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**Az ESG szerepe a befektetésekben**

Empirikus elemzés az amerikai bank és energia szektorban

**The role of ESG in investments**

Empirical evidence from US Banking and Energy sectors

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## **Abstract**

In my study I test the effect of the ESG score incorporation into investments in the banking and energy sector through the most common ESG investing styles. I test these investment strategies through a portfolio approach and also use the Fama-MacBeth regression simultaneously. Therefore, compelling a more comprehensive analysis. To better account for investor needs, I not only focus my analysis on the returns, but statistically test the standard deviation and downside standard deviation as two measures of risk. I also evaluate the performance through three different risk-adjusted return ratios (Sharpe, Sortino and Information ratio). Looking for structural or systemic differences I divide the data into sub-periods at the Paris Agreement, and into period of recessions. The most interesting result is for the Environment portfolio in the banking sector, which consistently outperforms the sector average in terms of risk-adjusted returns, standard deviation and in some cases in raw return as well. The results are robust for equal and value weighting, different time periods, market conditions and testing methods. It is especially strong in time of recessions. The positive screening investing style in the banking sector also generally outperforms the sector average in terms of risk-adjusted return. However, the results in the energy sector are not so clear. There is no clear good strategy, the results are sensitive for weighting and for time. The positive screening style shows some positive results and the negative screening technics also have some promising results in the energy sector. In conclusion my results support the incorporation of ESG into investment decisions for better risk-adjusted performance in both the banking and the energy sector. With a stronger performance in the banking sector for the Environmental factor.

# **1. Introduction**

## **1.1 Sustainability and responsibility in investing**

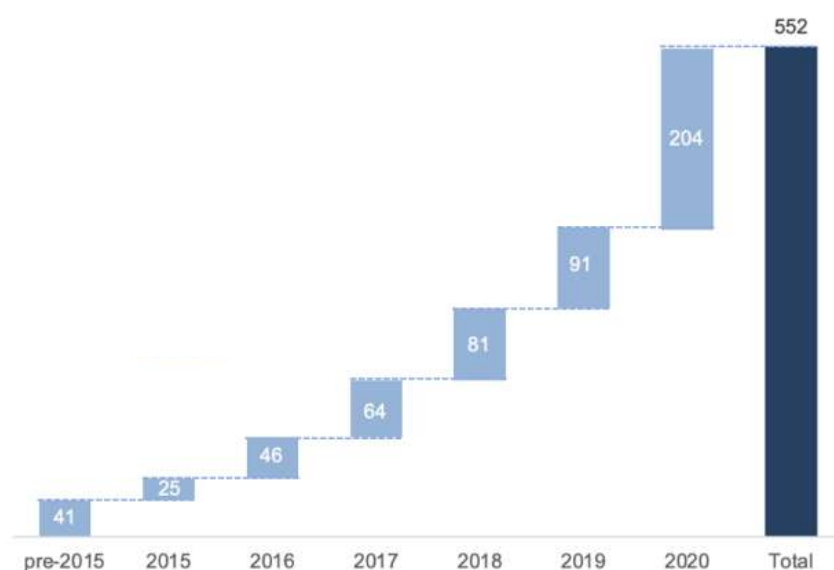
In most case sustainability and responsibility in investing involves incorporating the ESG score, which is a measure of a company's performance on Environmental (E), Social (S), and Governance (G) issues. ESG scores are typically used by investors and other stakeholders to evaluate a company's sustainability and ethical practices. It can be calculated in different ways, based on a combination of quantitative and qualitative factors that assess a company's performance on a range of ESG issues, such as carbon emissions, labor practices, diversity and inclusion, and board diversity (Thomson Reuters, 2017). The scores are usually presented on a numerical scale, such as a 0-100. Usually, higher scores indicate better ESG performance. It is increasingly being used by investors as a tool for portfolio management and investment decision-making, as it can provide insight into a company's long-term sustainability and risks.

Generally, ESG investments refer to investments that consider the sustainability, responsibility and ethical impact of companies and are increasingly becoming important in the investment world. This is due to a variety of reasons such as climate change, changing societal values, regulatory requirements, and financial performance considerations. Climate change is caused by the emission of greenhouse gases, primarily carbon dioxide, which trap heat in the atmosphere and lead to rising temperatures, sea level rise, and changes in weather patterns (IPCC, 2007; Mikhaylov et al., 2020). With growing media attention concerns are getting bigger and people give more attention to climate and sustainability issues the previously (Pearce et al., 2019). Attracting more investors into sustainable or ESG investing as well (Matos, 2020; Verma and Shukla, 2021). Societal values are also changing. In recent years, there has been a growing awareness and concern regarding the environmental and social impact of businesses. People are more interested in investing in companies that prioritize sustainable and ethical practices (Lewis and Webley, 1994; Camilleri, 2021). Therefore, companies that focus on ESG issues are likely to attract more investors who are interested in supporting sustainable and ethical business practices. This is particularly true for younger generations who are more likely to consider the environmental and social impact of their investments (Hale, 2016). There is also regulatory pressure to prioritize ESG investments. Governments around the world are enacting laws that require companies to report on their ESG practices. For example, The EU has introduced two important regulations related to sustainable finance: the Taxonomy Regulation and the

Corporate Sustainability Reporting Directive (CSRD) (European Commission, 2021). The Taxonomy Regulation sets out a classification system for environmentally sustainable economic activities, with the aim of guiding investment towards activities that contribute to the EU's climate and environmental objectives, focusing on the role of banking (KPMG, 2021). The CSRD, on the other hand, aims to improve the quality, comparability, and reliability of sustainability reporting by companies. It will require large companies operating in the EU to disclose information on their sustainability practices, including information on social and governance issues as well as environmental impact (European Commission, 2021). In the United States, the Securities and Exchange Commission (SEC) requires companies to disclose material information that could affect an investor's decision to buy or sell a security, including information related to ESG issues, such as climate risks or social and governance practices (Rose, 2020). Most US stock exchanges, such as the Nasdaq, require listed companies to disclose information related to ESG issues, information related to board diversity and other social and governance issues (Karpoff et al., 2022). Therefore, it is important for companies and investors to pay attention to ESG investments to comply with these regulations and to ensure that their investments are aligned with ESG principles. However, these investments can be important for financial performance considerations as well. It has been shown that companies that focus on ESG issues tend to perform better financially in the long term (Giese et al., 2019; Huang, 2021). This is because companies that prioritize ESG issues are better positioned to manage risks associated with these issues, such as climate change and social inequality. They are also more likely to attract customers and employees who are interested in supporting sustainable and ethical practices (Henisz, 2019). Therefore, companies that focus on ESG issues are more likely to be successful in the long term, which is important for investors who are looking for sustainable returns.

In line with the above-mentioned reasons, ESG investments significantly increased in recent years both in number and in value. For example, the number of ESG ETFs grow from 41 to 552 from 2015 until 2020 (see the 1. Figure). Bloomberg (2021) estimates that ESG assets could reach \$53 trillion in value by 2025. The topic is also popular among researchers, there are many studies on the effects of ESG in investments (Hvidkjær, 2017; Gillan et al., 2021). However, the results are quite mixed (Daugaard, 2020), see the details in the literature review chapter later.

1. Figure, The number of ESG ETFs between 2015 and 2020



Source: ESG ETFs 2021, <https://files.trackinsight.com/ESG-ETF-Report.pdf>

As we see there are several reasons why it is important to pay attention to and study ESG investments. These investments align with the mitigation of climate change, currently changing societal values, comply with future stricter regulatory requirements, and are also important for financial performance considerations for investors. Therefore, it is an important research topic.

However, ESG standards and reporting requirements can differ a lot across regions and sectors as well (Arvidsson and Dumay, 2022). Reporting in general is especially important in the banking sector, this is also true for ESG and sustainability reporting (Buallay et al., 2021). Banks are under increasing pressure to demonstrate their commitment to sustainability and responsible business practices. ESG reporting can help banks build their reputation as responsible corporate citizens and enhance their brand image. ESG issues can have a material impact on a bank's risk profile, including reputation, operational, legal, and credit risks. Many countries and regions are introducing regulations requiring banks to report on their ESG performance (Buallay et al., 2021). Therefore, incorporating the ESG score into investment has a larger possible impact in the banking sector (Buallay, 2019).

The energy sector is one of the largest emitters of greenhouse gases, which contribute to climate change (Hu et al., 2020). ESG considerations are critical in mitigating the environmental impact of energy production and consumption, including reducing carbon emissions, improving energy efficiency, and investing in renewable energy sources. It can have significant social impacts too, including on the health and safety of workers, the well-being of communities, and access to energy for marginalized populations (Dye et al., 2021). Investors are increasingly looking for

energy companies that prioritize sustainability, as they recognize the financial risks associated with environmental issues. Companies that demonstrate a strong commitment to ESG considerations are likely to attract investment from ESG-focused investors (Arvidsson and Dumay, 2022). This sector is also subject to a wide range of regulations aimed at mitigating pollution and environmental risks. For these reasons, it is also highly affected by ESG considerations. Because of the sensitivity and the detail-oriented nature of the effect of ESG on investments, I focus my investigation on these two sectors where the possible effects are larger than on the average market. With this my aim is to get more detailed and consistent results.

## **1.2 Different types of ESG investments**

ESG investing is a general term referring to many types of sustainability, responsibility, and ethical consideration methods. Amel-Zadeh and Serafeim (2018) conducted a global survey of institutional investors and analyzed their responses to understand their motivations for using ESG information. They found that investors use ESG information for a variety of reasons, including to manage risk, enhance returns, and align investments with their values. The most commonly used specific ESG investment styles are the following according to Amel-Zadeh and Serafeim (2018):

- **Positive screening:** This method involves selecting companies for an investment portfolio based on their positive ESG performance. This could include companies with strong environmental practices, diverse boards, or a commitment to social responsibility. Basically, investing only in companies with the highest ESG score.
- **Negative screening:** This style involves excluding certain companies or industries from an investment portfolio based on their low ESG score or involvement in controversial activities, such as tobacco, weapons, or fossil fuels. This can also apply to involvement in controversial events, such as scandals reported by the media.
- **Overlay/portfolio tilt:** This style involves using an ESG overlay to adjust the weighting of individual securities or sectors within an investment portfolio. Investors may tilt their portfolios towards companies or industries that score well on ESG metrics or away from those that score poorly. One possible example can be taking a long position in companies with high ESG score, while shorting companies with low scores.
- **Thematic investment:** This style involves investing in companies that are aligned with a particular theme or goal, such as clean energy, sustainable agriculture, or good environmental practices. This can also be measured through the Environmental score of ESG.

- Risk factor/risk premium investing: This style involves using ESG factors to identify companies with lower risk profiles or higher expected risk-adjusted returns. Investors may use ESG data to identify companies with strong governance practices or low carbon footprints, which may be associated with lower risk or higher returns.
- Active ownership: This style involves actively engaging with companies to influence their behavior and improve their ESG performance. Investors may use their shareholder voting rights, engage in dialogue with company management, or collaborate with other stakeholders to encourage positive change.
- Relative screening/best-in-class screening: This style involves selecting the best-performing companies within a particular industry or sector based on ESG metrics. Investors may compare companies within an industry or sector to identify those with the strongest ESG performance relative to their peers.
- Full integration into individual stock valuation: This style involves integrating ESG factors into the fundamental analysis of individual stocks. Investors may use ESG data and analysis to assess a company's long-term risks and opportunities, and incorporate this information into their financial valuation models.

