Tonje Helland Dirdal
Kristin Gjone

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Motivation

New investments in renewable energy on a global scale reached an all time high in 2015, amounting to $285.9 billion. This entails a growth of 5% from 2014, which has been driven by developing countries. From 2014 to 2015, the growth in global investments was 17%. (Bloomberg, 2016)

According to REN21, the renewable energy share (excluding hydropower) of global final energy consumption was 15.3% in 2014. Also excluding traditional biomass, the share was 6.4%. (REN21, 2016) OECD reports that non-hydro renewables and waste accounted for 10% of the electricity generation mix in 2014. These numbers may seem small in the total mix of energy sources. However, what is striking – and hence our motivational starting point – is the recent development within the renewable energy industry. From 2013-2014 it was by far the largest growing energy source within the OECD electricity generation with a 9.7% increase, whereas the share of fossil fuel decreased by 2%. (OECD, 2016 preliminary) Furthermore, renewable energy is seen as the fastest growing energy source in the future. (International Energy Outlook 2016, EIA) For the next 25 years, the International Energy Agency see renewables to replace coal and decrease the demand for gas and oil. (World Energy Oulook 2016, IEA) Bloomberg points to the rising interest and potential for battery storage as a means to balance the fluctuations in electricity generation, which is one of the challenges facing the renewable energy industry. (Bloomberg, 2016)

In light of these facts, it is interesting to ask whether the growth observed over the past few years has been driven by profitable investments or social responsibility. Bloomberg states that climate change policies such as 'green stimulus' programs, government and corporate spending on R&D have contributed to the boost in investments, especially in 2011. Yet, large investments in renewables despite low fossil fuel prices points towards a rising cost-competitiveness, enabling renewables to increase their share of world electricity generation at the expense of carbon-emitting sources. (ibid) Also, renewables are gaining grounds in developing countries where there is a rush in the need for new capacity. Building

wind farms and solar parks takes 3-9 months, compared to fossil fuel plants which can take several years. (ibid)

Our interest in the renewable energy industry is therefore two-fold:
1. Renewables are seen as clean sources of energy, which are free from CO_2-emissions and externalities that are imposed by the fossil fuel industries.
2. Renewables are seen as sources of energy that are becoming more competitive (particularly with respect to cost and time), and increasingly so.

Within the academic literature in finance, our impression is that renewable energy is a fairly new topic of interest. Scholars emphasize the fast evolution in the renewable energy industry as well as the limited data available, and encourage more research as the industry matures. By comparing previous findings to the recent development, we become curious as to whether the estimated systematic risk is changed and whether the stated relationship between the oil price and the systematic risk still holds. According to Sadorsky (2012), an increase in the oil price should have a positive effect on the systematic risk of publicly traded renewable energy companies. This is somewhat puzzling taking into account the data for 2015, which motivates us to do further research on this specific topic with more recent data.

Furthermore, it would be interesting to investigate whether the cost of CO_2-emissions/externalities is somehow incorporated into the price of renewable energy, making it more price-competitive.

Literature review

Donovan and Nunez (2010) analyze the risk faced by renewable energy investors in large emerging markets. Motivated by a limited academic literature on the topic despite the rapidly growing subsidies to renewable energy projects, their aim is to estimate the cost of capital of clean energy firms, and thereby promote clarity about private sector hurdle rates. Hence, a central objective of the study is to provide guidance to those who evaluate funding decisions within the industry, such as regulators and corporate managers. Using various extensions to the

standard CAPM, Donovan and Nunez estimate expected return on equity by focusing on the market risk factor. Their main finding is that renewable energy firms in Brazil, China and India expose multinational investors to the same risks as investing in emerging markets generally. Thus, this finding of near-average risk diverges largely from the findings in previous research, which has estimated market betas close to 2. With this article, Donovan and Nunez encourage further research on this topic as the renewable energy industry matures and longer time series can be exploited. Furthermore, they suggest that the role of market risk in determining the cost of equity should be a primary consideration for setting appropriate levels of subsidy to climate-friendly industries.

Ziegler, Busch and Hoffman (2011) find a positive relationship between US energy firms' disclosed corporate responses to climate change and stock performance. They consider two specific measures: 'climate impact statement' and 'released carbon reduction measures', which is public information available to all investors. Their finding is strengthening our motivation to explore systematic risk in the energy sector. However, we find the measures too broad or more like a signal rather than de facto investments in renewable energy. In order to tighten the scope of our analysis as well as avoiding measures that may be more connected to company image, our aim is to look at firms with an exposure to renewable resources.

Wüstenhagen and Menichetti (2012) lay out the current status and processes underlying the strategic choices for renewable energy investment, and how they are influenced by energy policy. They suggest that the heterogeneous universe of investors requires a segmentation of policies. Moreover, this paper has served as a useful collection of relevant research in our area of interest, while simultaneously suggesting topics for further research.

