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How much are sustainable funds influenced by changes in the oil price?

An empirical analysis of risk-adjusted returns, 2018-2023

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Preface

We are delighted to present this master's thesis. This research aims to examine the extent to which ESG funds are affected by fluctuations in the oil price and assess their risk-adjusted returns within this context.

We would like to express our sincere gratitude to our supervisors, Ole Gjølberg and Torun Fretheim, whose guidance and expertise have been invaluable throughout this thesis. Their encouragement and insightful feedback have significantly shaped the direction and quality of this research.

Embarking on this study has been a journey of discovery and learning. It has required extensive research, data analysis, and critical thinking. We are grateful for the opportunity to delve into the complex relationship between ESG funds and oil price dynamics and explore its implications for investors and the broader financial landscape.

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Abstract

This thesis examines the impact of oil price changes on Environmental, Social, and Governance (ESG) funds. As sustainable investment funds gain popularity in response to growing environmental concerns, understanding the relationship between oil prices and ESG fund performance becomes important. The study investigates whether variations in oil prices significantly affect the risk-adjusted returns of ESG funds and explores the mechanisms underlying this link.

To achieve this objective, the research employs regression models and utilizes key performance metrics such as the information ratio, Sharpe ratio, and Jensen's Alpha. These metrics provide a comprehensive assessment of ESG fund performance, considering risk-adjusted returns, reward-to-volatility ratio, and excess return relative to a benchmark. By analyzing these metrics, the study aims to ascertain the extent to which oil price changes impact ESG fund performance.

The sample consists of 12 ESG funds marketed as sustainable investments, with a focus on funds managed in Norway. The data collection process involved gathering reliable information from Refinitiv Eikon, with a minimum requirement of five years of data or close to five years for each fund. The selected funds exhibit a range of investment strategies and focus areas, including renewable energy, climate action, gender equality, and exclusion of fossil fuel companies.

The findings from the regression analysis indicate that while the alpha values for the funds are not statistically significant at a 5% level, the majority of the funds are significantly affected by market changes, including oil price fluctuations. This effect is observed even in funds explicitly avoiding investments in the oil and gas sectors. Additionally, the study incorporates dummy variables to investigate the impact of oil price shocks on the risk-adjusted returns of ESG funds.

We find that oil prices have a significant influence on the risk-adjusted returns of ESG funds, regardless of their investment focus. Through a regression analysis, we observe that the majority of ESG funds exhibit negative oil betas, indicating that increases in oil prices negatively affect the performance of these funds. When considering the regression models that account for oil price shocks exceeding 8% and oil price shocks below -8%, we find that most of these oil price shocks are not statistically significant, indicating that ESG funds are

less affected by extreme oil price movements. These insights are valuable for investors, fund managers, and policymakers seeking to align financial returns with sustainability goals. The study highlights the importance of considering oil price dynamics in ESG investment strategies and provides a foundation for further research in this field.

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1.0 Introduction

In this thesis we will investigate the impact of oil price changes on ESG funds. With the increased focus and awareness of the effect of climate changes, many look to invest in funds that take environmental, social and corporate governance (ESG) factors into account. This has led to an increase in the number of ESG funds.

ESG funds invest in a variety of companies that focus on renewable energy, promote gender diversity, and reduce their carbon footprint. ESG fund investing is a strategy in which investors allocate their capital to funds that invest in companies with a focus on ESG factors. These companies strive to make the world a better place through their environmental performance, social impact, and governance policies. ESG investing relies on independent ratings to assess a company's behaviour and policies in these areas. By investing in these companies, ESG funds aim to generate competitive returns compared to traditional funds while achieving positive outcomes (Napoletano & Curry, 2022), this can also be supported by a report from NYU Stern School of Business that ESG funds have shown that they can deliver strong financial performance while promoting positive social and environmental outcomes (Whelan, Atz, Holt, & Clark, 2021)

Despite the increasing popularity of ESG investing, there are some criticisms of this approach. McKinsey & Company suggests that ESG is not desirable because it is a distraction. It also suggests that ESG is not feasible because it is intrinsically too difficult. Additionally, ESG is not measurable to any practicable degree. Even when ESG can be measured, there is no meaningful relationship with financial performance. (Pérez, Hunt, Samandari, Nuttall, & Biniek, 2022). ESG investing also faces criticism of greenwashing. Asset managers such as BlackRock and Vanguard have been accused of watering down their ESG commitments. (Clarke, 2022). The criticisms of ESG investing are important to consider when evaluating the effectiveness of this approach. While some argue that ESG investing is not desirable or feasible, others suggest that it offers a range of potential benefits for both companies and investors.

ESG funds come in many different categories, each with its own set of criteria and investments. Some of the most popular categories include green funds, which focus on renewable energy and environmental protection; social funds, which focus on human rights and social justice; and ethical funds, which focus on ethical and responsible investing.

The objective of this thesis is to investigate the relationship between fluctuations in oil prices and the risk-adjusted returns of ESG funds. More specifically, we aim to determine whether an increase in oil prices corresponds to a decrease in the risk-adjusted returns of ESG funds, and conversely, whether a decrease in oil prices results in an increase in the risk-adjusted returns of ESG funds.

How do changes in oil prices affect ESG funds and why is the relationship between oil price changes and ESG fund important?

Oil price changes, according to Tew (2020), have the potential to affect the returns of ESG funds through a variety of processes. For instance, oil prices are a major driver of inflation according to Ha et. al (2023), resulting in higher business expenditures. As a result, businesses that are unable to pass on these increased expenses to their customers see lower profits and stock prices. Second, increased oil prices can lead to higher interest rates, increasing borrowing costs for companies that rely significantly on debt financing. As a result, these companies' profitability and stock values may suffer. Third, rising oil prices contribute to increased transportation costs, raising the costs connected with items supplied for businesses. Lower profitability and stock prices may result in companies that are unable to pass on these additional costs to their customers. Finally, rising oil prices can restrict consumer spending, reducing demand for goods and services. Profits and stock values for companies that rely on consumer spending may suffer as a result (Tew, 2020). Furthermore, ESG funds have paid the price for their over-allocation to technology stocks; on average, 28.5% of their portfolio is allocated to the information technology sector, compared to 23% for the overall market, according to a Reuters article. This means that when technology stocks fall, ESG funds are more likely to suffer (Reuters, 2022)

2.0 Background: The Importance of Environmental, Social, and Governance (ESG) Factors in Investment Decision-Making

Investors utilize environmental, social, and governance (ESG) aspects as non-financial criteria to assess an investment's sustainability and societal impact. Environmental variables take into account a company's performance in areas including resource depletion, pollution, and climate change. Social variables evaluate a company's interactions with its constituents, such as its workers, clients, suppliers, and communities. A company's leadership, risk management, board structure, and transparency are assessed using governance factors. ESG variables offer a comprehensive perspective of a company's performance that goes beyond traditional financial measurements. They can help investors make decisions about investments that will support sustainable and ethical business practices and, perhaps, lead to long-term financial performance.

The Principles for Responsible Investment (PRI) is a global initiative launched by the United Nations in 2006, aimed at promoting the incorporation of environmental, social, and governance (ESG) factors into investment decision-making and ownership practices. The PRI is supported by a network of signatories, including institutional investors, asset managers, and service providers, who commit to implementing the six principles outlined in the initiative.