As we can see there are many possibilities to include ESG or sustainability criteria into investments. But which of these has an effect or can yield higher returns? In my study I investigate the effect of using different methods both on return and risk, with this providing an overview of the role of ESG.

### **1.3 Literature review**

In this chapter I show the current standing of the literature on ESG investing. The literature review of Friede et al. (2015), summarizing earlier studies from before 2015, shows some evidence of a positive relationship between ESG score and financial performance. However, also stating that portfolio studies exhibit, on average, a neutral or mixed ESG - financial performance relation. Their results propose that capital markets so far demonstrate no consistent learning effects regarding the ESG - financial performance relation.

There are other studies suggesting a positive relationship between ESG score and stock returns or risk reduction as well. Verheyden et al. (2016) test the effects of using different ESG filters on an investable universe that serves as the starting point for a fund manager. Negative screening (removing companies with the lowest 10% of ESG rankings), both on the global and developed markets portfolios show higher returns and lower risk. The study of Sherwood and Pollard

(2018) focuses on ESG incorporation on emerging markets, includes measuring historical returns, beta, the Sharpe ratio, the Sortino ratio, the Conditional Value at Risk for ESG and non-ESG integrated emerging market indices. A paired t-test analysis is used for significance testing. The results show a significant outperformance based on ESG integration. Indicating that integrating ESG emerging market equities into institutional portfolios could provide institutional investors the opportunity for higher returns and lower downside risk. Zhao et al. (2018) study China's listed power generation groups to explore the relationship between ESG performance and financial indicators in the energy power market based on the panel regression model. The results show that good ESG performance can indeed improve financial performance. According to Gerard (2019) fixed income studies provide mixed evidence about the link between issuer ESG scores and bond prices and return characteristics: the bonds of issuers with both excellent and very poor ESG behavior tend to underperform the bonds of issuers with neither very strong nor very poor ESG scores. Glossner (2017) examines the relationship between ESG risks and stock returns. The study concentrates on US stock markets and analyzes ESG ratings and returns over a 10-year period using Fama and French (1997) methodology. The study finds that companies with higher ESG risk ratings have lower stock returns, and this relationship is robust across different time periods. A negative correlation between ESG risks and stock returns gives evidence that weak CSR destroys firm value by increasing the risk of an ESG incident. Jin (2018) uses the Five-factor Asset Pricing Model of Fama and French (2015) combined with a ESG-related factor applies to returns on 1,425 US open-end equity funds for the period from April 2009 to December 2016. Empirical findings include that US open-end equity funds tend to hedge the ESG-related systematic risk, and that the exposure to ESG-related systematic risk is significantly priced in the market. Sassen et al. (2016) investigate the impact of ESG factors on firm risk in Europe. The study uses a sample of European panel dataset of 8752 firm-year observations covering the period 2002–2014 to estimate the relationship between ESG ratings and firm risk. They find that a higher CSP decreases total and idiosyncratic risk. The results suggest that higher ESG ratings are associated with lower firm risk. Giese and Lee (2019) suggest that incorporating ESG factors into investment decisions can lead to better risk-adjusted returns. The authors argue that ESG information is material and relevant for investment decisions and can help investors identify companies that are better positioned to weather environmental, social, and governance risks. They also highlight the importance of considering the quality and consistency of ESG data, when analyzing their impact. Engelhardt et al. (2021) use a sample of European stocks and analyzes their ESG ratings and stock returns during the first quarter of 2020, when the COVID-19 pandemic had a significant impact. Using

Fama and French (1997) methodology, they find that in most cases companies with higher ESG ratings outperformed companies with lower ESG ratings during the crisis period. They also argue that ESG is value-enhancing in low-trust countries, and in countries with poorer security regulations and where lower disclosure standards prevail. Rodionova et al. (2022) investigates the connection between US logistics companies' commitment to ESG strategy and their performance on the US stock market during the 2007–2022 period. They find a somewhat positive relationship. Examining the Great Recession (2007–2009) and the COVID-19 pandemic (2020) separately, green logistics portfolios were shown to have higher returns and Sharpe ratios. The further break down the ESG performance suggests that environmental and social factors had a more significant impact on stock returns compared to governance factors.

On the other hand, many studies show a non-significant or mixed not robust relationship. Halbritter and Dorfleitner (2015) study the US market from 1991 to 2012. Applying an ESG portfolio approach using the Carhart (1997) four-factor model as well as cross-sectional Fama and MacBeth (1973) regressions. ESG portfolios do not have a significant return difference between companies with high and low ESG ratings. Although the Fama and MacBeth (1973) regressions reveal a significant influence of several ESG variables, investors are hardly able to exploit this relationship. The magnitude and direction of the impact are substantially dependent on the rating provider, the company sample and the particular subperiod. Sahut and Pasquini-Descomps (2015) investigate how news-based scores in ESG may affect the monthly stocks' market returns in Switzerland, the US, and the UK during the 2007–2011 period. Using Fama and French (1992) methodology, they find that the variation of the overall ESG score is only significant in the UK. Sahut and Pasquini-Descomps (2015) study the influence of ESG on the monthly market return, using a four-factor based linear model during the 2007-2011 period. For market returns, they find that the variation of the ESG score is a significant but slightly negative factor of a stock's monthly performance in the UK, but not significant in the US and Switzerland. Lööf and Stephan (2019) investigate the relationship between a firm's ESG scores and its downside risk. Using a panel of 887 stocks listed in five European countries over the period 2005-2017, their empirical results show that higher ESG scores are associated with reduced downside risk of stock returns. However, based on the Fama-French three factor model, they found no systematic relationship between ESG score and the level of risk-adjusted return.

La Torre et al. (2020) analyze the performance of companies included in the Eurostoxx50 index over the 2010–2018 period according to their ESG score. Their results show that the Eurostoxx50 companies' performance does not seem to be affected by their efforts in terms of

ESG commitments. Cao et al. (2022) use a sample of US stocks and analyzes their ESG ratings, institutional ownership, and trading data over a six-year period. The authors find that institutional investors with higher ESG preferences are more likely to buy stocks with high ESG ratings and sell stocks with low ESG ratings. They suggest that companies with strong ESG performance may experience higher demand from institutional investors with high ESG preferences, resulting in higher stock returns. But the mispricing signals only emerge in recent years with the rise of ESG investing and are significant only when there are arbitrage-related funding constraints. Naffa and Fain (2022) use a factor approach to performance measurement of global ESG equity investments. They construct ESG pure factor portfolios following Fama-MacBeth; then, applying Fama-French spanning regressions that simultaneously test performance and the validity of adding new ESG factors. Testing on global equities between 2015-2019. The ESG portfolios do not generate significant alphas and there is no sufficient evidence for ESG factors to complement the five-factor model. Meira et al. (2022) examine daily closing prices of ESG best practices indices, for the period between 2011 and 2021, along with proxies for the market. Empirical assessments include classic and modern portfolio metrics as well as nonparametric tests. Their results indicate a considerable degree of differentiation of the governance factor in every region studied, while the environmental and social agendas have remained considerably similar to the market portfolio. The relative performance of ESG factors across regions also varied considerably. In one of my previous studies analyzing the New York Stock Exchange only (Timár, 2021), I also find non-significant results and for some industries a minor negative impact can be seen. Temporal decomposition shows the increasing significance of ESG, but even for the later time series it is not considered significant. The results suggest that the aspects under investigation are not yet priced by the market. Cornell (2021) examines the evidence on the impact of ESG preferences on risk and return and suggests that the evidence is mixed and inconclusive. He argues that there is a trade-off between incorporating ESG preferences and achieving optimal risk and return outcomes. He suggests that investors who prioritize ESG preferences may face lower returns with similar risk. However, the benefits for investors might be non-financial factors such as ethical concerns. Shanaev and Ghimire (2022) use a sample of firms with an AAA rating, the highest rating given by MSCI ESG Fundamentals, and analyze the abnormal returns around the announcement of ESG rating changes of US firms over 2016–2021. They find that downgrades in ESG ratings lead to negative abnormal returns, whereas upgrades in ESG ratings do not lead to significant abnormal returns.

In some cases, we can also see evidence for a negative effect of the ESG score. Auer and Schuhmacher (2016) study ESG investing globally and on industry level, on a monthly sample from August 2004 to December 2012. They use different portfolio creation methods and test the Sharpe ratios. The selection of high or low ESG rated stocks does not provide superior performance. In the Asia-Pacific region and the US, ESG investors perform similar to the market. While in Europe, investors even tend to pay an extra price for responsible investments. The results are robust along a variety of dimensions. Landi and Sciarelli (2018) aim exploring whether socially responsible investors can outperform the market return on the Italian Stock Exchange. They found a negative and statistically significant impact in terms of market premium, in case of undertaking a socially responsible investment. The findings described above show that ethics is not yet a reliable fundraising tool for Italian-listed companies, despite socially responsible investments having a positive growth rate over past decade.

Specific studies focusing on the banking sector: ESG and financial performance of European banks were analyzed in a study by Bătae et al. (2020). The authors used a sample of 108 European banks from 2010 to 2018 and found a positive relationship between ESG performance and financial performance. Additionally, the study found that banks with high ESG performance experienced lower levels of risk. Danisman (2022) examines the impact of ESG scores on bank stock returns as a response to the COVID-19 pandemic. The authors use a sample of 73 publicly listed banks from 15 developed European countries. They perform the analysis using two different periods that cover the pandemic. They find that, during the first wave, stock returns of banks with higher ESG scores were more resilient to the pandemic but it becomes insignificant for the second period. Ersoy et al. (2022) test ESG and ESG pillar scores on the market value of U.S. commercial banks by using linear and non-linear panel regression models over the period of 2016–2020. They highlight that only a limited number of studies have focused on the banking sector. Results show an inverted U-shaped relationship between market value and ESG. The results of El Khoury et al. (2023) support the presence of a non-linear ESG-bank profitability relationship. ESG incremental investments remain beneficial till reaching an inflection point. Their tested sample consists of 46 listed banks from the MENAT region between 2007–2019 period. Chiaramonte et al. (2022) use a sample of European banks operating in 21 countries over 2005–2017, finding that the total ESG score, as well as the sub-pillars, reduces bank fragility during periods of financial distress. But only the largest European banking groups seem to obtain benefits on financial stability during crisis periods. The results show that greater effects are attributable to environmental innovation.

Specific studies focusing on the energy sector: Wanday and Ajour El Zein (2022) uses a quantitative methodology that includes an analysis of the financial performance of publicly listed companies using return on equity, return on assets, return on sales, return on investment and also used the SARIMA (seasonal autoregressive integrated moving average) model to forecast revenues for the companies included in the research. They find a positive relationship between ESG and investor returns is identified after considering regional and sectoral effects but they are not too robust. Xie (2020) uses data from shareholder proposals submitted by institutional investors to energy companies and analyzes the relationship between these proposals and company performance, as well as the reactions of other investors. The author finds that shareholder activism by institutional investors on ESG issues is positively associated with future stock performance and company innovation, as well as with improvements in ESG practices. The authors also find that institutional investors are more likely to submit proposals related to climate change and renewable energy, indicating a growing concern about the environmental impact of energy companies. Baran et al. (2022) investigate whether ESG score of companies operating in the energy sector can be associated with their corporate financial performance. The research covers data from eight companies with a dominant position in the Polish energy sector. The research used the comparative analysis between ESG performance and accounting-based measures of profitability, such as return on equity (ROE), return on assets (ROA) and an Additional DuPont model. The results do not reveal repetitive dependencies that would suggest a pattern of the impact of the factors of ESG on the financial performance of energy companies.