Henriques and Sadorksy (2008) study the short-term relationship between oil prices and the performance of renewable (alternative) energy sources. It is widely accepted that high oil prices are positive for alternative energy sources, yet there has been little statistical work done in the past to test this assumption. In this paper, Henriques and Sadorsky examine how sensitive the stock prices of renewable energy companies are to changes in oil prices, technology prices and

interest rate, using a four variable vector autoregression model. Their results show that shocks to technology stock prices have the largest impact, while shocks to oil prices had little significance. Henriques and Sadorsky claim that investors may view renewable energy companies as comparable to technology companies and therefore oil prices are not so important as many believe.

Sardorsky (2012) examine the relationship between systematic risk and return for publically traded renewable energy companies. To find out how different factors (such as oil price, market return, firm size, debt to equity ratio etc.) determine the systematic risk, he uses a variable beta model. Sadorsky finds two main sources of risk, sales growth and changes in oil price. Sales growth have a negative impact on systematic risk while increases in oil price have a positive impact, where Monte Carlo simulation showed that oil prices have the largest impact on beta. The relationship between market risk and stock prices is examined by applying panel data techniques to fifty-two firms for the time period 2001-2007. Sadorsky conclude that market returns, oil prices and sales growth have the most impact on stock returns, respectively.

Marques et al. (2010) explore the forces promoting renewable energy use in European countries. Motivated by a limited amount of empirical work done earlier, they aim to shed some light over the subject by applying panel data techniques to twenty-four European countries for the 1990-2006 period. They found that the more use of coal and oil, the less focus there is on renewables, which suggest lobbying of traditional energy sources. Further, higher levels of CO_2 emissions where found to have a negative relationship with renewable energy development, which could imply that the higher level of economic activity and pollutant activity, the less incentive there will be to invest in renewables. Among other implications, Marques et al. motivate further research based on extension of the time horizon by including recent years.

Laurikka (2005) study the effect of European Union Emissions Trading Scheme (EU ETS) on the risk and return of power generating technologies in Finland. For the purpose of this thesis, Laurikka also explores opportunities for portfolio diversification among different types of renewable sources.

Theory

At this stage, we have chosen to focus on the theory used in the articles we found most useful and inspiring.

The capital asset pricing model (Sharpe 1964) describes the relationship that we should observe between the risk of an asset and its expected return. According to CAPM, the expected return of an asset or portfolio is determined by risk-free rate, market risk premium and the assets sensitivity to market instabilities. Although this model is widely used, it is subject to both theoretical and empirical criticism. A large number of authors have found that the basic CAPM is not able explain stock returns, for instance Fama and French (1993).

Several extensions to the CAPM have been suggested to deal with its weaknesses. A variable beta model (Abell and Krueger 1989) can provide a better understanding of the risk-return relationship by including the impact of various components on systematic risk. In their study, Abell and Krueger find the prediction of future betas using a variable beta model to be more accurate than utilizing historical betas.

In the case of renewable energy companies, many operate in emerging countries. A number of studies have concluded that the CAPM does not perform well in emerging markets. For instance, Estrada (2000) found that some measures for downside risk (beta) are closely related to stock returns in emerging markets. Downside beta is an extension to the CAPM that incorporates non-normal return distributions. According to the conventional CAPM, an asset A which value rises more than the market average, but falls less than the market average, and an asset B with the opposite characteristics would be assigned the same beta – that is, the same sensitivity to market fluctuations. Yet, the downside risk of the two assets differs, meaning that a high beta not necessarily imply a higher risk from the point of view of an investor. The downside beta is therefore calculated in a manner to address this problem. (Donovan and Nunez, 2012)

According to modern portfolio theory, an investor can construct a portfolio of different assets with the lowest possible risk, given a preferred level of expected return. Markowitz (1952) was the first to shed light on the importance of portfolio diversification, noting the different risk-return ratio of a single asset than of a portfolio of different assets. Wüstenhagen and Menichetti (2012) state that opportunities for diversification for renewable energy investment are on two levels: First, by adding renewable energy assets to a portfolio of conventional energy assets. Second, by combining different types of renewables, e.g. solar and wind.

Methodology

At this stage, we are exploring the possibility of performing a two-fold analysis:

The first part will consist of statistical analysis to a sample of Norwegian publically traded renewable energy firms. Norges Forskningråd (2016) have published a paper where they examine the Norwegian market of renewable energy. Some firms within each sector in the report are provided, however it might be possible to receive the full list to our use. We intend to not include hydropower-generating companies since they are well incorporated in the Norwegian market and can be considered a competitor to other renewable sources. According to Norges Forskningråd hydropower counts for 49% of firms related to renewable energy.