The Principles for Responsible Investment (PRI, u.d.), defines ESG as a set of factors that include environmental, social, and governance considerations. The PRI encourages investors to systematically integrate ESG factors into their investment analysis and decision-making, as these factors can have a significant impact on long-term investment performance. The organization provides a set of six Principles for Responsible Investment, one of which specifically focuses on incorporating ESG factors into investment practices. the growing importance of ESG issues in investment decision-making reflects a broader recognition of the impact that companies and investments can have on the environment and society, increased regulatory pressure, and the potential for strong investment returns. As investors continue to incorporate ESG factors into their decision-making processes, the investment industry is likely to become more focused on sustainability and responsible investing practices.

Research has shown that companies that focus on ESG issues have higher financial performance and better management practices, as well as improved corporate governance and increased stakeholder engagement (Fabregat-Aibar et. al., 2019). In addition, ESG has been shown to be a predictor of long-term financial performance and has been linked to reduced risk and greater resilience in the face of market shocks. Furthermore, ESG-integrated investments have been shown to be an effective tool for mitigating certain environmental and social risks (Gordon L. Clark, 2015).

The history of ESG investing can be traced back to the socially responsible investing (SRI) movement that emerged in the 1960s and 1970s. SRI involved investing in companies that aligned with certain ethical or social values, such as avoiding investments in companies that produce tobacco, alcohol, or weapons.

In the mid-2000s, the concept of ESG investing began to take shape, as investors began to recognize the importance of environmental and social factors in addition to governance issues. This led to the development of ESG ratings and assessments, which evaluate companies on their performance in these areas.

Around this time, the idea of corporate social responsibility (CSR) spread throughout the world. As a result, boycott campaigns were launched to pressure multinational corporations to address social issues (such as child labor, forced labor, lengthy workdays, low pay, and sexual harassment) that occurred in foreign subcontractor factories. In order to achieve long-term profitability, many investors believe that a company's CSR assessment, which is non-financial information, should be considered while making investment decisions. However, there is a strong disagreement about whether Socially Responsible Investing (SRI) goes against the legal duty of investment professionals to prioritize profitability for their clients. This disagreement is mainly due to concerns that SRI might result in lower financial returns (Nakajima et. Al 2016).

In recent years, ESG investing has become increasingly mainstream, as more investors seek to incorporate sustainability and social responsibility into their investment portfolios. This trend has been driven in part by growing awareness of environmental and social issues, as well as by the increasing availability of ESG data and research. While there is still debate over the effectiveness of ESG investing and the best ways to evaluate companies on ESG factors, it is clear that ESG investing is likely to continue to play an important role in the global economy in the coming years.

2.1 IS ESG the way?

Wall Street's newest obsession, ESG investment, aims to make companies and the world more environmentally, socially, and economically just. However, the effective fees can be three times what's reported, and ESG funds tend to favor software and healthcare, while tilting away from oil and gas. When describing how green funds outperformed over the past five years, earning an average of 8.1% annually while non-sustainable funds gained at 6.9%, Wallstreet is citing Friede et al. (2015) in its article. Energy faltered last year as the tech and healthcare industries flourished. Green funds performed worse than conventional funds in 2015, losing 19.7%. (Zweig, 2023).

A 2015 analysis of more than 2,000 research papers conducted by Friede et. Al (2015) found that those adopting ESG principles improved their financial results, but only one in six studies found that these portfolios performed significantly better than average. According to the study, ESG funds invest approximately 68% of their assets in the same securities as non-ESG funds. This means that for every dollar invested in a responsible fund, only 30% of that dollar is allocated to stocks that make no effort to improve the world. While ESG funds do prioritize social and environmental factors in their investment analysis, the majority of their assets are still invested in companies that may not prioritize these considerations.

These findings suggest that investors who are primarily motivated by promoting positive social and environmental outcomes may need to be more discerning in their selection of ESG funds and consider factors beyond the label itself. However, the growing popularity of ESG investing may also serve as a catalyst for companies to improve their sustainability practices and make positive changes to benefit both society and the environment.

However, Friede et. Al (2015) have a main conclusion, which is based on this comprehensive review effort, is that the orientation toward long-term responsible investing should be important for all types of rational investors in order to fulfill their fiduciary duties and may better align investors' interests with the more general goals of society. One must have a good understanding of how to apply ESG criteria into investment processes in order to properly exploit value-enhancing ESG components.

The summary of (Zweig, 2023) journal article concludes that ESG-funds are more like the S&P 500 than traditional funds, with an average R-squared of 0.95. Asset managers are taking a liking to ESG because it generates larger fees and because the money is "sticky." However, they don't punish "bad" companies by avoiding their stocks or rewarding "good" ones by

buying theirs, and sky-high stock prices are no incentive to better corporate decision-making. However, one may need to account for paying triple than what it says on the label.

2.2 The Intersection of ESG Investing and Sustainable Finance

As ESG investing has grown in popularity, it has also become more complex and diverse. Today, there are a variety of different ESG investing strategies and approaches, ranging from exclusionary screening (avoiding investments in companies that engage in certain activities) to positive screening (actively seeking out investments in companies that are doing well on ESG criteria). There is also a growing focus on impact investing. Impact investing goes beyond traditional ESG considerations by specifically targeting investments that aim to generate measurable positive social and environmental impact alongside financial returns.

In addition to these strategies, there are also a variety of ESG investment products available to investors, including mutual funds, exchange-traded funds (ETFs), and separately managed accounts. Many large institutional investors, including pension funds and endowments, have also begun to incorporate ESG considerations into their investment strategies.

Despite the growing popularity of ESG investing, there is still debate over the effectiveness of these strategies and the best ways to measure ESG performance. Some critics argue that ESG metrics can be difficult to measure and compare across companies and industries, while others question whether ESG investing can really deliver positive financial returns (Gerard, 2019).

However, there is growing evidence that ESG factors can have a significant impact on financial performance. A study conducted by Kumar et. Al (2016) with timeseries of 2 years (2014-2015), have shown that companies with strong ESG performance are more likely to outperform their peers in the long run, and that ESG factors can help to mitigate risk and increase resilience in the face of environmental and social challenges. The findings demonstrate that ESG-integrated businesses exhibit less stock performance volatility than their contemporaries in the same sector. During the timespan of the data conducted in the research, it is worth noting that in that same period the global oil market experienced a significant downturn in 2014 and 2015, characterized by a sharp decline in oil prices from around $100 per barrel to below $40 per barrel. This decline was driven by factors such as oversupply of oil, slowdown in global economic growth, and changes in oil production

patterns. In financial markets, the decline in oil prices contributed to increased volatility and uncertainty, particularly in the commodities and energy sectors.

As ESG investing has grown in popularity, it has also become more closely linked with broader trends in sustainable finance and impact investing. These approaches emphasize the importance of investing in companies and projects that generate positive social and environmental impact, in addition to delivering financial returns.

2.3 The Evolution of ESG Investing: A Historical Overview

ESG investing has its roots in socially responsible investing (SRI), which can be traced back to religious groups and other organizations that avoided investing in industries such as tobacco, alcohol, and gambling due to ethical or moral concerns. In the 1960s and 1970s, the SRI movement gained traction among investors, who began to see the potential for investing in companies that aligned with their values.

However, early SRI strategies often focused solely on ethical or moral considerations and did not take into account environmental or social factors. This began to change in the 1990s, as concerns about issues such as climate change and labor practices became more prominent.

The term "ESG" was first coined in a 2005 report by the United Nations Global Compact, which called for companies to adopt sustainable and responsible business practices. Since then, ESG investing has become increasingly popular, with investors seeking to incorporate sustainability and social responsibility into their investment portfolios. The market economy brought on by the collapse of the Soviet Union, the emergence of massive multinational corporations, and the explosive economic development of emerging nations all contributed to the acceleration of economic globalization in the 1990s. At the Earth Summit hosted by the United Nations (UN) in Rio de Janeiro, Brazil, in 1992, Agenda 21, a plan of action that nations and pertinent international organizations carry out to achieve "sustainable development" in the twenty-first century, was adopted (Nakajima et. Al 2016).