In conclusion based on the current literature we can see that the Fama and French (1997) factor model approach and the Fama-MacBeth (1973) regression are commonly used method for testing the possible benefits of incorporating the ESG rating into investment include higher return, lower risk or better risk-adjusted return. Overall, the literature supports the hypothesis that it is worth following some kind of ESG investing style but the results are mixed and not too robust. It is unclear which one is the best style and what can be the exact benefits of incorporating the ESG score into investment decisions. In my study I test six different approaches for return, risk and risk-adjusted return as well to answer these questions. The literature lacks complex studies focusing on more than one possible benefit of ESG investing. So, the contribution of my study is at least threefold: delivering comprehensive evidence on the effect of ESG on investments, specifically examining special sectors (banking and energy) with high ESG possibilities and to support the robustness of previous results by focusing on different

sectors and time periods. My hypothesis is that incorporating ESG into investment decisions has a positive effect on risk-adjusted return in both the banking and energy sector.

## **2. Data and Methodology**

The US stock market is one of the largest and most diverse in the world, with thousands of publicly traded companies spanning a range of sectors and industries. This provides investors with a wide range of investment options, which can help to spread risk. It is highly liquid, meaning that there is a lot of buying and selling activity happening at any given time. This makes it easier for investors to buy and sell shares quickly and at a market price, which can be important for researchers studying possible abnormal returns (Jones, 2018). However, the US stock market has a long history of stability and strong returns over the long term. While there have been periods of volatility and uncertainty, the overall trend has been upward, which can provide a good basis for analysis (Jin, 2018). Data availability and quality also plays an important role, because the US stock market is so widely followed and analyzed by financial analysts, there is a wealth of information available to investors about individual companies, sectors, and the overall market (Lee, 2019). This can make it more reliable and easier to perform meaningful research. The US also has a global role in the world economy, which can impact other countries as well. For these reasons I focus on the US market in my study.

The literature shows that the effect of ESG is sensitive for market circumstances, time and different sectors. Therefore, it can be misleading to draw conclusions based on a single whole market not accounting for sector and time differences. To avoid this, I study two specific sectors with the largest possible impact of ESG (Banking and Energy). I also dived the data into different sub sets to account for the effect time periods. To account for the change in societal and governmental support of sustainability, I dived the full time period at the Paris Agreement into two sub-periods. The Paris Agreement was a landmark in sustainability and mitigating climate change, therefore it is a good representation of a turning point (Dröge, 2016; Tingley and Tomz, 2020). Some research indicates that ESG can have special benefit in case of market turmoil (Broadstock et al., 2021; Rodionova et al., 2022). To test this, I also examine separately the period of the Great Recession (2007–2009) and the COVID-19 pandemic (2020-2021).

### **2.1 US stock level data**

In this study I use the monthly data of individual stocks in banking and energy sector from the major US stock markets, New York Stock Exchange (NYSE) and NASDAQ from 2000.01.01. to 2023.03.01. These are the two largest, most efficient, and most widely used stock markets in

the world (Mexmonov, 2020). I downloaded all the necessary data from Refinitive Eikon Datastream (previously known as Thomson Reuters), which is a commonly used and accepted data source internationally (Velte, 2017; Landis and Skouras, 2021). Refinitive Eikon and Datastream provide access to a vast amount of financial market data, including real-time and historical data on equities, commodities, fixed income. All the necessary data was available on it. In the calculation of the returns, I use the “Total return index” which accounts for the effect of dividend payments and possible stock splits as well. To avoid look-ahead bias I always use the future returns (returns for the next month) in the analysis. For the risk free rate, I used 1 month US treasury rate, because it is considered to have a very low risk of default, it is also highly liquid, matches the frequency of other variables and it is commonly used in the literature too. Controlling for the survivorship bias (Shumway, 1997), I leave all the stock in the data that were since taken off the market. Penny stocks (stocks with very small price) have an access liquidity risk and can cause different anomalies (Liu, 2011), therefore I exclude all the stocks with a price smaller than one dollar. I also exclude stocks with low trading frequency based on turnover following Amihud (2002). In further data cleaning and outlier filtering methods, I follow Ince and Porter (2006): In order to filter data errors, dropping observations with higher than 200 % monthly return. Dropping the first five percentile of stocks by market capitalization (Size), and winsorizing the that at a 1% level, thereby filtering the outliers but not decreasing the sample size. I use the Eikon ESG score, which provides a comprehensive assessment of a company's ESG performance based on more than 250 indicators. Refinitive Eikon uses a standardized methodology to calculate the score, in a transparent manner, providing users with a detailed breakdown of how the score is calculated (Ribando and Bonne, 2010). Their ESG score is measured on a scale 0-100 and can be decomposed into the three sub-scores Environmental, Social and Governance for further analysis. The final full time period after the data clearing dates from 2005.01.01. to 2022.12. 31. The sub-periods for pre-Paris Agreement is from 2005.01.01. to 2015.12. 31 and the post- period is from 2016.01.01 to 2022.12.31. The recession period includes the Great Recession (2007.12.01. - 2009.06.30) and the COVID-19 pandemic (2020.01.01. – 2021.12.31.).

## **2.2 Methodology**

I use two different methods one for a portfolio analysis and one on stock level data, to maximize the reliability and robustness of my results. All the analysis was done by using STATA.

### **2.2.1 Portfolio approach**

The most commonly used method in the literature to test the effect of ESG on returns is some variation of the approach of Fama and French (1997). Which is a method based on factors to estimate abnormal returns. Fama and French (1992) introduced two factors, market capitalization (Size) and book to market ratio (Btm), in addition to the Beta of CAPM to estimate future returns. Carhart (1997) further developed the model by adding the momentum factor (Mom) based on the work of Jegadeesh and Titman (1993). Since then, many studies tried to introduce new factors or used the factor model approach for different tests (Feng et al. 2020; Ang et al., 2020). In this study I also follow this common method in academic literature for testing the effect of a given variable, which is called univariate sort. Which is basically the testing of returns of a trading strategy that, according to a given variable, buys high-value stocks and sells low-value ones. First the stocks are sorted by the given variable (ESG in this case), then, classified into terciles, and we take a long position in the top tercile and a short position in the bottom tercile to create a portfolio in every month (Fama and French, 1992). Based on that, portfolio returns can be calculated both in equal- and in value- (market capitalization) weighted form, to test the robustness of results. With equal weighting, the investment ratio is the same for all stocks in the portfolio. In the case of value weighting, the investment is made in proportion to the market share of the company in question. Finally, we take the mean of the monthly portfolio returns to obtain an approximation of their expected value. I calculate the portfolio return by subtracting the bottom tercile return from the return of the top quantile each month. Then I test the significance of the mean portfolio return by using the corrected t-statistics developed by Newey and West (1987), which is designed to minimize the loss of efficiency that occurs when autocorrelation is present in the data, so it is robust to the presence of autocorrelation in the error term. And it is also applicable to models with heteroscedasticity and other forms of non-constant variance, so it is robust for heteroscedasticity too. I consider the usual significance levels of 5% and 1% for the tests. I compare the result also to the sector average as a benchmark to get a better comparison for the relative performance.

The advantage of the portfolio approach is that it is simple to implement and easy to understand. It involves grouping assets based on a single characteristic, which can make it more straightforward to analyze and interpret the results. The univariate sort method is flexible

because it can be used with a wide range of characteristics or factors. This allows for tailoring it for any specific strategy. The method can be used with small sample sizes, which can be an advantage in cases where data is limited or difficult to obtain and it requires not assumption on the distribution of returns but still provides statistical results. However, it has some disadvantages as well, by focusing on a single characteristic or factor, the univariate sort method can overlook other important factors that may be relevant to asset performance. This can lead to incomplete or biased results or can make it difficult to draw definitive conclusions about the relationship between that factor and asset performance.

The described univariate sort method tests the Overlay/portfolio tilt investment style, however I do not want to limit my research to one style only. So, I introduce other portfolio creation methods to simulate the different investment styles. After the ESG portfolio approach (buy the high ESG scores tercile and sell the low), I separately examine positive screening, meaning only buying the high ESG score tercile, and also negative screening, excluding the low ESG score tercile from the sector portfolio. Based on the literature controversies and negative association with certain practices can have a negative effect on returns as well. To test this, I introduce a negative screening portfolio creation based on ESG controversies score of Eikon. This score measures the extent to which a company has been involved in any controversies, the best score is 100 and a significant number of companies have this maximum score. So, for the ESG controversies negative screening portfolio, I exclude every stock which does not have a score of 100. Furthermore, to test a possible thematic investment style following only sustainable and environmentally conscious practices, I create a portfolio similar to the ESG but based on only the environmental score (Env) using the univariate sort method, where we buy the high Env scores tercile and sell the low. To test the critiques of too, I look at the return of the bottom ESG tercile as well. Greenwashing claims would support the idea that ESG rating is just a waste of money financially therefore not spending on rating or having a bad one can actually be more profitable (Du, 2015). In this case we would see a significant abnormal return for the bottom tercile, indicating that a high ESG score have possible financial costs.

To get a wider picture of the role of ESG in investments, I not only look at the significance of the returns of the mentioned ESG investing styles, but also examine their standard deviation as a proxy for their risk, and I calculate different risk-adjusted return ratios to get a better understanding of the underlying patterns. First, I calculate the standard deviation of the portfolio returns to measure the general risk associated with them (Rockafellar et al. 2002; Larequad, 2015). However, the standard deviation by itself does not provide statistical proof, so I

statistically test the difference between the standard deviation of the sector (market portfolio) and the given ESG portfolio. For this a traditional tests on the equality of standard deviations with an F-statistic could be used, however it requires the assumption that the data are drawn from an underlying Gaussian distribution, which is usually not true for stock market data (Mandelbrot and Taylor, 1967; Nagahara, 1996; De Domenico et al., 2023). But Levene (1960) proposed a test statistic for equality of variance that was found to be robust under nonnormality. Later Brown and Forsythe (1974) proposed alternative formulations of Levene's test statistic that use more robust estimators of central tendency in place of the mean. The test works by first calculating the median of each group instead of the mean (like Levene's). Then, it calculates the absolute deviations of each observation from its group median and replaces the squared deviations in the standard variance formula with the absolute deviations. This modified formula results in a test statistic that follows an F-distribution under the null hypothesis of equal variances. This way the results are more robust than Levene's test when dealing with skewed populations and it is less sensitive to outliers. Therefore, I used the corrected test of Brown and Forsythe (1974) to test the portfolio's standard deviation against the sector's standard deviation. A significantly lower standard deviation would show evidence for the risk decreasing effect of ESG incorporation.

