABLE C4.4: RESULTS FROM LSDV ESTIMATION FOR PRICE PER EARNINGS RATIO VARIABLE IN BIOTECHNOLOGY SECTOR.

For the period of January 2011 - December 2015. The LSDV coefficients are concatenated using annual data from Morningstar.

LSDV results for Price per earnings ratio in Biotechnology sector							
			2011	2012	2013	2014	2015
		Average	*0,0020*	***0,0027***	***0,0022***	***0,0027***	***0,0027***
		t-stat	*1,64*	*1,97*	*1,87*	*1,98*	*1,97*
Company	***Country***						
Cosan Ltd	Brazil						
Green Plains Renewable Energy	USA						
Novozymes A/S	Denmark						
Pacific Ethanol	USA			-0,5422	-0,7261	-0,5740	-0,5653
	R-squared		0,355	0,161	0,378	0,158	0,157

TABLE C4.5: RESULTS FROM LSDV ESTIMATION FOR CASH FLOW PER SALES VARIABLE IN BIOTECHNOLOGY SECTOR.

For the period of January 2011 - December 2015. The LSDV coefficients are concatenated using annual data from Morningstar.

LSDV results for Cash flow per sales in Biotechnology sector							
			2011	2012	2013	2014	2015
		Average	*0,0022*	***0,0039***	***0,0022***	***0,0040***	***0,0034***
		t-stat	*1,34*	*2,07*	*1,37*	*2,16*	*2,19*
Company	***Country***						
Cosan Ltd	Brazil						
Green Plains Renewable Energy	USA						
Novozymes A/S	Denmark						
Pacific Ethanol	USA			-0,5436	-0,7144	-0,5526	-0,5541
	R-squared		0,3505	0,1635	0,3705	0,1628	0,1628

TABLE C4.6: RESULTS FROM LSDV ESTIMATION FOR BOOK-TO-MARKET VALUE VARIABLE IN BIOTECHNOLOGY SECTOR.

For the period of January 2011 - December 2015. The LSDV coefficients are concatenated using annual data from Morningstar.

LSDV results for Book to market value in Biotechnology sector							
			2011	2012	2013	2014	2015
		Average	*-0,0009*	***-0,0010***	***-0,0008***	***-0,0010***	***-0,0010***
		t-stat	*-2,43*	*-2,41*	*-2,32*	*-2,46*	*-2,46*
Company	***Country***						
Cosan Ltd	Brazil						
Green Plains Renewable Energy	USA						
Novozymes A/S	Denmark						
Pacific Ethanol	USA			-0,5358	-0,7149	-0,5611	-0,5525
	R-squared		0,3697	0,1726	0,3863	0,1712	0,1705

Appendix C-5 Results from LSDV regression in Energy technology sector

TABLE C5.1: RESULTS FROM LSDV ESTIMATION FOR BETA IN ENERGY TECHNOLOGY SECTOR.
For the period of January 2011 - December 2015. The LSDV coefficients are concatenated using annual data from Morningstar.

LSDV results for Beta in Energy Technology sector

Company	Country		2011	2012	2013	2014	2015
		Average	***0,2028***	***0,3316***	***0,2839***	***0,4107***	***0,3279***
		t-stat	*1,81*	*2,49*	*2,64*	*2,83*	*2,62*
Ballard Power Systems Inc	Canada				-0,5905		
EnerNoc	USA			-0,8253	-0,9200	-0,8951	-0,8244
Itron	USA				-0,5764		
Maxwell Tehnologies	USA			-0,7092	-0,7841	-0,8116	-0,7067
ON Semiconductor	USA						
Plug Power	USA				-0,5781		
Power Integration	USA						
Tesla Motors	USA						
Universal Display Corporation	USA						
Veeco	USA			-0,6337	-0,7246	-0,7098	-0,6325
	R-squared		0,3575	0,1749	0,3934	0,1826	0,1753

TABLE C5.2: RESULTS FROM LSDV ESTIMATION FOR FIRM SIZE VARIABLE IN ENERGY TECHNOLOGY SECTOR.
For the period of January 2011 - December 2015. The LSDV coefficients are concatenated using annual data from Morningstar.

LSDV results for Firm size in Energy Technology sector

Company	Country		2011	2012	2013	2014	2015
		Average	***0,25574***	***0,3356***	***0,2721***	***0,3349***	***0,3384***
		t-stat	*3,57*	*4,09*	*3,91*	*4,16*	*4,20*
Ballard Power Systems Inc	Canada		-1,1032	-1,6437	-1,4837	-1,6321	-1,6417
EnerNoc	USA		-1,6863	-2,2925	-2,0803	-2,2803	-2,2927
Itron	USA		-1,8210	-2,5567	-2,2415	-2,5433	-2,5614
Maxwell Tehnologies	USA		-1,4036	-2,0005	-1,7956	-1,9884	-2,0004
ON Semiconductor	USA		-1,8163	-2,6209	-2,2508	-2,6068	-2,6279
Plug Power	USA		-1,2000	-1,7331	-1,5790	-1,7216	-1,7308
Power Integration	USA		-1,6422	-2,3606	-2,0591	-2,3474	-2,3647
Tesla Motors	USA						
Universal Display Corporation	USA						
Veeco Instruments	USA		-1,7876	-2,4934	-2,2019	-2,4802	-2,4971
	R-squared		0,3988	0,2328	0,4272	0,2329	0,2338

TABLE C5.3: RESULTS FROM LSDV ESTIMATION FOR LEVERAGE VARIABLE IN ENERGY TECHNOLOGY SECTOR.
For the period of January 2011 - December 2015. The LSDV coefficients are concatenated using annual data from Morningstar.