Another important development has been the growth of impact investing, which seeks to generate positive social or environmental outcomes in addition to financial returns. Impact investing has become an important part of the ESG landscape, as more investors seek to invest in companies and funds that have a measurable positive impact on society or the environment.

The growth of ESG investing has been driven by a number of factors, including increasing awareness of environmental and social issues, changing investor preferences, and advances in technology that have made it easier to collect and analyze data on ESG factors. In addition, regulatory changes such as the Paris Agreement on climate change have put pressure on companies to adopt more sustainable practices, creating incentives for investors to invest in companies that are taking action on ESG issues.

Critics argue that ESG investing may not always deliver superior returns, and that there is a risk of "greenwashing" - companies making false or exaggerated claims about their ESG performance in order to attract investors.

Despite these challenges, ESG investing is likely to continue to grow in popularity as investors seek to align their investment portfolios with their values and priorities. The history of ESG investing shows that sustainability and social responsibility are becoming increasingly important factors in the global economy, and that investors have a role to play in promoting positive change (PwC, 2022).

According to the working papers of Albuquerque et al. (2022), recent research shows that there is greater interest among investors in ESG funds. Bauer et al. (2021) documents that a majority of individual investors in a Dutch pension fund are willing to increase investments based on the UN Sustainable Development Goals even at the expense of financial returns. Research has been carried out and evidence has been found that ESG funds perform as well as traditional funds in the market.

2.4 ESG key challenges

One key challenge for the ESG investing industry is the lack of standardization in ESG ratings and assessments. The lack of standardization in ESG ratings and assessments, as well as the lack of consistent ESG data disclosure by companies, can make it difficult for investors to accurately evaluate companies on ESG factors and to make informed investment decisions.

There are currently multiple ESG rating agencies and frameworks, each with their own methodology and criteria for evaluating companies on ESG factors. If the ratings and assessments used to evaluate sustainable funds lack standardization or reliability, it can potentially impact the performance of these funds, particularly when the companies they invest in are susceptible to oil price fluctuations or other market risks.

Another challenge is the lack of consistent ESG data disclosure by companies (Probert, 2021). While many companies now provide some information on their sustainability and social responsibility practices, there is no standardized reporting framework for ESG data, and the quality and completeness of the data provided can vary widely.

Additionally, there is ongoing debate over the effectiveness of ESG strategies and the extent to which they can deliver superior financial returns. While some studies have found a positive correlation between strong ESG performance and financial performance, others have found little or no correlation. This has led some investors to question the value of ESG investing and to focus more narrowly on financial performance (Raghunandan et. al 2022).

The ongoing debate surrounding the effectiveness of ESG strategies and their potential to deliver superior financial returns has the potential to impact the performance of sustainable funds, including those that invest in companies exposed to the oil industry. While some argue that the performance may be negatively affected, it is also contended that the removal of interest and price pressure could potentially lead to increased returns. If some investors focus more narrowly on financial performance and question the value of ESG investing, they may be less willing to invest in sustainable funds, potentially affecting their performance in the face of oil price changes. It is important for investors to carefully evaluate the evidence on the correlation between ESG performance and financial performance when making investment decisions.

Despite these obstacles, the ESG investment market is steadily expanding and evolving. Industry-wide standards and reporting frameworks are being established to address the issue of uneven ESG ratings and assessments. Notably, groups like the Global Reporting Initiative (GRI) and the Sustainability Accounting Standards Board (SASB) are actively trying to build standardized reporting standards for ESG data. The Sustainable Finance Disclosure Regulation (SFDR) and its supporting taxonomy, which have become important components in the effort to standardize ESG reporting within the EU, must also be included. In order to categorize sustainable economic activities and provide a thorough framework for their identification, the SFDR introduces a taxonomy. We acknowledge the SFDR's function in fostering uniformity and openness throughout the ESG investing environment by incorporating the SFDR and its taxonomy into talks regarding standardized ESG reporting.

Another potential solution is the use of artificial intelligence and other advanced technologies to improve the collection and analysis of ESG data. These technologies can help investors to

more accurately evaluate companies on ESG factors and to identify potential risks and opportunities.

Overall, while the ESG investing industry faces challenges, it is clear that sustainability and social responsibility are becoming increasingly important factors in the global economy. As more investors seek to align their investment portfolios with their values and priorities, the demand for ESG investments is likely to continue to grow, and the industry will need to continue to evolve and adapt to meet this demand.

3.0 Literature review

We seek to present a thorough overview of the literature on the effects of oil prices on sustainable funds and their environmental, social, and governance (ESG) returns in this literature review. We look at both the larger body of research on ESG returns as well as particular studies that look at the connection between oil prices and ESG returns. We want to improve the understanding of the intricate relationship between oil prices and sustainable investing by synthesizing and evaluating this material.

Sustainable investing has gained increasing attention in recent years, with more and more investors seeking to align their investments with their values and beliefs. One important factor that has been shown to influence the performance of sustainable funds is the price of oil. As a key driver of economic growth and a major input cost for many companies, fluctuations in oil prices can have significant implications for the financial performance of firms and, in turn, for the returns of sustainable investment portfolios.

Given the growing importance of sustainable investing and the significant role of oil prices in the global economy, understanding the relationship between these two factors is of great interest to investors, policymakers, and academics alike. In this literature review, we aim to provide a comprehensive overview of the existing research on the impact of oil prices on sustainable funds. Specifically, we will examine the theoretical foundations underlying this relationship, review the empirical evidence on the topic, and discuss the implications of these findings for sustainable investors. By synthesizing and critically analyzing the existing literature, we hope to contribute to a better understanding of the complex interplay between oil prices and sustainable investment.

Oil prices are one of the most significant factors that can impact the performance of sustainable funds. (Nandha & Faff, 2008) analyze 35 DataStream global industry indices 1983 – 2005, and find that oil prices have a significant impact on stock market returns, especially for energy-intensive industries such as manufacturing, transportation, and construction. They also found that the impact of oil prices on stock market returns is asymmetric, with negative oil price shocks having a larger impact than positive shocks.

(Alamgir & Bin Amin, 2021) use a Nonlinear Autoregressive Distributed Lag (NARDL) to investigate the dynamic relationship between oil prices and the stock market in four South

Asian nations, 1997-2018. They found that there is a strong positive correlation between oil prices and the stock market, especially for companies in the energy sector. When oil prices rise, energy companies tend to perform better, which can have a positive spillover effect on other industries that rely on energy. Conversely, when oil prices fall, energy companies tend to perform poorly, which can have a negative impact on the stock market as a whole.

To study how oil prices affect particular stock market sectors, (Henriques & Sadorsky, 2011) used a recently created generalized method of moment estimation approach for panel data sets. According to their findings, the stock values of energy businesses are significantly impacted by oil prices, especially during times of high oil price volatility. On non-energy companies, however, the effect of oil prices is substantially less significant.

Pedersen et al. (2020) develop an equilibrium model and tests it empirically to explore the concept of the ESG-efficient frontier. The portfolios are evaluated over a period of more than 10 years, from January 2007 to March 2018. The authors also use statistical analysis to measure the relationship between ESG performance and financial performance, as well as the impact of ESG constraints on portfolio performance. The article examines three distinct investor categories. Type-U (ESG-unaware) investors place more emphasis on maximizing their unconditional mean-variance utility than on ESG rankings. Mean-variance preferences are equally significant to type-A (ESG-aware) investors, but they additionally adjust their expectations for risk and return based on the ESG ratings of assets. ESG data is used by Type-M (ESG-motivated) investors, who favor investments with high ESG scores. In other words, M investors are seeking a portfolio that provides the ideal ratio between a high projected return, minimal risk, and a high average ESG score.