Sortino and Van Der Meer (1991), criticize measuring the risk with the standard deviation of the returns. They argue that investors only care about volatility if it happens in the case of negative returns and big upwards movements are not harmful. They propose a better measurement option in the form of downside risk, it accounts for all the observations where the return is negative. It can be measured with downside standard deviation, which is the standard deviation of all the negative returns only. To have a better understanding of the characteristics of risk I also calculate the downside standard deviation of the portfolios and test them compared to the sector with the same corrected test of Brown and Forsythe (1974).

Looking at return and risk separately might not be optimal, because what mostly matters for investors is the combination of the two measures. To capture this, I calculate risk-adjusted return ratios, a simple but still widely used option is the Sharpe ratio. It was proposed by Sharpe (1998). The Sharpe ratio is a measure that takes into account both risk and return. It provides a way for investors to evaluate an investment's risk-adjusted return by comparing the excess return above the risk-free rate with the investment's standard deviation:

$$Sharpe_i = \frac{E(R_i) - rf}{\sigma_i} \quad (1.)$$

Where  $E(R_i)$  is the average (expected) return,  $\sigma_i$  is the standard deviation of  $i$  investment in the given period and  $rf$  is the risk free rate. The Sharpe ratio is a measure of the return an investor earns for each “unit” of risk taken. The higher it is, the better the investment's risk-adjusted return. In other words, the Sharpe ratio considers the tradeoff between risk and return. An investment that generates a high return but is very volatile will have a lower Sharpe ratio compared to an investment with a lower return but less volatility.

A modified version of the ratio (Sortino), accounting for the downside risk, can be used as well. It was introduced by Sortino and Hopelain (1980) for better risk-adjusted return measurement:

$$Sortino_i = \frac{E(R_i) - rf}{\sigma_{down,i}} \quad (2.)$$

Where,  $\sigma_{down,i}$  is calculated by only counting the standard deviation of returns under zero. The Sortino ratio penalizes only the downside deviation or the volatility of returns below the threshold, usually zero. This is in contrast to the Sharpe ratio, which penalizes both upside and downside volatility. As a result, the Sortino ratio provides a better measure of the risk that investors are most concerned about. It is better suited for investments with skewed return distributions, because it only considers the downside deviation and does not penalize an investment for having high volatility in its positive returns (Rollinger and Hoffman, 2013). It is also good for actively managed portfolios, where the focus is on minimizing downside risk rather than simply achieving high returns.

According to Goodwin (1998) another advanced risk-adjusted return measure is the Information ratio (IR). The Information Ratio is designed to measure the performance of an actively managed portfolio, which is one that seeks to outperform a benchmark index. This is important because many investors are interested in outperforming a benchmark rather than simply achieving high returns (Goodwin, 1998). It measures the excess return of an investment over its benchmark index, adjusted for risk, calculated the in the following way:

$$IR_i = \frac{E(R_i) - E(R_b)}{\sigma_{e,i}} \quad (3.)$$

Where,  $E(R_b)$  is the average benchmark return (market or sector in this case) and  $\sigma_{e,i}$  is the standard deviation of the tracking error, which is the difference between the portfolio return and the benchmark (the numerator:  $E(R_i) - E(R_b)$ ). This is important because tracking error reflects the risk taken by deviating from the benchmark, and a higher tracking error may indicate higher risk. IR provides a standardized measure of risk-adjusted performance that can be compared across different investment strategies and benchmarks.

In this study I use these ratios to provide a better understanding of the effect of ESG strategies on risk-adjusted returns. These three ratios together are able to provide a well rounded picture, using the advantage of each separate ratio. Other additions could be the Treynor ratio or Jensen alpha, however they are very sensitive to changes in beta, which can be volatile and subject to rapid changes in market conditions (Scholz and Wilkens, 2005). It is not suitable for comparing portfolios that have different betas or different levels of systematic risk. This can make it difficult to compare the risk-adjusted performance of portfolios, especially through different time periods. Therefore, I avoid using ratios calculating with beta.

### 2.2.2 Individual stock level analysis

To account for some of the disadvantages of the portfolio approach (limited in scope, lack of control variables) and to further test the robustness of the results, I also use an individual stock level analysis in the form of Fama-MacBeth (1973) regression. This method is also widely used and accepted in the seen international literature. In a Fama-Macbeth regression, the cross-sectional correlation is accounted for by estimating the regression parameters separately for each time period and then taking the average of the estimated coefficients across time. Specifically in this case the steps are the followings: In the first step, a separate regression is run for each month using cross-sectional data. This produces a set of estimated coefficients for each month and variable. In the second step, the estimated coefficients from each cross-sectional regression are averaged over time to produce a single set of coefficients. Lastly these average coefficients are statistically tested by using the corrected t-statistics of Newey and West (1987). By estimating the coefficients separately for each time period and then averaging them over time, the Fama-Macbeth regression can provide more accurate estimates of the relationship between risk factors and asset returns. It can be used to test the relationship between multiple independent variables and the dependent variable (future return). This can help to identify the relative importance of different variables and help to control for the effect of other factors. In this study I use the following Fama-MacBeth (1973) regression model:

$$E(R_i) = \beta_0 + \beta_{Beta}Beta + \beta_{Size}Size + \beta_{Btm} Btm + \beta_{Mom}Mom + \beta_{ESG}ESG \quad (4.)$$

Which controls for the four-factor model of Carhart (1997) to avoid the omitted variable bias. Overall, the Fama-MacBeth (1973) regression gives much better results than a Pooled OLS regression for example. The Fama-Macbeth regression can provide more efficient estimates than a pooled OLS regression, because it allows for the estimation of coefficients separately for each time period, and then averages them over time, which can reduce the variance of the estimates (Koulafetis and Levis, 2002). The Pooled OLS regression also assumes

homoscedasticity (constant variance) across observations, but in financial research, heteroscedasticity is often present (Pasquariello, 1999). The Fama-Macbeth regression allows for heteroscedasticity in the error terms, which can lead to more accurate and efficient estimates.

Applying the portfolio approach and the Fama-MacBeth regression simultaneously allows to use the advantages of both method: The univariate sort method allows to group assets based on a single factor, while the Fama-Macbeth regression accounts for cross-sectional correlation and allows for the estimation of coefficients separately for each time period. Therefore, compelling a more comprehensive analysis. Using both techniques together can improve hypothesis testing by allowing us to compare the performance of different groups of assets based on a single factor while also controlling for other factors. Providing much more robust results at the end

### **3. Results**

In this chapter I present the results of the previously described methods, first the results of the portfolio analysis for the full time period, then I test the robustness for different time periods, and lastly I present the results of the Fama-MacBeth regressions.

#### **3.1 The performance of ESG style portfolio investments**

A small summary of the tested ESG incorporating investment styles (See the details in 2.2.1 Portfolio approach chapter earlier):

- **Sector average (market):** As a benchmark I always present the market portfolio, which is the average of the whole sector in this case. This represents investing in all the stocks in the sector with equal- or value- weighting according to the given test. In the analysis of the portfolio's standard deviation, I always compare them to the standard deviation of this benchmark.
- **ESG portfolio (3rd tercile – 1st tercile):** Created by the univariate sort method, it represents the Overlay/portfolio tilt investment style. This strategy buys high ESG score stocks (top tercile) and sells low-value ones (bottom tercile). The significance of this strategy would give the most evidence for the positive effect of ESG incorporation, because it rewards good and punishes bad rating as well.
- **Positive screening (3rd tercile):** This style only buys the high ESG score tercile, the significance of this strategy would show evidence for the following argument, that high ESG score companies perform somewhat better than the market. But does not provide information about the low score stocks.

- Low score (1st tercile): To get a better understanding and test greenwashing claims too, I separately test buying only the bottom tercile too. The significance of this would suggest that ESG rating negatively effects future returns.
- Negative screening (2nd & 3rd Tercile): This style excludes the low ESG score stocks (bottom tercile) from the sector portfolio, investing only int the second and third tercile. Arguing that only a bad ESG score has some negative effect, and a good one after a certain threshold does not necessarily mean better returns.
- Negative screening (controversies): Similar to the previous negative screening, but the exclusion is based on ESG controversies, with bad connotation or scandals get dropped from the portfolio to achieve possible better returns.
- Environment portfolio (3rd tercile – 1st tercile): The same univariate sort method is used as in ESG portfolio, but based on only the Environmental pillar (Env) of ESG. Buying high Env score stocks (top tercile) and sells low-value ones (bottom tercile). This argues that only sustainability, pollution and environmental consciousness have an effect from the ESG score for better future returns.

I tested the characteristics of these ESG investing styles for the US banking and energy sector. The 2. Table shows the results for the banking sector for the full time period with equal weighting, all the data is based on a monthly basis. For the sector average we can see a relatively high return, which is significant on 10% but not on 5%, setting as benchmark for the other portfolios with 5.31% standard deviation. The ESG portfolio style has a much lower return and standard deviation, which is significantly lower than the sector average. Decomposing the portfolio we can see that both the third and the first tercile have a significantly positive return with similar standard deviation to the benchmark. The negative screening styles have very similar characteristics to the sector average. However, the Environment portfolio shows a significant positive return (similar in magnitude to the benchmark) but with significantly lower standard deviation. Based on the downside risk, also Environment portfolio seems to be the best, although the ESG portfolio has lower downside standard deviation it is only due to providing basically zero return. This is also supported by the Sharpe and Sortino ratios, the Environment portfolio seems to yield the highest return per unit of risk. The information ratio does not provide any meaningful evidence in this case, which is due to the fact that every strategy have similar return to the benchmark.

2. Table, The performance of different ESG style investments in the Banking sector, with equal weighting for the full time period

|                          | Sector average (market) | ESG portfolio | Positive screening (3rd tercile) | Low score (1st tercile) | Negative screening (2nd & 3rd Tercile) | Negative screening (controversies) | Environment portfolio |
|--------------------------|-------------------------|---------------|----------------------------------|-------------------------|----------------------------------------|------------------------------------|-----------------------|
| <b>Return</b>            | <b>0.81%</b>            | <b>0.17%</b>  | <b>1.04%</b>                     | <b>0.88%</b>            | <b>0.82%</b>                           | <b>0.78%</b>                       | <b>0.71%</b>          |
| Newey t-statistic        | (1.92)                  | (1.07)        | (2.49)                           | (2.62)                  | (1.81)                                 | (1.88)                             | (2.40)                |
| <b>St dev</b>            | <b>5.31%</b>            | <b>2.35%</b>  | <b>6.05%</b>                     | <b>5.01%</b>            | <b>5.53%</b>                           | <b>5.15%</b>                       | <b>3.87%</b>          |
| W50 test statistic       | -                       | (78.42)       | (1.79)                           | (0.52)                  | (0.22)                                 | (0.07)                             | (13.28)               |
| Downside St dev          | 3.98%                   | 1.67%         | 4.63%                            | 3.70%                   | 4.17%                                  | 3.80%                              | 2.46%                 |
| W50 test statistic       | -                       | (38.06)       | (0.40)                           | (0.45)                  | (0.12)                                 | (0.10)                             | (8.47)                |
| <b>Sharpe ratio</b>      | <b>0.137</b>            | <b>0.034</b>  | <b>0.158</b>                     | <b>0.158</b>            | <b>0.133</b>                           | <b>0.134</b>                       | <b>0.161</b>          |
| <b>Sortino ratio</b>     | <b>0.183</b>            | <b>0.048</b>  | <b>0.207</b>                     | <b>0.214</b>            | <b>0.176</b>                           | <b>0.182</b>                       | <b>0.254</b>          |
| <b>Information ratio</b> | <b>-</b>                | <b>-0.111</b> | <b>0.028</b>                     | <b>0.009</b>            | <b>0.015</b>                           | <b>-0.064</b>                      | <b>-0.015</b>         |
| Track. error St dev      | -                       | 5.84%         | 8.20%                            | 7.44%                   | 0.53%                                  | 0.61%                              | 6.84%                 |

Table description: The columns represent the different ESG investment styles, starting with the Sector average as a benchmark. The first row shows the average monthly return for each investment for the given period. Below them in parentheses are the corresponding corrected Newey-West t-statistics (the critical value for 5% level of significance is 1.96 and 2.576 for 1%). The third row shows the standard deviation of the monthly return of the investment styles. Below in parentheses are the corrected test statistics of Brown and Forsythe (1974) for the difference between the standard deviation of the market and the given investment style (the critical value for 5% level of significance is ~3.936 and ~6.895 for 1%). After that the same is presented for the Downside standard deviation. The second part of the table shows the different risk-adjusted return ratios (Sharpe, Sortino and Information ratio). The last row shows the standard deviation of the Tracking error compared to the market, this is used for the calculation of the information ratio. Source: own edit.