LSDV results for Leverage in Energy Technology sector

Company	Country		2011	2012	2013	2014	2015
		Average	***0,0073***	***0,0038***	***-0,0004***	***0,0043***	***0,0035***
		t-stat	*0,78*	*0,36*	*-0,05*	*0,40*	*0,33*
Ballard Power Systems Inc	Canada						
EnerNoc	USA				-0,5324		
Itron	USA						
Maxwell Tehnologies	USA						
ON Semiconductor	USA						
Plug Power	USA						
Power Integration	USA						
Tesla Motors	USA		0,5871				
Universal Display Corporation	USA						
Veeco Instruments	USA						
	R-squared		0,3448	0,1377	0,3617	0,1348	0,1337

TABLE C5.4: RESULTS FROM LSDV ESTIMATION FOR PRICE PER EARNINGS RATIO VARIABLE IN ENERGY TECHNOLOGY SECTOR.
For the period of January 2011 - December 2015. The LSDV coefficients are concatenated using annual data from Morningstar.

LSDV results for Price per earnings ratio in Energy Technology sector

Company	Country		2011	2012	2013	2014	2015
		Average	***0,0020***	***0,0027***	***0,0022***	***0,0027***	***0,0027***
		t-stat	*1,64*	*1,97*	*1,87*	*1,98*	*1,97*
Ballard Power Systems Inc	Canada						
EnerNoc	USA			-0,5404			
Itron	USA						
Maxwell Tehnologies	USA						
ON Semiconductor	USA						
Plug Power	USA						
Power Integration	USA						
Tesla Motors	USA		0,5959				
Universal Display Corporation	USA						
Veeco Instruments	USA						
	R-squared		0,355	0,161	0,378	0,158	0,157

TABLE C5.5: RESULTS FROM LSDV ESTIMATION FOR PRICE PER EARNINGS RATIO VARIABLE IN ENERGY TECHNOLOGY SECTOR.

For the period of January 2011 - December 2015. The LSDV coefficients are concatenated using annual data from Morningstar.

LSDV results for Cash flow per sales in Energy Technology sector

Company	Country		2011	2012	2013	2014	2015
		Average	***0,0022***	***0,0039***	***0,0022***	***0,0040***	***0,0034***
		t-stat	*1,34*	*2,07*	*1,37*	*2,16*	*2,19*
Ballard Power Systems Inc	Canada						
EnerNoc	USA						
Itron	USA						
Maxwell Tehnologies	USA						
ON Semiconductor	USA						
Plug Power	USA						
Power Integration	USA						
Tesla Motors	USA		0,7515	0,7281		0,7293	0,7272
Universal Display Corporation	USA						
Veeco Instruments	USA						
	R-squared		0,3505	0,1635	0,3705	0,1628	0,1628

TABLE C5.6: RESULTS FROM LSDV ESTIMATION FOR BOOK-TO-MARKET VALUE VARIABLE IN ENERGY TECHNOLOGY SECTOR.

For the period of January 2011 - December 2015. The LSDV coefficients are concatenated using annual data from Morningstar.

LSDV results for Book to market value in Energy Technology sector

Company	Country		2011	2012	2013	2014	2015
		Average	***-0,0009***	***-0,0010***	***-0,0008***	***-0,0010***	***-0,0010***
		t-stat	*-2,43*	*-2,41*	*-2,32*	*-2,46*	*-2,46*
Ballard Power Systems Inc	Canada						
EnerNoc	USA						
Itron	USA						
Maxwell Tehnologies	USA						
ON Semiconductor	USA						
Plug Power	USA						
Power Integration	USA						
Tesla Motors	USA		0,6368				
Universal Display Corporation	USA		0,4997				
Veeco Instruments	USA						
	R-squared		0,3697	0,1726	0,3863	0,1712	0,1705

Appendix C-6 Results from LSDV regression in Geothermal Power sector

TABLE C6.1: RESULTS FROM LSDV ESTIMATION FOR FIRM SIZE VARIABLE IN GEOTHERMAL POWER SECTOR.
For the period of January 2011 - December 2015. The LSDV coefficients are concatenated using annual data from Morningstar.

LSDV results for Firm size in Geothermal Power sector							
			2011	2012	2013	2014	2015
		Average	***0,25574***	***0,3356***	***0,2721***	***0,3349***	***0,3384***
		t-stat	*3,57*	*4,09*	*3,91*	*4,16*	*4,20*
Company	***Country***						
Ormat Technologies Inc	USA		-1,6146	-2,3255	-2,0300	-2,3123	-2,3293
	R-squared		0,3988	0,2328	0,4272	0,2329	0,2338

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