However, in their study they find that minimal ex post improvement in the Sharpe ratio of an investor who uses such information in their portfolio decision when we estimate the ESG-SR frontier using E (carbon). Despite this, the frontier is still helpful since it illustrates the SR cost of shifting toward a portfolio that is less carbon intensive, a cost that is empirically negligible even for a significant reduction in carbon. In conclusion, these horizons demonstrate the potential set for a responsible investor while measuring the costs and gains associated with implementing ESG in investments.

Whelan et. al (2021), conduct a meta-analysis of more than 1,000 academic studies published between 2015 and 2020. The authors use a systematic review approach to identify relevant

studies, extract data, and synthesize findings. They analyze the studies to determine whether there is a positive, negative, or neutral relationship between ESG factors and financial performance. The study provides a comprehensive and rigorous review of the empirical evidence on the relationship between ESG and financial performance. The study finds that investing in ESG seems to offer downside protection, particularly in times of social or economic crises. The absence of uniformity with ESG data does, however, muddy the outcomes. Studies employ various scores from various data sources for various companies. This lack of consistency arises from the utilization of diverse ESG scores obtained from various data sources for a wide range of companies. As a result, studies in the field often face the challenge of dealing with disparate and sometimes conflicting data sets, hindering the ability to draw conclusive and comparable findings. The use of different methodologies, rating systems, and data collection approaches across the industry contributes to this lack of uniformity.

They find managing a future with minimal carbon emissions enhances financial performance. Just a handful of the several strategies mentioned in the study include ESG integration, ESG momentum, decarbonizing, socially responsible investment (SRI), negative screening, and impact investing. Despite the fact that each one has a varied impact on risk and reward, they are frequently combined.

Berle et al. (2022) examine the effects of portfolio exclusions based on ESG on the anticipated returns of omitted companies. The time sample for the data used is throughout 2005-2019, where 189 companies have been excluded. The largest sovereign wealth fund in the world, Norway's "Oil Fund," has excluded a sample of funds, offering a representative sample of the stocks that are frequently excluded by institutional investors. The portfolio of companies that were omitted has a performance advantage (alpha) of around 5%. The sheer size of these extra returns indicates that equities that are excluded have a return premium.

This is seen as evidence of dynamics: Companies with low ESG at the time of exclusion (scope for development) and higher revenue growth (investment needs) are more likely to have their exclusion revoked. In order to remove exclusions and minimize their cost of capital, businesses increase their ESG efforts. In actuality companies that are removed from the exclusion list do not perform better in the future.

The intuitive argument of Berle et. al (2022), is that ESG factors will influence all large institutional investor's portfolio decisions. To determine how to over- and under-weight

investments, the investor's investment universe must be ranked in the ESG dimension. An institutional investor's response to stocks with low ESG ratings will either be discussion or divestment. Institutional investors contend that conversation is a better strategy for bringing about change, nevertheless. The paper uses an empirical study to investigate the impact of ESG exclusion on expected returns and the costs of capital for companies. The authors employ a difference-in-differences (DID) methodology, which involves comparing the returns and costs of capital of companies that are excluded from the fund's ESG universe with those that are not excluded, before and after the exclusion. The study uses data from the world's largest sovereign wealth fund, Norway's Government Pension Fund Global (GPFG), and covers the period from 2008 to 2018.

The study provides evidence that exclusion from the GPFG's ESG universe has a negative impact on expected returns for excluded companies. However, the authors find no significant impact on the cost of capital for excluded companies. The study also provides insights into the channels through which ESG exclusion affects expected returns, suggesting that exclusion leads to lower demand for excluded companies' shares and higher risk perception among investors.

Kumar et. al (2016), present a quantitative model that aims to identify the impact of ESG factors on risk-adjusted performance. They analyze a sample of US companies and apply a multi-factor framework that includes ESG factors, traditional financial factors, and company-specific characteristics to identify the degree to which ESG factors impact risk-adjusted performance. The authors use descriptive statistics to present the characteristics of their sample and statistical modeling to estimate the relationship between ESG factors and risk-adjusted performance.

Cheema-Fox et al. (2019) investigates how decarbonization factors are built and discovered that various decarbonization tactics produce various risk-adjusted returns. They discovered that techniques that aggressively reduced carbon emissions performed better.

A study by (In, 2017), an analysis of 736 US public companies from 2005 to 2015 revealed that a strategy of buying carbon-efficient companies and selling them may generate an abnormal return of 3.5% to 5.4% per year. According to their study, buying stock in carbon-efficient companies can be advantageous even without government subsidies.

Ibikunle et al. (2015) conducts a comparative analysis and examine the financial performance of European green, black (fossil fuel and natural resource), and conventional mutual funds.

The study compares the financial success of the three distinct investing orientations 1991–2014 using a unique dataset of 175 green, 259 black, and 976 conventional mutual funds. While there were no discernible risk-adjusted performance differences between green and black mutual funds throughout the sample period, green mutual funds considerably underperform conventional funds. Black funds are more exposed to value companies than environmentally friendly investment vehicles, which have a strong exposure to small cap and growth firms.

3.1 Sustainable Investing and Climate Change: Assessing the Risks and Returns of the Oil, Gas, and Coal Sector

As concerns about climate change continue to grow, investors are increasingly looking for ways to make more sustainable investment decisions. One area of particular interest is the oil, gas, and coal sector, which is known for its high carbon emissions and significant impact on the environment.

In 2017, Norges Bank Investment Management (NBIM) released an analysis note on how variations in the price of oil affect equity sectors. The study found that the Oil & Gas industry was most susceptible to changes in the price of oil, and that the sector's cash flows were closely linked to oil prices. This suggests that oil price shocks can have long-lasting repercussions on sector returns, making it a high-risk investment for those concerned about climate change.

The analysis also found that there were no significant discrepancies between the predicted returns of Oil & Gas stocks and those of the overall market. This means that investors who are already highly exposed to changes in the price of oil outside of their financial portfolio may not benefit from adding Oil & Gas companies to their portfolio.

The note from NBIM highlighted the importance of considering the long-term risks associated with climate change when making investment decisions. This includes taking into account the potential for policies aimed at reducing greenhouse gas emissions to impact the profitability of companies in sectors with high exposure to fossil fuels.

In 2022, a new study by Güngör and Şeker (2022) delved deeper into the issue of sustainability in the oil, gas, and coal sectors. The study analyzed data from 57 companies in

the sector and examined the relationship between board characteristics and environmental, social, and governance (ESG) performance.

The study found that board size had a negative relationship with ESG performance, meaning that larger boards were associated with lower ESG performance. On the other hand, board independence had a positive relationship with ESG performance, indicating that companies with more independent directors tended to have higher ESG performance. The study also found that gender diversity on boards had a positive relationship with ESG performance, suggesting that companies with more women on their boards tended to have higher ESG performance.

Overall, the findings of the Güngör & Şeker study highlight the important role that board characteristics play in determining the ESG performance of companies in the oil, gas, and coal sector. The results may be useful for companies looking to improve their ESG performance and for investors seeking to make informed decisions based on ESG criteria.

4.0 Empirical methods

In this thesis, a linear regression model was used to investigate the potential impact of oil price changes on ESG funds. The primary aim was to assess whether the observed effects were statistically significant, thereby providing evidence for a relationship between oil prices and ESG funds.

The regression model was designed to test the statistical significance of the benchmark variable in relation to the ESG funds. Additionally, the study examined the statistical significance of oil price changes in relation to ESG funds, with the aim of identifying any potential oil price effects.