The 3. Table shows the same analysis for value weighting. In this case the sector's average return is basically zero with a small standard deviation. The ESG portfolio have similar return but with a significantly higher standard deviation than the benchmark. The third and first tercile behave similarly to the equal weighting, significant positive return (around 1%), with a standard deviation around 5%. However, in this case the sector benchmark has different characteristics. The negative screening styles again perform very similarly to the benchmark. While the Environment portfolio has a significant positive return, with some standard deviation. Based on the risk-adjusted ratios again the Environment portfolio seems to be the best choice. In this case also the Information ratio supports this, because there are differences from the sector's return. This show the robustness of the result for the full time period.

3. Table, The performance of different ESG style investments in the Banking sector, with value weighting for the full time period

|                          | Sector average (market) | ESG portfolio | Positive screening (3rd tercile) | Low score (1st tercile) | Negative screening (2nd & 3rd Tercile) | Negative screening (controversies) | Environment portfolio |
|--------------------------|-------------------------|---------------|----------------------------------|-------------------------|----------------------------------------|------------------------------------|-----------------------|
| <b>Return</b>            | <b>0.01%</b>            | <b>0.18%</b>  | <b>1.03%</b>                     | <b>0.86%</b>            | <b>0.03%</b>                           | <b>0.01%</b>                       | <b>0.70%</b>          |
| Newey t-statistic        | (1.23)                  | (1.12)        | (2.48)                           | (2.57)                  | (1.19)                                 | (1.08)                             | (2.36)                |
| <b>St dev</b>            | <b>0.13%</b>            | <b>2.42%</b>  | <b>6.11%</b>                     | <b>5.04%</b>            | <b>0.38%</b>                           | <b>0.19%</b>                       | <b>3.92%</b>          |
| W50 test statistic       | -                       | (170.58)      | (246.30)                         | (263.60)                | (53.23)                                | (10.18)                            | (259.61)              |
| Downside St dev          | 0.12%                   | 1.70%         | 4.67%                            | 3.71%                   | 0.37%                                  | 0.18%                              | 2.48%                 |
| W50 test statistic       | -                       | (41.08)       | (71.18)                          | (78.47)                 | (34.89)                                | (8.08)                             | (122.38)              |
| <b>Sharpe ratio</b>      | <b>-0.588</b>           | <b>0.038</b>  | <b>0.155</b>                     | <b>0.153</b>            | <b>-0.136</b>                          | <b>-0.373</b>                      | <b>0.158</b>          |
| <b>Sortino ratio</b>     | <b>-0.605</b>           | <b>0.054</b>  | <b>0.203</b>                     | <b>0.208</b>            | <b>-0.140</b>                          | <b>-0.403</b>                      | <b>0.249</b>          |
| <b>Information ratio</b> | <b>-</b>                | <b>0.070</b>  | <b>0.171</b>                     | <b>0.172</b>            | <b>0.087</b>                           | <b>0.042</b>                       | <b>0.180</b>          |
| Track. error St dev      | -                       | 2.37%         | 5.99%                            | 4.93%                   | 0.26%                                  | 0.07%                              | 3.86%                 |

Table description: The columns represent the different ESG investment styles, starting with the Sector average as a benchmark. The first row shows the average monthly return for each investment for the given period. Below them in parentheses are the corresponding corrected Newey-West t-statistics (the critical value for 5% level of significance is 1.96 and 2.576 for 1%). The third row shows the standard deviation of the monthly return of the investment styles. Below in parentheses are the corrected test statistics of Brown and Forsythe (1974) for the difference between the standard deviation of the market and the given investment style (the critical value for 5% level of significance is ~3.936 and ~6.895 for 1%). After that the same is presented for the Downside standard deviation. The second part of the table shows the different risk-adjusted return ratios (Sharpe, Sortino and Information ratio). The last row shows the standard deviation of the Tracking error compared to the market, this is used for the calculation of the information ratio. Source: own edit.

The 4. Table shows the results for the energy sector for the full time period with equal weighting. For the sector average we can see a relatively high return, which is significant on 5% level, setting as benchmark for the other portfolios with 4.87% standard deviation. The ESG portfolio style has a much lower return and standard deviation, which is significantly lower than the sector average. Decomposing the portfolio we can see that both the third and the first tercile have a significantly positive return with similar standard deviation to the benchmark. The negative screening styles have very similar characteristics to the sector average. These are all similar to the result of the banking sector, however in the case of the energy sector Environment portfolio do not have a significant return and show similar characteristics to the ESG portfolio. Based on the risk-adjusted ratios positive and negative screening based on ESG could be the

best choices. But none of them really outperformed the sector benchmark. Showing small evidence for the positive effect of ESG incorporation.

4. Table, The performance of different ESG style investments in the Energy sector, with equal weighting for the full time period

|                          | Sector average (market) | ESG portfolio | Positive screening (3rd tercile) | Low score (1st tercile) | Negative screening (2nd & 3rd Tercile) | Negative screening (controversies) | Environment portfolio |
|--------------------------|-------------------------|---------------|----------------------------------|-------------------------|----------------------------------------|------------------------------------|-----------------------|
| <b>Return</b>            | <b>0.86%</b>            | <b>0.23%</b>  | <b>1.00%</b>                     | <b>0.77%</b>            | <b>0.92%</b>                           | <b>0.88%</b>                       | <b>0.23%</b>          |
| Newey t-statistic        | (2.39)                  | (0.96)        | (3.34)                           | (1.71)                  | (2.77)                                 | (2.36)                             | (0.91)                |
| <b>St dev</b>            | <b>4.87%</b>            | <b>3.11%</b>  | <b>4.13%</b>                     | <b>5.77%</b>            | <b>4.58%</b>                           | <b>4.98%</b>                       | <b>3.17%</b>          |
| W50 test statistic       | -                       | (16.08)       | (3.51)                           | (6.26)                  | (0.51)                                 | (0.10)                             | (15.18)               |
| Downside St dev          | 3.98%                   | 1.67%         | 4.63%                            | 3.70%                   | 4.17%                                  | 3.80%                              | 1.87%                 |
| W50 test statistic       | -                       | (38.06)       | (0.40)                           | (0.45)                  | (0.12)                                 | (0.10)                             | (27.16)               |
| <b>Sharpe ratio</b>      | <b>0.160</b>            | <b>0.048</b>  | <b>0.222</b>                     | <b>0.119</b>            | <b>0.183</b>                           | <b>0.159</b>                       | <b>0.044</b>          |
| <b>Sortino ratio</b>     | <b>0.195</b>            | <b>0.089</b>  | <b>0.198</b>                     | <b>0.185</b>            | <b>0.201</b>                           | <b>0.209</b>                       | <b>0.075</b>          |
| <b>Information ratio</b> | <b>-</b>                | <b>-0.103</b> | <b>0.022</b>                     | <b>-0.013</b>           | <b>0.090</b>                           | <b>0.047</b>                       | <b>-0.102</b>         |
| Track. error St dev      | -                       | 6.12%         | 6.34%                            | 7.23%                   | 0.67%                                  | 0.33%                              | 6.24%                 |

*Table description: The columns represent the different ESG investment styles, starting with the Sector average as a benchmark. The first row shows the average monthly return for each investment for the given period. Below them in parentheses are the corresponding corrected Newey-West t-statistics (the critical value for 5% level of significance is 1.96 and 2.576 for 1%). The third row shows the standard deviation of the monthly return of the investment styles. Below in parentheses are the corrected test statistics of Brown and Forsythe (1974) for the difference between the standard deviation of the market and the given investment style (the critical value for 5% level of significance is ~3.936 and ~6.895 for 1%). After that the same is presented for the Downside standard deviation. The second part of the table shows the different risk-adjusted return ratios (Sharpe, Sortino and Information ratio). The last row shows the standard deviation of the Tracking error compared to the market, this is used for the calculation of the information ratio. Source: own edit.*

The 5. Table shows the same analysis for value weighting for the energy sector for the full time period. Similar to the banking sector the value weighted sector average return is close to zero with very small standard deviation. While the other results are the same as with equal weighting the negative screening portfolio based on ESG, loses its significant return. Again conforming the uncertainty of the positive effect of ESG. Only the positive screening is able to provide a statistically and economically significant return, robust for both equal and value weighting. In case of value weighting based on all the ratios, the positive screening is the best option if we consider risk-adjusted returns.

5. Table, The performance of different ESG style investments in the Energy sector; with value weighting for the full time period

|                          | Sector average (market) | ESG portfolio | Positive screening (3rd tercile) | Low score (1st tercile) | Negative screening (2nd & 3rd Tercile) | Negative screening (controversies) | Environment portfolio |
|--------------------------|-------------------------|---------------|----------------------------------|-------------------------|----------------------------------------|------------------------------------|-----------------------|
| <b>Return</b>            | <b>0.01%</b>            | <b>0.12%</b>  | <b>0.95%</b>                     | <b>0.83%</b>            | <b>0.02%</b>                           | <b>0.01%</b>                       | <b>0.15%</b>          |
| Newey t-statistic        | (2.58)                  | (0.49)        | (3.18)                           | (1.85)                  | (2.77)                                 | (2.42)                             | (0.60)                |
| <b>St dev</b>            | <b>0.04%</b>            | <b>3.10%</b>  | <b>4.10%</b>                     | <b>5.76%</b>            | <b>0.11%</b>                           | <b>0.06%</b>                       | <b>3.11%</b>          |
| W50 test statistic       | -                       | (325.49)      | (206.98)                         | (280.64)                | (75.59)                                | (11.57)                            | (302.79)              |
| Downside St dev          | 0.03%                   | 1.91%         | 3.29%                            | 4.02%                   | 0.09%                                  | 0.05%                              | 1.86%                 |
| W50 test statistic       | -                       | (118.80)      | (80.22)                          | (94.74)                 | (32.58)                                | (6.02)                             | (98.90)               |
| <b>Sharpe ratio</b>      | <b>-1.899</b>           | <b>0.012</b>  | <b>0.211</b>                     | <b>0.129</b>            | <b>-0.584</b>                          | <b>-1.277</b>                      | <b>0.020</b>          |
| <b>Sortino ratio</b>     | <b>-2.498</b>           | <b>0.020</b>  | <b>0.263</b>                     | <b>0.185</b>            | <b>-0.736</b>                          | <b>-1.542</b>                      | <b>0.033</b>          |
| <b>Information ratio</b> | <b>-</b>                | <b>0.037</b>  | <b>0.232</b>                     | <b>0.143</b>            | <b>0.212</b>                           | <b>0.153</b>                       | <b>0.044</b>          |
| Track. error St dev      | -                       | 3.12%         | 4.06%                            | 5.72%                   | 0.07%                                  | 0.02%                              | 3.13%                 |

Table description: The columns represent the different ESG investment styles, starting with the Sector average as a benchmark. The first row shows the average monthly return for each investment for the given period. Below them in parentheses are the corresponding corrected Newey-West t-statistics (the critical value for 5% level of significance is 1.96 and 2.576 for 1%). The third row shows the standard deviation of the monthly return of the investment styles. Below in parentheses are the corrected test statistics of Brown and Forsythe (1974) for the difference between the standard deviation of the market and the given investment style (the critical value for 5% level of significance is ~3.936 and ~6.895 for 1%). After that the same is presented for the Downside standard deviation. The second part of the table shows the different risk-adjusted return ratios (Sharpe, Sortino and Information ratio). The last row shows the standard deviation of the Tracking error compared to the market, this is used for the calculation of the information ratio. Source: own edit.