In econometrics, a serious problem is often a lack of data at hand for testing the theory or hypothesis of interest (Brooks 2014). While focusing on Norwegian firms might be important for some part of the analysis, it could be necessary to expand the number of firms in order to properly investigate the relationship between risk and return, thus avoiding the "small samples problem". Sadorsky and Henriques (2008) use the WilderHill Clean Energy Index (ECO) to measure stock performance, while Sadorsky (2012) chose to draw a set of 52 firms from The PowerShares WilderHill Clean Energy Portfolio (Fund). One option could be to extend one of these analyses by including more data from recent years, which is a method suggested by several authors, or to draw a set of firms from other clean energy funds and perform similar analysis.

We have identified some possible challenges that can occur with this approach. Some Norwegian renewable companies operate in other parts of the world where policies and conditions are different, for instance with regards to subsidies, tax-cuts or carbon offsets. It might also be that some firms operating in emerging countries and as we discussed earlier, the basic CAPM does not perform well under such circumstances.

Further, not all companies are purely based on renewables; it could be a part of other business or a division within the firm. The challenge would then be to extract the part of business dealing with renewables in order to properly examine it.

In the second part of the analysis, we wish to investigate the aspect of renewables as a clean source of energy. By being free from CO_2-emissions, this alternative cost should optimally be incorporated in the prices and thus affect the risk and return relationship of renewables. However, since this is a new way of thinking it would be difficult to set a price on CO_2-emissions and therefore not possible to perform any exploratory analysis. With this in mind, we could consider taking a qualitative approach to this part of the study, for instance by performing in-debt analysis or surveys to a sample of Norwegian companies. In this way we hope to gain a better understanding of how the market participants view this aspect of renewables, and what their thoughts are for the future.

Reference list

- Abell, John D., and Krueger, Thomas M. 1989. "Macroeconomic influences on beta". *Journal of Economics and Business* 41 (2): 185-193.
- Brooks, Chris. 2014. "Introductory Econometrics for Finance". New York: *Cambridge University Press* 3.
-Donovan, Charles, and Laura Nunez, 2012. "Figuring what's fair: The cost of equity capital for renewable energy in emerging markets". *Energy Policy 40,* pp. 49-58.
- Estrada, Javier. 2000. "The Cost of Equity in Emerging Markets: A Downside Risk Approach". *EFMA 2000 Athens, EFA 2000 London, FMA 2000 Edinburgh.* Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=170748

- Fama, Eugene F., and French, Kenneth R. 1993. "Common risk factors in the returns on stocks and bonds". *Journal of Financial Economics* 33 (1): 3-56.

-Henriques, Irene, and Perry Sadorsky, 2008. "Oil prices and the stock prices of alternative energy companies". *Energy Economics 30,* pp. 998-1010.

-International Energy Agency, 2016. Available at:

http://www.iea.org/newsroom/news/2016/november/world-energy-outlook-2016.html

-Laurikka, Harri, 2005. "A case study on risk and return implications of emissions trading in power generation investments". In Antes, R., Hansjürgens, B., Letmathe, P. (eds) *Emissions Trading and Business 2, 16 p.* Physica Publisher.

- Markowitz, Harry. 1952. "Portfolio Selection". *The Journal of Finance* 7 (1): 77-91.

-Marques, António C., José A. Fuinhas and J. R. Pires Manso, 2010. "Motivations driving renewable energy in European countries: A panel data approach". *Energy Policy 38,* pp. 6877-6885.

- Norges Forskningsråd. 2016. "Norsk næringsliv innenfor miljøvennlig energy" Available at: http://energiogklima.no/nyhet/1800-bedrifter-jobber-med-miljovennlig-energi-halvparten-med-vannkraft/

-OECD, 2016 premilinary. *Recent trends in the OECD: energy and CO2 emissions.* Available at:

https://www.iea.org/media/statistics/Recent_Trends_in_the_OECD.pdf

-Renewable Energy Policy Network for the 21st Century (REN21), 2016. *Renewables 2016 Global Status Report.* (Paris: REN21 Secretariat) ISBN 978-3-9818107-0-7. Available at:

http://www.ren21.net/wp-content/uploads/2016/06/GSR_2016_Full_Report.pdf

-Sadorsky, Perry, 2012. "Modeling renewable energy company risk". *Energy Policy 40,* pp. 39-48.

- Sharpe, William F. 1964. "Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk". *The Journal of Finance* 19 (3): 425-442.

-U.S. Energy Information Administration, 2016. *International Energy Outlook 2016.* Available at: http://www.eia.gov/outlooks/ieo/exec_summ.cfm

-Wüstenhagen, Rolf and Emanuela Menichetti, 2012. "Strategic choices for renewable energy investment: Conceptual framework and opportunities for further research". *Energy Policy 40,* pp. 1-10.

-Ziegler, Andreas, Timo Busch and Volker H. Hoffman, 2011. "Disclosed corporate responses to climate change and stock performance: An international empirical analysis". *Energy Economics 33,* pp. 1283-1294.