The regression model was developed with the goal of determining the statistical significance of the benchmark variable in relation to ESG funds. The inclusion of the benchmark variable attempted to determine if the observed fluctuations were due to random chance or if they represented a legitimate effect or association. Furthermore, the study investigated the statistical significance of oil price changes in relation to ESG funds, with the goal of identifying any potential effects caused by changes in oil prices.

Is specified as follows:

$$(R_t^{ESG\ fund} - Rf_t) = \alpha^{ESG\ fund} + \beta^M (R_t^M - Rf_t) + \beta^{Oil} * \Delta^{Oil} + \epsilon_t$$

β^M represents the beta for the respective benchmark associated with each individual ESG fund. It measures the degree to which the ESG fund's returns move in relation to the benchmark's returns. The excess return of the benchmark over the 10-year government bond $(R_t^M - Rf_t)$ is employed as a measure to capture the relative performance of the benchmark. The oil beta, β^{Oil}, is a coefficient that describe the sensitivity of the ESG funds to changes in oil prices. It represents the extent to which the ESG funds' returns are influenced by fluctuations in the price of oil. Δ^{Oil} represents oil price changes.

We have also implemented more regression models by including a dummy variable to see whether spikes in oil price changes effects ESG funds.

Is specified as follows:

$$(R_t^{ESG\ fund} - Rf_t) = \alpha^{ESG\ fund} + \beta^M (R_t^M - Rf_t) + \beta^{Oil} * D_{H,L}\Delta^{Oil} + \epsilon_t$$

Where $D_H\Delta^{Oil}$ is the dummy variable that takes into the account of oil price over 8% as 1 and 0 for returns under 8% whereas $D_L\Delta^{Oil}$ takes into the account of oil price under -8% as 1 and 0 for returns over -8%.

5.0 Sample

We have collected data of 12 funds that are marketed towards sustainable investment. Table 1 presents all the funds we have used in this thesis.

MSCI AC WORLD U$	S&P GLOBAL CLEAN ENERGY $	OSLO EXCHANGE MUTUAL FUND IND
DNB GLOBAL LAVKARBON A	DNB MILJOINVEST A	STOREBRAND NORGE FOSSILFRI A
CPR INVEST - CLIMATE ACTION EURO A EUR ACC	HANDELSBANKEN HALLBAR ENERGI (A1 NOK)	
NORDEA 1-GLOBAL CLIMATE AND ENVIRONMENT BP NOK		
BNP PARIBAS CLIMATE IMPACT CLASSIC CAP		
KLP AKSJE GLOBAL MSA P		
STOREBRAND GLOBAL ESG PLUS A		
STOREBRAND GLOBAL ESG		
DNB BARNEFOND A		
DNB GRONT SKIFTE NORDEN A		

Table 1: ESG and corresponding benchmark used by each fund.

The data used in this study was obtained from Refinitiv Eikon, with a focus on Norwegian funds. To assure data reliability, a strict criterion was employed, requiring a minimum data duration of five years or an approximate period close to five years. Another criterion that was employed was the funds had to have titles that indicated their clear concentration on environmental, social, and governance (ESG) investments, such as "Lav karbon" or "Fossilfri" As a result, twelve funds was chosen. The monthly observations spanned from December 31, 2017, to January 31, 2023. Except for KLP Aksje Global MSA P, which had data from July 31, 2018, to January 31, 2023,

5.1 Benchmarks and WTI crude oil

The twelve funds we used have three different benchmarks, S&P Global Clean Energy, MSCI AC World, and OSLO EXCHANGE Mutual Fund. We used these benchmarks to calculate performance measures such as Jensen's Alpha, Sharpe ratio, and Information Ratio (IR).

We collected monthly observations of S&P Global Clean Energy, MSCI AC World, OSLO EXCHANGE Mutual Fund, and WTI crude oil spot prices from 31.01.2017 to 31.01.2023. This was due to our interest in finding out how much oil price changes affected the ESG funds' performance.

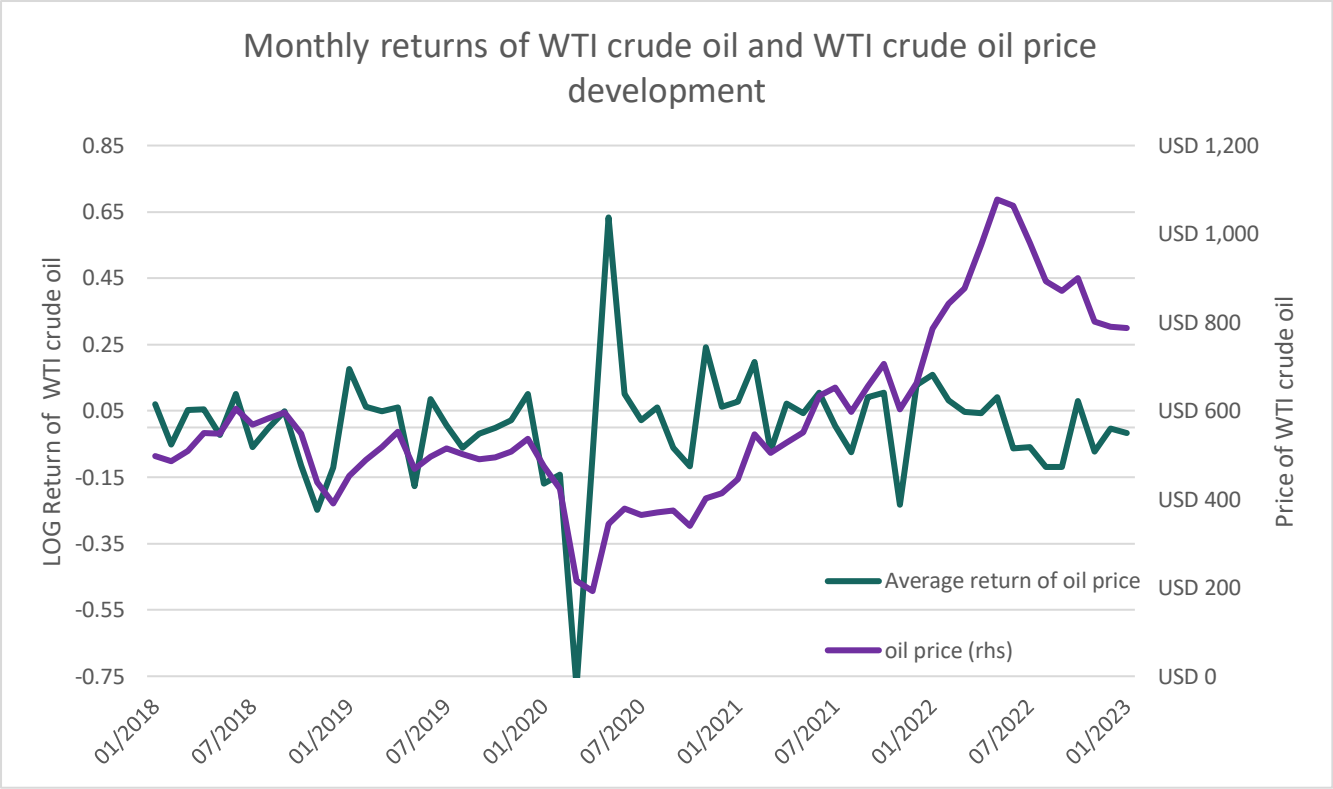

Figure 1: Monthly return of WTI crude oil spot price and WTI crude oil spot price development from 31.01.18 – 31.01.23

As presented in Figure 7 it is important to take into the account of war between Ukraine and Russia on 24 of February 2022 and its effect on oil price development which can cause some concerns when looking at the regression model.