### 3.2 Robustness across different time periods

After the analysis of the full time period, in this section I present the results for different time horizons. First dividing the data into pre- and post-Paris Agreement periods, then focusing only on times of market turmoil with recessions.

The 6. Table shows the result for the banking sector for the pre-Paris Agreement with equal weighting. In this case the sector's average return is basically zero with a some standard deviation. The ESG portfolio has similar return but with a significantly higher standard deviation than the benchmark. The third and first tercile behave similarly to the full time period, around 1% return with a standard deviation around 5%. The negative screening styles again perform very similarly to the benchmark. However, the Environment portfolio in this period too

has a significant positive return, with some standard deviation. Based on all the risk-adjusted ratios again the Environment portfolio is the best choice. This is because compared to its significant positive return, it has both a relatively lower standard deviation and downside standard deviation. This supports the robustness of the result for Environment portfolio.

6. Table, The performance of different ESG style investments in the Banking sector, with equal weighting for the pre-Paris agreement time period

|                          | Sector average (market) | ESG portfolio | Positive screening (3rd tercile) | Low score (1st tercile) | Negative screening (2nd & 3rd Tercile) | Negative screening (controversies) | Environment portfolio |
|--------------------------|-------------------------|---------------|----------------------------------|-------------------------|----------------------------------------|------------------------------------|-----------------------|
| <b>Return</b>            | <b>0.01%</b>            | <b>0.18%</b>  | <b>1.03%</b>                     | <b>0.86%</b>            | <b>0.03%</b>                           | <b>0.01%</b>                       | <b>0.70%</b>          |
| Newey t-statistic        | (1.23)                  | (1.12)        | (2.48)                           | (2.57)                  | (1.19)                                 | (1.08)                             | (2.36)                |
| <b>St dev</b>            | <b>0.13%</b>            | <b>2.42%</b>  | <b>6.11%</b>                     | <b>5.04%</b>            | <b>0.38%</b>                           | <b>0.19%</b>                       | <b>3.92%</b>          |
| W50 test statistic       | -                       | (170.58)      | (246.30)                         | (263.60)                | (53.23)                                | (10.18)                            | (259.61)              |
| Downside St dev          | 0.12%                   | 1.70%         | 4.67%                            | 3.71%                   | 0.37%                                  | 0.18%                              | 2.48%                 |
| W50 test statistic       | -                       | (41.08)       | (71.18)                          | (78.47)                 | (34.89)                                | (8.08)                             | (122.38)              |
| <b>Sharpe ratio</b>      | <b>-0.634</b>           | <b>0.036</b>  | <b>0.155</b>                     | <b>0.152</b>            | <b>-0.152</b>                          | <b>-0.403</b>                      | <b>0.156</b>          |
| <b>Sortino ratio</b>     | <b>-0.652</b>           | <b>0.051</b>  | <b>0.202</b>                     | <b>0.207</b>            | <b>-0.156</b>                          | <b>-0.436</b>                      | <b>0.247</b>          |
| <b>Information ratio</b> | <b>-</b>                | <b>0.070</b>  | <b>0.171</b>                     | <b>0.172</b>            | <b>0.087</b>                           | <b>0.042</b>                       | <b>0.180</b>          |
| Track. error St dev      | -                       | 2.37%         | 5.99%                            | 4.93%                   | 0.26%                                  | 0.07%                              | 3.86%                 |

Table description: The columns represent the different ESG investment styles, starting with the Sector average as a benchmark. The first row shows the average monthly return for each investment for the given period. Below them in parentheses are the corresponding corrected Newey-West t-statistics (the critical value for 5% level of significance is 1.96 and 2.576 for 1%). The third row shows the standard deviation of the monthly return of the investment styles. Below in parentheses are the corrected test statistics of Brown and Forsythe (1974) for the difference between the standard deviation of the market and the given investment style (the critical value for 5% level of significance is ~3.936 and ~6.895 for 1%). After that the same is presented for the Downside standard deviation. The second part of the table shows the different risk-adjusted return ratios (Sharpe, Sortino and Information ratio). The last row shows the standard deviation of the Tracking error compared to the market, this is used for the calculation of the information ratio. Source: own edit.

The results for the post-Paris Agreement periods for the banking sector are shown in the 7. Table. The sector benchmark return is significantly positive compared to the previous zero. This is because the pre- period includes the 2008 banking crises which highly affected the profitability of banks. Again both the positive screening and the low score portfolio have a significant positive return with relatively standard risk. Negative screenings are very similar to the market portfolio. But in this period the Environment portfolio has similar characteristics to positive

screening. It has similar standard deviation, and downside standard deviation to the tercile strategies. Based on the risk-adjusted ratios it is still a good choice, but the positive screening might be a bit better for this period. However, the returns are bigger for the whole sector and not only for the ESG strategies, so there is no indication of a structural break or systemic change.

*7. Table, The performance of different ESG style investments in the Banking sector, with equal weighting for the post-Paris agreement time period*

|                          | <b>Sector average (market)</b> | <b>ESG portfolio</b> | <b>Positive screening (3rd tercile)</b> | <b>Low score (1st tercile)</b> | <b>Negative screening (2nd &amp; 3rd Tercile)</b> | <b>Negative screening (controversies)</b> | <b>Environment portfolio</b> |
|--------------------------|--------------------------------|----------------------|-----------------------------------------|--------------------------------|---------------------------------------------------|-------------------------------------------|------------------------------|
| <b>Return</b>            | <b>1.28%</b>                   | <b>0.11%</b>         | <b>1.43%</b>                            | <b>1.32%</b>                   | <b>1.30%</b>                                      | <b>1.27%</b>                              | <b>0.94%</b>                 |
| Newey t-statistic        | (2.36)                         | (0.85)               | (2.36)                                  | (2.46)                         | (2.35)                                            | (2.33)                                    | (1.54)                       |
| <b>St dev</b>            | <b>4.17%</b>                   | <b>1.41%</b>         | <b>4.59%</b>                            | <b>3.82%</b>                   | <b>4.33%</b>                                      | <b>4.15%</b>                              | <b>4.30%</b>                 |
| W50 test statistic       | -                              | (54.73)              | (1.10)                                  | (1.15)                         | (0.17)                                            | (0.00)                                    | (0.02)                       |
| Downside St dev          | 2.20%                          | 0.72%                | 2.17%                                   | 2.07%                          | 2.24%                                             | 2.17%                                     | 2.30%                        |
| W50 test statistic       | -                              | (17.99)              | (0.02)                                  | (0.02)                         | (0.03)                                            | (0.00)                                    | (0.28)                       |
| <b>Sharpe ratio</b>      | <b>0.289</b>                   | <b>0.025</b>         | <b>0.295</b>                            | <b>0.325</b>                   | <b>0.284</b>                                      | <b>0.288</b>                              | <b>0.202</b>                 |
| <b>Sortino ratio</b>     | <b>0.546</b>                   | <b>0.050</b>         | <b>0.624</b>                            | <b>0.599</b>                   | <b>0.549</b>                                      | <b>0.549</b>                              | <b>0.378</b>                 |
| <b>Information ratio</b> | <b>-</b>                       | <b>-0.250</b>        | <b>0.024</b>                            | <b>0.007</b>                   | <b>0.087</b>                                      | <b>-0.090</b>                             | <b>-0.058</b>                |
| Track. error St dev      | -                              | 4.66%                | 6.13%                                   | 5.36%                          | 0.30%                                             | 0.10%                                     | 5.78%                        |

*Table description: The columns represent the different ESG investment styles, starting with the Sector average as a benchmark. The first row shows the average monthly return for each investment for the given period. Below them in parentheses are the corresponding corrected Newey-West t-statistics (the critical value for 5% level of significance is 1.96 and 2.576 for 1%). The third row shows the standard deviation of the monthly return of the investment styles. Below in parentheses are the corrected test statistics of Brown and Forsythe (1974) for the difference between the standard deviation of the market and the given investment style (the critical value for 5% level of significance is ~3.936 and ~6.895 for 1%). After that the same is presented for the Downside standard deviation. The second part of the table shows the different risk-adjusted return ratios (Sharpe, Sortino and Information ratio). The last row shows the standard deviation of the Tracking error compared to the market, this is used for the calculation of the information ratio. Source: own edit.*

If we look at the results of the energy sector pre-Paris Agreement period we see no significant return for any strategy. This again might be explained by the market conditions of the Great Recession and the years after. All the strategies including the sector average have some return but it is not statistically significant, and some standard deviation around 5%. The only exceptions are the ESG and Environment portfolio, where we see absolutely zero return with lower standard deviation. Without a significant return there is little point in analyzing the ratios

in detail- But based on them surprisingly besides the positive screening the market portfolio seems to be one of the best in this period.

8. Table, The performance of different ESG style investments in the Energy sector, with equal weighting for the pre-Paris agreement time period

|                          | Sector average (market) | ESG portfolio | Positive screening (3rd tercile) | Low score (1st tercile) | Negative screening (2nd & 3rd Tercile) | Negative screening (controversies) | Environment portfolio |
|--------------------------|-------------------------|---------------|----------------------------------|-------------------------|----------------------------------------|------------------------------------|-----------------------|
| <b>Return</b>            | <b>0.76%</b>            | <b>0.02%</b>  | <b>0.82%</b>                     | <b>0.80%</b>            | <b>0.73%</b>                           | <b>0.78%</b>                       | <b>0.08%</b>          |
| Newey t-statistic        | (1.51)                  | (0.07)        | (1.92)                           | (1.30)                  | (1.56)                                 | (1.49)                             | (0.27)                |
| <b>St dev</b>            | <b>5.00%</b>            | <b>3.18%</b>  | <b>4.13%</b>                     | <b>6.04%</b>            | <b>4.65%</b>                           | <b>5.19%</b>                       | <b>3.23%</b>          |
| W50 test statistic       | -                       | (12.78)       | (2.85)                           | (4.12)                  | (0.48)                                 | (0.15)                             | (11.53)               |
| Downside St dev          | 4.53%                   | 2.08%         | 5.60%                            | 4.39%                   | 4.92%                                  | 4.42%                              | 1.85%                 |
| W50 test statistic       | -                       | (24.09)       | (1.04)                           | (0.10)                  | (0.48)                                 | (0.00)                             | (26.18)               |
| <b>Sharpe ratio</b>      | <b>0.135</b>            | <b>-0.022</b> | <b>0.176</b>                     | <b>0.117</b>            | <b>0.138</b>                           | <b>0.133</b>                       | <b>-0.003</b>         |
| <b>Sortino ratio</b>     | <b>0.149</b>            | <b>-0.033</b> | <b>0.130</b>                     | <b>0.161</b>            | <b>0.130</b>                           | <b>0.156</b>                       | <b>-0.005</b>         |
| <b>Information ratio</b> | <b>-</b>                | <b>-0.116</b> | <b>0.009</b>                     | <b>0.004</b>            | <b>-0.048</b>                          | <b>0.042</b>                       | <b>-0.105</b>         |
| Track. error St dev      | -                       | 6.38%         | 6.38%                            | 7.38%                   | 0.65%                                  | 0.38%                              | 6.53%                 |

Table description: The columns represent the different ESG investment styles, starting with the Sector average as a benchmark. The first row shows the average monthly return for each investment for the given period. Below them in parentheses are the corresponding corrected Newey-West t-statistics (the critical value for 5% level of significance is 1.96 and 2.576 for 1%). The third row shows the standard deviation of the monthly return of the investment styles. Below in parentheses are the corrected test statistics of Brown and Forsythe (1974) for the difference between the standard deviation of the market and the given investment style (the critical value for 5% level of significance is ~3.936 and ~6.895 for 1%). After that the same is presented for the Downside standard deviation. The second part of the table shows the different risk-adjusted return ratios (Sharpe, Sortino and Information ratio). The last row shows the standard deviation of the Tracking error compared to the market, this is used for the calculation of the information ratio. Source: own edit.

The 9. Table shows the result for the energy sector post-Paris Agreement. The benchmark return is a bit higher but still not significant on a 5% level. The ESG and Environment portfolio have a small insignificant return with smaller standard deviation. The positive screening outperforms everything else, however the negative screenings have a significant return too in this period. Based on the risk-adjusted ratios positive screening and negative screening are the best strategies, indicating that the stocks in the first tercile might underperform in terms of risk-adjusted returns.

9. Table, The performance of different ESG style investments in the Energy sector, with equal weighting for the post-Paris agreement time period

|                          | Sector average (market) | ESG portfolio | Positive screening (3rd tercile) | Low score (1st tercile) | Negative screening (2nd & 3rd Tercile) | Negative screening (controversies) | Environment portfolio |
|--------------------------|-------------------------|---------------|----------------------------------|-------------------------|----------------------------------------|------------------------------------|-----------------------|
| <b>Return</b>            | <b>1.02%</b>            | <b>0.58%</b>  | <b>1.31%</b>                     | <b>0.73%</b>            | <b>1.24%</b>                           | <b>1.04%</b>                       | <b>0.47%</b>          |
| Newey t-statistic        | (1.93)                  | (1.47)        | (3.27)                           | (0.98)                  | (2.66)                                 | (1.96)                             | (1.07)                |
| <b>St dev</b>            | <b>4.66%</b>            | <b>2.97%</b>  | <b>4.14%</b>                     | <b>5.32%</b>            | <b>4.46%</b>                           | <b>4.65%</b>                       | <b>3.08%</b>          |
| W50 test statistic       | -                       | (4.67)        | (0.85)                           | (2.01)                  | (0.13)                                 | (0.00)                             | (4.44)                |
| Downside St dev          | 2.22%                   | 0.72%         | 2.17%                            | 2.07%                   | 2.23%                                  | 2.19%                              | 1.91%                 |
| W50 test statistic       | -                       | (16.21)       | (0.03)                           | (0.00)                  | (0.04)                                 | (0.02)                             | (0.11)                |
| <b>Sharpe ratio</b>      | <b>0.204</b>            | <b>0.171</b>  | <b>0.299</b>                     | <b>0.122</b>            | <b>0.260</b>                           | <b>0.207</b>                       | <b>0.127</b>          |
| <b>Sortino ratio</b>     | <b>0.427</b>            | <b>0.710</b>  | <b>0.570</b>                     | <b>0.314</b>            | <b>0.521</b>                           | <b>0.441</b>                       | <b>0.205</b>          |
| <b>Information ratio</b> | <b>-</b>                | <b>-0.077</b> | <b>0.045</b>                     | <b>-0.043</b>           | <b>0.313</b>                           | <b>0.067</b>                       | <b>-0.097</b>         |
| Track. error St dev      | -                       | 5.72%         | 6.33%                            | 7.02%                   | 0.68%                                  | 0.21%                              | 5.75%                 |

Table description: The columns represent the different ESG investment styles, starting with the Sector average as a benchmark. The first row shows the average monthly return for each investment for the given period. Below them in parentheses are the corresponding corrected Newey-West t-statistics (the critical value for 5% level of significance is 1.96 and 2.576 for 1%). The third row shows the standard deviation of the monthly return of the investment styles. Below in parentheses are the corrected test statistics of Brown and Forsythe (1974) for the difference between the standard deviation of the market and the given investment style (the critical value for 5% level of significance is ~3.936 and ~6.895 for 1%). After that the same is presented for the Downside standard deviation. The second part of the table shows the different risk-adjusted return ratios (Sharpe, Sortino and Information ratio). The last row shows the standard deviation of the Tracking error compared to the market, this is used for the calculation of the information ratio. Source: own edit.

Some studies indicate that the effects of ESG incorporation is larger in case on uncertain periods (Engelhardt et al., 2021; Broadstock et al., 2021). To further test this in the selected sectors I performed the same portfolio analysis for the period of Great Recession and the COVID-19 pandemic.

The 10. Table shows the results for the banking sector for time periods of recessions. We see that the sector benchmark is basically zero with a very high standard deviation (7.92%). No strategy has a significant return except the Environment portfolio. It has a significant return of 1.62% with much lower standard deviation than the benchmark. Thanks to this the Environmental portfolio way outperforms the other strategies in terms of risk-adjusted return

ratios. This indicates a very robust positive effect of the Environmental score on expected returns in the banking sector.

*10. Table, The performance of different ESG style investments in the Banking sector, with equal weighting for time period of recessions*

|                          | Sector average (market) | ESG portfolio | Positive screening (3rd tercile) | Low score (1st tercile) | Negative screening (2nd & 3rd Tercile) | Negative screening (controversies) | Environment portfolio |
|--------------------------|-------------------------|---------------|----------------------------------|-------------------------|----------------------------------------|------------------------------------|-----------------------|
| <b>Return</b>            | <b>0.16%</b>            | <b>0.32%</b>  | <b>0.94%</b>                     | <b>0.62%</b>            | <b>0.12%</b>                           | <b>0.20%</b>                       | <b>1.62%</b>          |
| Newey t-statistic        | (0.12)                  | (0.57)        | (0.75)                           | (0.61)                  | (0.09)                                 | (0.16)                             | (2.21)                |
| <b>St dev</b>            | <b>7.92%</b>            | <b>3.32%</b>  | <b>9.37%</b>                     | <b>7.26%</b>            | <b>8.29%</b>                           | <b>7.72%</b>                       | <b>4.86%</b>          |
| W50 test statistic       | -                       | (28.32)       | (0.68)                           | (0.80)                  | (0.10)                                 | (0.03)                             | (9.89)                |
| Downside St dev          | 5.42%                   | 2.35%         | 7.10%                            | 5.52%                   | 5.73%                                  | 5.17%                              | 2.48%                 |
| W50 test statistic       | -                       | (18.79)       | (1.73)                           | (0.02)                  | (0.16)                                 | (0.10)                             | (13.58)               |
| <b>Sharpe ratio</b>      | <b>0.014</b>            | <b>0.083</b>  | <b>0.096</b>                     | <b>0.079</b>            | <b>0.009</b>                           | <b>0.020</b>                       | <b>0.324</b>          |
| <b>Sortino ratio</b>     | <b>0.020</b>            | <b>0.117</b>  | <b>0.126</b>                     | <b>0.104</b>            | <b>0.013</b>                           | <b>0.030</b>                       | <b>0.637</b>          |
| <b>Information ratio</b> | <b>-</b>                | <b>0.020</b>  | <b>0.065</b>                     | <b>0.043</b>            | <b>-0.053</b>                          | <b>0.080</b>                       | <b>0.164</b>          |
| Track. error St dev      | -                       | 8.37%         | 12.17%                           | 10.80%                  | 0.67%                                  | 0.58%                              | 8.94%                 |

*Table description: The columns represent the different ESG investment styles, starting with the Sector average as a benchmark. The first row shows the average monthly return for each investment for the given period. Below them in parentheses are the corresponding corrected Newey-West t-statistics (the critical value for 5% level of significance is 1.96 and 2.576 for 1%). The third row shows the standard deviation of the monthly return of the investment styles. Below in parentheses are the corrected test statistics of Brown and Forsythe (1974) for the difference between the standard deviation of the market and the given investment style (the critical value for 5% level of significance is ~3.936 and ~6.895 for 1%). After that the same is presented for the Downside standard deviation. The second part of the table shows the different risk-adjusted return ratios (Sharpe, Sortino and Information ratio). The last row shows the standard deviation of the Tracking error compared to the market, this is used for the calculation of the information ratio. Source: own edit.*

As for the energy sector can see the results in the 11. Table for the recession periods. The sector average return is somewhat positive but not statistically significant with a high standard deviation of 7.62%. There is no significant return for any strategy and some returns even turn somewhat negative. Similarly to the post-Paris period there is no specifically good strategy, but the risk-adjusted returns might be the best for the Positive screening style. Overall, in the energy sector we do not see robust results as in the banking sector.