Table 2: Annualized return and standard deviation of benchmark and WTI crude oil from 31.12.17 - 31.01.23

	Return	Standard deviation
S&P GLOBAL CLEAN ENERGY $	17.6%	30.4%
MSCI AC WORLD U$	6.9%	17.9%
OSLO EXCHANGE MUTUAL FUND IND	7.3%	17.2%
Crude Oil-WTI Spot Cushing U$/BBL	7.6%	16.2%

6.0 Econometric Results

Table 3: Regression model,31.12.17 - 31.01.23 (KLP AKSJE GLOBAL MSA P from 31.07.18 – 31.01.23). Figures marked in bold are statistically significant at a 5% level.

Regression							
	Jensens Alpha	t-stat	Market beta	t-stat	Oil beta	t-stat	Adjusted R Square
DNB GLOBAL LAVKARBON A	0.01	1.71	**0.50**	-6.61	**-0.06**	-2.51	0.42
DNB MILJOINVEST A	0.01	1.02	**0.56**	-6.34	0.03	0.87	0.57
CPR INVEST - CLIMATE ACTION EURO A EUR ACC	0.00	0.05	**0.55**	-5.58	-0.02	-0.90	0.47
NORDEA 1-GLOBAL CLIMATE AND ENVIRONMENT BP NC	0.01	1.66	**0.62**	-4.33	**-0.08**	-2.83	0.45
BNP PARIBAS CLIMATE IMPACT CLASSIC CAP	0.00	0.98	**0.68**	-3.34	**-0.06**	-2.18	0.47
KLP AKSJE GLOBAL MSA P	**0.01**	2.16	**0.59**	-5.71	**-0.08**	-3.41	0.55
STOREBRAND GLOBAL ESG PLUS A	0.01	1.75	**0.60**	-5.64	**-0.07**	-3.32	0.53
STOREBRAND GLOBAL ESG	0.01	1.86	**0.58**	-5.98	**-0.07**	-2.96	0.53
HANDELSBANKEN HALLBAR ENERGI (A1 NOK)	0.00	1.05	**0.66**	-6.09	-0.04	-1.50	0.72
DNB BARNEFOND A	0.00	1.44	**0.61**	-5.05	**-0.06**	-2.60	0.51
DNB GRONT SKIFTE NORDEN A	0.00	1.04	**0.61**	-4.35	**-0.07**	-2.39	0.44
STOREBRAND NORGE FOSSILFRI A	0.00	0.31	0.92	-1.44	-0.03	-1.57	0.85

From table 3 we can see that most funds have negative oil betas except DNB Miljøinvest A. This implies that these funds' performance is negatively influenced by increases in oil prices.

Based on the regression analysis presented in table 3, we conclude that oil price changes have an effect on the performance of most of the ESG funds. The negative oil betas and their corresponding t-statistics indicate that increases in oil prices have a negative impact on the returns of ESG funds. This relationship is supported by the negative oil beta coefficients, which suggest a negative correlation between oil price movements and the funds' performance. The exception is DNB Miljøinvest A, CPR INVEST, Handelsbanken Hallbar Energi (A1 NOK) and Storebrand Norge Fossilfri A, where the oil beta is not statistically significant.

The t-statistics associated with Jensen's Alpha indicate the statistical significance of the alpha values. In the provided table, only one of the funds has a significant Jensen's alpha namely KLP Aksje Global MSA P. Whilst the rest of the fund did not have a significant Jensen's Alpha, which indicates that there is no abnormal return after controlling for the market and the oil price.

The adjusted R-square is a measure of how well the independent variables (such as market beta and oil beta) explain variation in the dependent variable (ESG fund returns). In Table 3, the adjusted R-square values range from 0.42 to 0.85. These values suggest that the independent variables, including oil beta, collectively explain a relatively large portion of the funds' returns.

The market beta provides insights into the sensitivity of the funds' returns to overall market movements. The t-statistics associated with market beta indicate that the market beta is

statistically significant for all the funds, implying that changes in the overall market have a significant impact on their returns.

We have included two more regression models with the objective of determining whether oil price shocks have an impact on the ESG funds. The initial regression model has a criterion by setting the dummy variable to 1 for oil return greater than 8%, alternatively 0 for returns less than 8%. The latter regression model included a dummy variable with a value of 1 for oil return less than -8%, and 0 for oil return greater than -8%.

Table 4: Regression model with dummy variable when oil is higher than 8% from 31.12.17 - 31.01.23 (KLP AKSJE GLOBAL MSA P from 31.07.18 – 31.01.23). Figures marked in bold are statistically significant at a 5% level.

Regression when oil price changes > 0.08							
	Jensens Alpha	t-stat	Market beta	t-stat	Oil beta	t-stat	Adjusted R Square
DNB GLOBAL LAVKARBON A	**0.01**	2.02	**0.42**	-8.36	-0.05	-1.21	0.37
DNB MILJOINVEST A	0.01	0.92	**0.58**	-6.36	0.00	0.00	0.57
CPR INVEST - CLIMATE ACTION EURO A EUR ACC	0.00	0.44	**0.53**	-6.65	-0.04	-1.03	0.47
NORDEA 1-GLOBAL CLIMATE AND ENVIRONMENT BP NC	**0.01**	2.14	**0.52**	-5.93	-0.07	-1.66	0.40
BNP PARIBAS CLIMATE IMPACT CLASSIC CAP	0.01	1.60	**0.61**	-4.60	-0.08	-1.77	0.46
KLP AKSJE GLOBAL MSA P	**0.01**	2.74	**0.49**	-7.54	-0.07	-1.91	0.48
STOREBRAND GLOBAL ESG PLUS A	**0.01**	2.33	**0.50**	-7.47	**-0.07**	-1.97	0.48
STOREBRAND GLOBAL ESG	0.01	1.57	**0.64**	-6.84	-0.07	-1.51	0.49
HANDELSBANKEN HALLBAR ENERGI (A1 NOK)	0.01	1.57	**0.64**	-6.84	-0.07	-1.51	0.72
DNB BARNEFOND A	0.01	1.94	**0.53**	-6.66	-0.06	-1.62	0.48
DNB GRONT SKIFTE NORDEN A	0.01	1.44	**0.52**	-5.86	-0.05	-1.24	0.40
STOREBRAND NORGE FOSSILFRI A	0.00	0.34	**0.87**	-2.75	0.00	-0.02	0.85

Regression analysis results for ESG funds when oil price changes exceed 8% are presented in Table 4. The table provides information on Jensen's Alpha, t-statistics for alpha, market beta, oil beta, and the adjusted R-square. These metrics help us understand the relationship between oil price movements and the performance of the ESG funds.

When examining the alpha values, we observe that most of the ESG funds have positive Jensen's Alpha values, suggesting some level of outperformance compared to their respective benchmarks. However, it is important to note that the statistical significance of these alpha values varies among the funds. Four funds, namely DNB Global Lavkarbon A, Nordea 1-Global Climate and Environment BP NOK, KLP Aksje Global MSA P and Storebrand Global ESG Plus A, exhibit a statistically significant alpha at the 5% significance level. The remaining funds' alpha values are not statistically significant, indicating that there is

insufficient evidence to conclude that their performance differs significantly from what would be expected given their systematic risk exposure.

Now, looking at the oil beta and their corresponding t-statistics for oil return greater than 8%. The negative oil betas observed for the majority of the funds, such as DNB Global Lavkarbon A, CPR INVEST - Climate Action Euro A EUR ACC, etc. indicate a negative relationship between oil price movements and the funds' returns. This suggests that increases in oil prices tend to have a negative impact on the performance of these funds. However, it is worth noting that the t-statistics associated with these oil betas are not statistically significant except for Storebrand Global ESG Plus A at the 5% level, indicating that the relationship between oil price movements and fund returns might have occurred by chance.