11. Table, The performance of different ESG style investments in the Energy sector, with equal weighting for time period of recessions

|                          | Sector average (market) | ESG portfolio | Positive screening (3rd tercile) | Low score (1st tercile) | Negative screening (2nd & 3rd Tercile) | Negative screening (controversies) | Environment portfolio |
|--------------------------|-------------------------|---------------|----------------------------------|-------------------------|----------------------------------------|------------------------------------|-----------------------|
| <b>Return</b>            | <b>0.62%</b>            | <b>-0.43%</b> | <b>0.65%</b>                     | <b>1.08%</b>            | <b>0.63%</b>                           | <b>0.61%</b>                       | <b>-0.39%</b>         |
| Newey t-statistic        | (0.56)                  | -(1.13)       | (0.61)                           | (0.91)                  | (0.57)                                 | (0.53)                             | -(0.98)               |
| <b>St dev</b>            | <b>7.62%</b>            | <b>4.09%</b>  | <b>6.46%</b>                     | <b>8.73%</b>            | <b>7.20%</b>                           | <b>7.73%</b>                       | <b>4.20%</b>          |
| W50 test statistic       | -                       | (10.74)       | (1.06)                           | (1.07)                  | (0.13)                                 | (0.01)                             | (10.11)               |
| Downside St dev          | 5.50%                   | 2.31%         | 4.81%                            | 6.00%                   | 5.43%                                  | 5.79%                              | 2.30%                 |
| W50 test statistic       | -                       | (20.42)       | (0.43)                           | (0.10)                  | (0.00)                                 | (0.04)                             | (20.53)               |
| <b>Sharpe ratio</b>      | <b>0.075</b>            | <b>-0.117</b> | <b>0.093</b>                     | <b>0.118</b>            | <b>0.080</b>                           | <b>0.073</b>                       | <b>-0.105</b>         |
| <b>Sortino ratio</b>     | <b>0.104</b>            | <b>-0.207</b> | <b>0.125</b>                     | <b>0.172</b>            | <b>0.107</b>                           | <b>0.097</b>                       | <b>-0.191</b>         |
| <b>Information ratio</b> | <b>-</b>                | <b>-0.113</b> | <b>0.003</b>                     | <b>0.043</b>            | <b>0.005</b>                           | <b>-0.041</b>                      | <b>-0.107</b>         |
| Track. error St dev      | -                       | 9.33%         | 9.44%                            | 10.56%                  | 0.88%                                  | 0.34%                              | 9.50%                 |

Table description: The columns represent the different ESG investment styles, starting with the Sector average as a benchmark. The first row shows the average monthly return for each investment for the given period. Below them in parentheses are the corresponding corrected Newey-West t-statistics (the critical value for 5% level of significance is 1.96 and 2.576 for 1%). The third row shows the standard deviation of the monthly return of the investment styles. Below in parentheses are the corrected test statistics of Brown and Forsythe (1974) for the difference between the standard deviation of the market and the given investment style (the critical value for 5% level of significance is ~3.936 and ~6.895 for 1%). After that the same is presented for the Downside standard deviation. The second part of the table shows the different risk-adjusted return ratios (Sharpe, Sortino and Information ratio). The last row shows the standard deviation of the Tracking error compared to the market, this is used for the calculation of the information ratio. Source: own edit.

### 3.3 Regression approach on individual stock level data

To account for the lack of control variables and to further test the robustness of the results on a stock level basis, I also used Fama-MacBeth (1973) regressions to test the effect of ESG incorporation into investments.

The 12. Table presents the regression results for the banking sector for the full time period. Using only the ESG score as a predictor of future returns, we see a significant positive effect. However, it is not too big in magnitude. If we control for the four factor model (Carhart, 1997) the effect still stays significant. This indicates that the ESG score has extra information beyond the four factor model and has a positive relationship with future returns. Although the size of the effect is economically debatable. The significance of the four factor variables can vary

through time, region and sector (Griffin, 2002). Therefore, I do not want to focus on those, they are present in the model only for control purposes. The results are basically the same for the Environment pillar, but the effect is even stronger. The economic significance is still not clear, but it is clearly a stronger positive effect. The lack of economic significance can might be explained by the strictly linear assumption of the regression mode, which is not present in the portfolio approach. These results are still completely in line with the findings of the portfolio approach. The ESG score has some positive effect, but the Environment score has an even stronger robust positive effect in the banking sector.

*12. Table, The results of Fama-MacBeth regressions in the Banking sector for the full time period*

|                   | 1. ESG<br>only | 2. ESG<br>control | 3.<br>Environment<br>only | 4.<br>Environment<br>control |
|-------------------|----------------|-------------------|---------------------------|------------------------------|
| <b>ESG</b>        | <b>0.00004</b> | <b>0.00003</b>    |                           |                              |
| Newey t-statistic | (3.93)         | (3.08)            |                           |                              |
| <b>Env</b>        |                |                   | <b>0.00008</b>            | <b>0.00016</b>               |
| Newey t-statistic |                |                   | (4.16)                    | (4.50)                       |
| <b>Beta</b>       |                | <b>-0.00418</b>   |                           | <b>-0.00352</b>              |
| Newey t-statistic |                | -(0.24)           |                           | -(0.20)                      |
| <b>Size</b>       |                | <b>-0.00024</b>   |                           | <b>-0.00154</b>              |
| Newey t-statistic |                | -(0.52)           |                           | -(2.61)                      |
| <b>Btm</b>        |                | <b>-0.00012</b>   |                           | <b>-0.00142</b>              |
| Newey t-statistic |                | -(0.25)           |                           | -(1.97)                      |
| <b>Mom</b>        |                | <b>-0.02306</b>   |                           | <b>-0.02374</b>              |
| Newey t-statistic |                | -(3.23)           |                           | -(3.34)                      |

*Table description: Each column shows the result of a different Fama-MacBeth regression, including only the variable where numbers are presented in the column. The rows show the  $\beta$  regression coefficient for the given variable. Below them in parentheses are the corresponding corrected Newey-West t-statistics (the critical value for 5% level of significance is 1.96 and 2.576 for 1%). Source: own edit.*

The results of the Fama-MacBeth regressions for the energy sector can be seen in the 13. Table. The ESG is not significant by itself in explaining future returns and stays the same in the model with the four control variables. Although the Environment score seems significant by itself, the effect is very small and loses statistical significance upon introducing the four control variables into the model. These results are also consistent with the findings of the portfolio approach,

because there were only small indications for the positive effect of ESG incorporation and even those were for the risk-adjusted return only.

*13. Table, The results of Fama-MacBeth regressions in the Energy sector for the full time period*

|                   | 1. ESG<br>only | 2. ESG<br>control | 3.<br>Environment<br>only | 4.<br>Environment<br>control |
|-------------------|----------------|-------------------|---------------------------|------------------------------|
| <b>ESG</b>        | <b>0.00003</b> | <b>0.00003</b>    |                           |                              |
| Newey t-statistic | (1.87)         | (1.32)            |                           |                              |
| <b>Env</b>        |                |                   | <b>0.00002</b>            | <b>0.00002</b>               |
| Newey t-statistic |                |                   | (2.11)                    | (1.09)                       |
| <b>Beta</b>       |                | <b>0.00188</b>    |                           | <b>0.00191</b>               |
| Newey t-statistic |                | (0.62)            |                           | (0.64)                       |
| <b>Size</b>       |                | <b>0.00035</b>    |                           | <b>0.00042</b>               |
| Newey t-statistic |                | (0.49)            |                           | (0.62)                       |
| <b>Btm</b>        |                | <b>0.00325</b>    |                           | <b>0.00330</b>               |
| Newey t-statistic |                | (2.58)            |                           | (2.65)                       |
| <b>Mom</b>        |                | <b>-0.00904</b>   |                           | <b>-0.00892</b>              |
| Newey t-statistic |                | -(2.16)           |                           | -(2.13)                      |

*Table description: Each column shows the result of a different Fama-MacBeth regression, including only the variable where numbers are presented in the column. The rows show the  $\beta$  regression coefficient for the given variable. Below them in parentheses are the corresponding corrected Newey-West t-statistics (the critical value for 5% level of significance is 1.96 and 2.576 for 1%). Source: own edit.*

Summarizing the results, for the banking sector from the portfolio approach we can see that the positive screening investing style generally outperforms the sector average in terms of risk-adjusted return. However, this advantage is only true for the risk-adjusted return and not necessarily true for the return and standard deviation separately. So, the better performance is not that robust but still consistent. Negative screenings usually follow the performance of the market with only a few exceptions. Surprisingly the performance of the low score tercile is also similar to the market or is just a bit below. So, there is no indication of a possible punishment from investors for an especially bad ESG score. But the most interesting result is for the Environment portfolio, which consistently outperforms the sector average in terms of risk-adjusted returns, standard deviation and in some cases in raw return as well. This result is robust for equal and value weighting, different time periods and market conditions. It is especially

strong in case of recessions. While also staying consistent for the Fama-MacBeth regression too. In general, this is in line with the literature (Bătae et al., 2020; Danisman, 2022), however the strong performance of the Environment portfolio is an addition to existing results.

The results for the energy sector are far more mixed and lack robustness for any strategy. The result highly differs for different periods, however the positive screening style shows some positive results. In most cases its return is a bit higher than the market with similar risk. Negative screening technics also have some promising results, but it is not robust for value weighting. The Environment portfolio does not show any outperformance as in the banking sector. In general, it seems like stocks with low ESG score in the energy sector perform a bit worse but it is not always the case. The Fama-MacBeth regressions do not show any strong significance also consistent with previous results. So it is hard to recognize any general pattern in the energy sector. The literature for the energy sector is not too wide and the results are mixed as well (Wanday and Ajour El Zein, 2022; Baran et al., 2022). My study also confirms that there are no clear findings in the energy sector in regard to ESG performance.

#### **4. Conclusion**

In my study I test the effect of the ESG score incorporation into investments in the banking and energy sector through the most common ESG investing styles. Which are ESG portfolio (3rd tercile – 1st tercile), Positive screening (3rd tercile), Low score (1st tercile), Negative screening (2nd & 3rd Tercile), Negative screening (controversies) and Environment portfolio (3rd tercile – 1st tercile). I test these investment strategies through a portfolio approach and also use the Fama-MacBeth regression simultaneously. This allows to use the advantages of both method: The portfolio method allows to group assets based on a single factor, while the Fama-Macbeth regression accounts for cross-sectional correlation and allows for the estimation of coefficients separately for each time period. Therefore, compelling a more comprehensive analysis. To better account for investor needs, I not only focus my analysis on the returns, but statistically test the standard deviation and downside standard deviation as two measures of risk. I also evaluate the performance through three different risk-adjusted return ratios (Sharpe, Sortino and Information ratio), to get more comprehensive results. Looking for structural or systemic differences I divide the data into sub-periods at the Paris Agreement, and into period of recessions. This allows me to test the robustness and time differences of the results.

My results for the banking sector are highly consistent, the most interesting result is for the Environment portfolio, which consistently outperforms the sector average in terms of risk-

adjusted returns, standard deviation and in some cases in raw return as well. The results are robust for equal and value weighting, different time periods, market conditions and testing methods. It is especially strong in time of recessions. This provides strong evidence for the positive effect of incorporating the Environment score of ESG into investment decisions in the banking sector. The positive screening investing style also generally outperforms the sector average in terms of risk-adjusted return, but it is not as strong as the Environment portfolio and lacks the results in the ESG portfolio's performance too. Negative screenings, and the low score tercile usually follow the performance of the market with only a few exceptions. These are supporting that even if ESG incorporation have only minor positive effect performance, it do not have any negative effect. Therefore, it is still worth it to incorporate ESG into investment decisions for the nonfinancial benefits, like mitigating climate change and pollution. However, the results in the energy sector are not so clear. There is no clear good strategy, the results are sensitive for weighting and for time. The positive screening style shows some positive results. In most cases its return is a bit higher than the market with similar risk. Negative screening techniques also have some promising results, but it is not robust for value weighting. The Environment portfolio does not show any outperformance as in the banking sector. Based on the results it seems like stocks with low ESG score in the energy sector perform a bit worse in some cases. Therefore, it is worth incorporating ESG into investment decisions in the energy sector for minor risk-adjusted return benefits. And also, for the nonfinancial benefits, like mitigating climate change and pollution, because high ESG score stock are not performing worse in any case than the sector benchmark.

In conclusion I accept the hypothesis that incorporating ESG into investment decisions has a positive effect on risk-adjusted return in both the banking and energy sector.

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