The observed adjusted R-square values, ranging from 0.37 to 0.72, indicate that the independent variables, including the oil beta, jointly account for a portion of the returns exhibited by the ESG funds. Nonetheless, it is crucial to acknowledge that the relatively low adjusted R-square values in Table 4 could stem from potential issues related to the suitability of the model specification for the given dataset, particularly due to a limited number of observations incorporated in the regression analysis when looking at returns greater than 8%.

Table 5: Regression model with dummy variable when oil is lower than 8% from 31.12.17 - 31.01.23 (KLP AKSJE GLOBAL MSA P from 31.07.18 – 31.01.23). Figures marked in bold are statistically significant at a 5% level.

Regression when oil price changes < - 0.08							
	Jensens Alpha	t-stat	Market beta	t-stat	Oil beta	t-stat	Adjusted R Square
DNB GLOBAL LAVKARBON A	0.00	0.80	**0.47**	-6.85	-0.06	-1.85	0.39
DNB MILJOINVEST A	0.01	1.55	**0.54**	-6.64	0.08	1.55	0.58
CPR INVEST - CLIMATE ACTION EURO A EUR ACC	0.00	0.05	**0.51**	-6.04	0.00	-0.01	0.46
NORDEA 1-GLOBAL CLIMATE AND ENVIRONMENT BP NC	0.00	0.69	**0.58**	-4.65	**-0.08**	-1.98	0.41
BNP PARIBAS CLIMATE IMPACT CLASSIC CAP	0.00	0.62	**0.61**	-4.00	-0.03	-0.67	0.43
KLP AKSJE GLOBAL MSA P	0.00	0.97	**0.55**	-5.90	**-0.08**	-2.31	0.50
STOREBRAND GLOBAL ESG PLUS A	0.00	0.78	**0.55**	-6.04	-0.06	-1.90	0.48
STOREBRAND GLOBAL ESG	0.00	0.98	**0.14**	-16.31	0.03	0.63	0.49
HANDELSBANKEN HALLBAR ENERGI (A1 NOK)	0.00	0.72	**0.65**	-6.20	-0.03	-0.68	0.71
DNB BARNEFOND A	0.00	0.59	**0.57**	-5.37	-0.06	-1.76	0.48
DNB GRONT SKIFTE NORDEN A	0.00	0.16	**0.59**	-4.55	**-0.08**	-1.98	0.42
STOREBRAND NORGE FOSSILFRI A	0.00	-0.59	0.94	-1.10	**-0.05**	-2.03	0.86

Regression analysis results for ESG funds, specifically when oil price changes exceed -8%, are presented in Table 5.

Examining the alpha values, we observe that most of the ESG funds have positive Jensen's Alpha values, indicating some level of outperformance relative to their respective benchmarks. However, it is important to consider the statistical significance of these alpha

values. Among the twelve funds analyzed none of the ESG funds demonstrate statistically significant alpha values at the 5% significance level.

Moving on to market beta, it is clear that the majority of funds have statistically significant market betas, as seen by the associated t-statistics. This regression model points to a strong link between the fund's performance and market fluctuations. As a result, it may be deduced that when the market performs well, the fund is more likely to outperform, whereas poor market performance indicates the tendency for the fund to underperform.

Now, let's explore the oil beta and their respective t-statistics. Most of the funds display negative oil betas, such as DNB GLOBAL LAVKARBON A, CPR INVEST - CLIMATE ACTION EURO A EUR ACC, etc. These negative oil betas suggest a negative relationship between negative oil price shock movements and the funds' returns. In other words, increases in oil prices tend to have a negative effect on the performance of these funds. However, it is noteworthy that the t-statistics associated with these oil betas are not statistically significant, except for Nordea 1-Global Climate and Environment BP NOK, KLP Aksje Global MSA P, DNB Grønt Skifte Norden A, and Storebrand Norge Fossilfri A at the 5% level. This implies that the observed relationship between oil price movements and fund returns may have also occurred by chance.

Considering the adjusted R-square values it is crucial to acknowledge that the relatively low adjusted R-square values in Table 5 also stem from potential issues related to the suitability of the model specification for the given dataset, particularly due to a limited number of observations incorporated in the regression analysis when looking at returns less than 8%.

We also tested for the validity of our regression model by using Breusch-Godfrey test for autocorrelation and Breusch-Pagan test for heteroskedasticity.

The results from Breusch-Godfrey test for autocorrelation indicate that Storebrand Norge Fossilfri A is the only fund that demonstrates statistical significance, as evidenced by its low p-value of 0.047. However, it is noteworthy that out of the twelve funds analyzed, only one exhibits evidence of autocorrelation. Given that this solitary case of autocorrelation does not significantly disrupt the overall regression analysis, it is reasonable to disregard its impact on the results.

The analysis from Breusch-Pagan test reveals that among the twelve funds examined, DNB Grønt Skifte Norden A stands out as the sole fund that exhibits statistical significance, with a

notably low p-value of 0.0035. Importantly, it is worth noting that only one fund demonstrates evidence of heteroskedasticity, thus representing an independent instance within the overall dataset. Given the limited presence of autocorrelation and its minimal impact on the regression analysis, it is justifiable to disregard its influence on the observed results.

Conclusion

This thesis investigates the relationship between changes in oil prices and the risk-adjusted returns of ESG funds.

Through a regression model, we found that the majority of funds exhibited negative oil betas, indicating that increases in oil prices negatively affect the performance of these funds. Notably, the absence of statistical significance in the t-statistics associated with the oil betas implies that the observed relationships may have occurred by chance, except for certain specific funds. However, when looking at the regression model that takes into account of oil price shocks at greater than 8% and oil price shock of less than -8% we can see that most of the oil price shocks are not statistically significant meaning that ESG funds are less affected when only looking at oil price shocks of return greater than 8% and oil price shock with a return less than -8%.

Moreover, the examination of Jensen's Alpha values revealed that most ESG funds demonstrated no statistical significance Alpha values. With only a select few funds demonstrating statistically significant alphas at the 5% significance level. This suggests that the performance of these funds may not significantly deviate from the expected return considering their systematic risk exposure.

The adjusted R-square values shed light on the explanatory power of the independent variables, including the oil beta, in revealing the variation in the returns of ESG funds. The adjusted R-square values imply that these independent variables collectively account for a portion of the funds' returns. Nevertheless, it is crucial to acknowledge that lower adjusted R-square values for oil price shocks could stem from potential issues related to the suitability of the model specification for the given dataset, particularly due to a limited number of observations incorporated in the regression analysis when looking at returns greater than 8% and for returns less than 8%.

Taken together, the findings indicate that changes in oil prices do impact the performance of ESG funds, with most funds experiencing negative effects on their risk-adjusted returns in response to increases in oil prices.

To conclude, this research contributes to the understanding of the relationship between oil price changes and the risk-adjusted returns of ESG funds. The findings suggest that oil price movements possess the ability to influence the performance of these funds, although the significance and magnitude of these effects vary across funds. Additional research is necessary to explore supplementary factors and mechanisms that may drive the observed relationships and to enhance our comprehension of the dynamics between oil prices and the performance of ESG funds.

Limitations:

While this research has provided important insights into the relationship between ESG funds and oil prices, it is critical to recognize its limits. To begin with, the research is based on short periods of time, from January 2018 to January 2023, which may not fully capture the long-term relationship and trends. Furthermore, while the use of three regression models improved the analysis, the addition of dummy variables for oil price shock resulted in substantially fewer samples. The second regression model's dummy variable for oil returns greater than 8% provided only 15 observations, while the third regression model's dummy variable for oil returns less than -8% provided only 12 observations. As a result of the limited sample sizes in these models, the generalizability and consistency of the findings may be compromised. Future studies should examine broadening the dataset, hence improving understanding of the factors affecting the ESG fund.

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Appendix

Table 6: Annualized return and standard deviation from 31.12.17 - 31.01.23 (KLP AKSJE GLOBAL MSA P from 31.07.18 – 31.01.23).

Fund return and standard deviation annualized				
	Return*	Standard deviation*	Sharpe	IR
DNB GLOBAL LAVKARBON A	10.8%	11.7%	0.77	0.33
DNB MILJOINVEST A	17.8%	23.3%	0.69	0.01
CPR INVEST - CLIMATE ACTION EURO A EUR ACC	4.6%	13.2%	0.22	- 0.17
NORDEA 1-GLOBAL CLIMATE AND ENVIRONMENT BP NOK	12.2%	14.0%	0.75	0.38
BNP PARIBAS CLIMATE IMPACT CLASSIC CAP	9.8%	15.4%	0.52	0.19
KLP AKSJE GLOBAL MSA P	13.1%	12.5%	0.91	0.50
STOREBRAND GLOBAL ESG PLUS A	11.0%	12.4%	0.75	0.33
STOREBRAND GLOBAL ESG	11.3%	12.2%	0.78	0.36
HANDELSBANKEN HALLBAR ENERGI (A1 NOK)	17.8%	22.7%	0.71	0.01
DNB BARNEFOND A	10.4%	13.1%	0.66	0.27
DNB GRONT SKIFTE NORDEN A	9.4%	14.1%	0.55	0.18
STOREBRAND NORGE FOSSILFRI A	7.6%	16.2%	0.36	0.02

Code in R for Breusch Godfrey test for autocorrelation and breusch pagan test for heteroskedasticity:

```
install.packages("tidyverse")

install.packages("lmtest")
```

```
library(tidyverse)

library(lmtest)

# Importing returns ----

library(readxl)

returns <- read_excel("C:/Users/Thoma/OneDrive/Desktop/ESG data.xlsx")

# All the regression models ----

reg_1 <- lm(returns$`DNB GLOBAL LAVKARBON A -` ~

            returns$`MSCI AC WORLD U$ -` +

            returns$`Crude Oil-WTI Spot Cushing U$/BBL`)

reg_2 <- lm(returns$`DNB MILJOINVEST A -` ~

            returns$`S&P GLOBAL CLEAN ENERGY $ -`+

            returns$`Crude Oil-WTI Spot Cushing U$/BBL`)

reg_3 <- lm(returns$`CPR INVEST - CLIMATE ACTION EURO A EUR ACC -` ~

            returns$`MSCI AC WORLD U$ -` +

            returns$`Crude Oil-WTI Spot Cushing U$/BBL`)

reg_4 <- lm(returns$`NORDEA 1-GLOBAL CLIMATE AND ENVIRONMENT BP NOK -` ~

            returns$`MSCI AC WORLD U$ -` +

            returns$`Crude Oil-WTI Spot Cushing U$/BBL`)


reg_5 <- lm(returns$`BNP PARIBAS CLIMATE IMPACT CLASSIC CAP -` ~

            returns$`MSCI AC WORLD U$ -` +

            returns$`Crude Oil-WTI Spot Cushing U$/BBL`)

reg_6 <- lm(returns$`KLP AKSJE GLOBAL MSA P -` ~

            returns$`MSCI AC WORLD U$ -` +

            returns$`Crude Oil-WTI Spot Cushing U$/BBL`)

reg_7 <- lm(returns$`STOREBRAND GLOBAL ESG PLUS A -` ~

            returns$`MSCI AC WORLD U$ -` +
```

```
        returns$`Crude Oil-WTI Spot Cushing U$/BBL`)
reg_8 <- lm(returns$`STOREBRAND GLOBAL ESG -` ~
        returns$`MSCI AC WORLD U$ -` +
        returns$`Crude Oil-WTI Spot Cushing U$/BBL`)
reg_9 <- lm(returns$`HANDELSBANKEN HALLBAR ENERGI (A1 NOK) -` ~
        returns$`S&P GLOBAL CLEAN ENERGY $ -` +
        returns$`Crude Oil-WTI Spot Cushing U$/BBL`)
reg_10 <- lm(returns$`DNB BARNEFOND A -` ~
         returns$`MSCI AC WORLD U$ -` +
         returns$`Crude Oil-WTI Spot Cushing U$/BBL`)
reg_11 <- lm(returns$`DNB GRONT SKIFTE NORDEN A -` ~
         returns$`MSCI AC WORLD U$ -` +
         returns$`Crude Oil-WTI Spot Cushing U$/BBL`)
reg_12 <- lm(returns$`STOREBRAND NORGE FOSSILFRI A -` ~
         returns$`OSLO EXCHANGE MUTUAL FUND IND -` +
         returns$`Crude Oil-WTI Spot Cushing U$/BBL`)
# The statistics (Do [4] for estimates) ----
coef_1 <- summary(reg_1)
coef_2 <- summary(reg_2)
coef_3 <- summary(reg_3)
coef_4 <- summary(reg_4)
coef_5 <- summary(reg_5)
coef_6 <- summary(reg_6)
coef_7 <- summary(reg_7)
coef_8 <- summary(reg_8)
coef_9 <- summary(reg_9)
coef_10 <- summary(reg_10)
```

```
coef_11 <- summary(reg_11)

coef_12 <- summary(reg_12)

# E.g., adj.R^2

summary(reg_1)[9]

# E.g., Estimates ---

summary(reg_1)[4]

# extract residuals for every model ----

resid_1 <- resid(reg_1)

resid_2 <- resid(reg_2)

resid_3 <- resid(reg_3)

resid_4 <- resid(reg_4)

resid_5 <- resid(reg_5)

resid_6 <- resid(reg_6)

resid_7 <- resid(reg_7)

resid_8 <- resid(reg_8)

resid_9 <- resid(reg_9)

resid_10 <- resid(reg_10)

resid_11 <- resid(reg_11)

resid_12 <- resid(reg_12)

# ========================================================================== #


# ======================== Serial correlation test ============================#

# ========================================================================== #


# initialize an empty dataframe to store the p-values

p_values_BG <- data.frame(matrix(ncol = 1, nrow = 0))
```

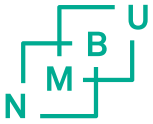
```
# loop through box_test_1 to box_test_12
for (i in 1:12) {
  # run Box.test and extract the p-value
  p_value <- bgtest(get(paste0("reg_", i)))[[4]]

  # add the p-value to the dataframe
  p_values_BG <- rbind(p_values_BG, data.frame(p_value))
}
# rename the column
names(p_values_BG) <- "p_value"
# show the dataframe From lowest p-value
p_values_BG
# ========================================================================== #
# ======================== Heteroskedasticity test ========================= #
# ========================================================================== #
# Initialize an empty dataframe to store the p-values
p_values_BP <- data.frame(matrix(ncol = 1, nrow = 0))
# loop through box_test_1 to box_test_12
for (i in 1:12) {
  # run Box.test and extract the p-value
  p_value <- bptest(get(paste0("reg_", i)))[[4]]

  # add the p-value to the dataframe
  p_values_BP <- rbind(p_values_BP, data.frame(p_value))
}
# rename the column
names(p_values_BP) <- "p_value"
```

```
# show the p-values for the test ----

p_values_BP
```



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