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The Power of Sustainability

Can ESG ETFs outperform their benchmarks after the introduction of new environmental regulation?

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ABSTRACT

In this thesis, I study the effect of new environmental regulation on ESG ETF performance. By calculating the abnormal returns for seven different ETF portfolios via five different factor models, I compare ESG ETFs to their non-ESG benchmark portfolios to examine whether they outperform these benchmarks after the introduction of three different climate regulations. Moreover, portfolios are constructed based on MSCI ESG-ratings to check if higher ESG-rated portfolios outperform lower-rated ones. I found that although no consistant outperformance of ESG ETFs exists looking at the full sample period, the highest-rated ESG portfolio did outperform the lower-rated ones in the last few years. Furthermore, I concluded that there is no significant difference in ESG ETF performance between Europe and the United States. Although more research is definitely needed on this topic, this research implies that ESG-orientated portfolios tend to outperform non-ESG portfolios in the most recent years.

Keywords: ESG ETFs; Environmental Regulation; Abnormal Returns; Factor Models.

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CHAPTER 1 Introduction

Fairly recent, when various environmental activist groups filed a lawsuit against oil giant Shell, the impact and seriousness of climate regulation was underlined. On 26 May 2021, The Hague District Court ordered Royal Dutch Shell to reduce the CO2 emissions of the Shell group by 45% in 2030, compared to 2019 levels (Milieudefensie et al. v. Royal Dutch Shell, 2021). Earlier, the introduction of the 2015 Paris Agreement, in which 195 parties made binding commitments to tackle the problem of climate change, already engendered a rise in investors' awareness of climate risks and attention to green investments (Fahmy, 2022). ESG ETFs, which are ETFs that track companies with strongly positive environmental, social, and governance characteristics, are an example of such green investments. By looking at the monthly risk-adjusted returns of ESG ETFs compared to their benchmarks before and after the introduction of new environmental regulation, we can observe whether these ESG ETFs have gained popularity after renewed climate regulation. Previous research by Pham et al. (2019) has already shown that environmental regulation on water, soil and air reduces risk for environmentally friendly firms in France. Contrarily, this risk tends to increase for polluting firms. This indicates that a change in environmental regulation engenders a change in strategy by investors, and a reaction by the stock market consequently.

Previous papers have examined the behaviour of ESG ETFs and how they respond to certain developments. In a paper by Pavlova and De Boyrie (2022), the monthly risk-adjusted returns of higher-rated ESG ETFs were compared to those of lower-rated ones before and during the COVID-19 market crash. They found that during the market crash, the performance of sustainable ETFs improved relative to that of lower-rated ESG ETFs. A possible reasoning behind this is that investors seek 'safety' in times of uncertainty, thus choosing long-term sustainable ETFs over polluting ETFs. Focussing more on developments concerning climate change, Ardia et al. (2023) show that green firms' stock prices tend to increase relative to those of non-green firms after an unexpected increase in climate change concerns. Here, we observe a shift from 'normal' stocks to greener ones after increased attention to environmental problems. Shanaev and Ghimire (2022) have similar findings, as they conclude that upgrades in ESG ratings lead to modest positive stock returns, while downgrades depress returns significantly. Again, we observe the increased value that investors attribute to more sustainable investments. This paper aims to combine these findings and answer the following question: *is there an observable difference in sustainable investment performance between ESG ETFs and their benchmarks after new impactful environmental regulation*?

In this paper, I will replicate the methods used by Pavlova and De Boyrie, although I will apply them to multiple periods in time, investigating the consequences of the introduction of three different regulations: the Paris Agreement, the Glasgow Climate Pact and the European Corporate Sustainability

Reporting Directive. Examining the consequences of these regulations for the performance of ESG ETFs compared to their benchmarks is highly interesting, since new environmental regulation has more influence on the difference in performance between those ETFs than a market crash. The main reason for this is that a market crash would influence almost the entire stock market, while new environmental regulation would be extremely more relevant to the performance of ESG ETFs relative to that of 'normal' ones, since ESG ETFs are more influenced by this new regulation. Yet, little research has been done on the effect of new environmental regulation on the relative sustainable investment performance of ESG ETFs in particular. Therefore, this paper will dive into how new environmental regulation influences the performance of ESG ETFs relative to that of their non-ESG benchmarks.

To study this relationship, performance is operationalised by the monthly risk-adjusted abnormal performance for each portfolio. Four portfolios will be created: U.S. equity ESG ETFs, European equity ESG ETFs, and a benchmark portfolio for both the United States and European ESG ETFs. To calculate this monthly risk-adjusted abnormal performance, I will use five different factor models.[1] Additionally, dummy variables will be incorporated in each model for the periods before and after the introduction of a new regulation, that will take the value of 1 if the month lies within the period, and 0 otherwise. For each regulation, the period 'before' represents the twelve months before the introduction of the regulation, and the period 'after' represents the twelve months thereafter. For each of the periods, data on closing prices and important fund characteristics such as Total Net Assets (TNA), age in years and expense ratios will be retrieved from Refinitiv Eikon. For each portfolio, data on risk factors needed to estimate the abnormal returns will be obtained from the Kenneth R. French database.

My hypothesis is that after the introduction of new environmental regulation, we will observe an increase in performance of the ESG ETF portfolios relative to that of their benchmark portfolios. The main argument behind this reasoning is that ESG ETFs track companies that already score well on ESG-scales, meaning that they presumably have less trouble with complying with new regulatory rules. Hence, firms tracked by ESG ETFs would have less additional costs that occur after having to meet new environmental requirements, meaning that an ESG ETF portfolio would likely financially outperform its benchmark. This expectation should be visible by a relative increase in (abnormal) monthly returns of ESG ETFs. By examining the consequences of climate regulation for these ETFs, I expect that we can better understand the effect that new environmental regulation has on specific ETFs.

In this thesis, ambiguous results were found after comparing the performance of European and US equity ESG ETFs to their benchmark portfolios before and after new environmental regulation. Moreover, I did not discover major differences between European and US ESG ETFs. However, after

[1] The Capital Asset Pricing Model (1), the Fama-French (1993) three-factor model (2), the Carhart (1997) four-factor model (3), the Fama-French (2015) five-factor model (4), and the Fama-French five-factor model plus momentum factor (5).

constructing three additional portfolios based on MSCI ESG-rating, it was found that the highest-rated portfolio outperformed the lowest-rated one in the last few years. This implies that over the last few years, additional environmental regulation has had a positive effect on high-rated ESG ETFs.

In the rest of this paper, I will firstly discuss findings by other researchers and elucidate on the relationships between them. Secondly, a summary of the sample will be provided, as well as a clear elaboration on the methods used to obtain the results. After presenting and explaining the results, a short conclusion will serve as the end of this paper. Lastly, the reference list is followed by Appendix A, which contains a list of all sample ETFs.

CHAPTER 2 Theoretical Framework

2.1 Environmental regulation

For the purpose of this study, it is highly salient to first elucidate on what environmental regulation is, as well as on the effects it already has proven to have on for example investment behaviour and decision-making. According to McManus (2009), environmental regulation refers to "the imposition of limitations or responsibilities on individuals, corporations, and other entities for the purpose of preventing environmental damage or improving degraded environments" (p. 546). What is extremely important to underline here, is that the goal of environmental regulation is not to limit production processes, but production results (Shao et al., 2020). In other words: environmental regulation aims to limit negative effects or consequences of a production process to protect the environment.

Considering the above, effective environmental regulation should engender a reduction in pollution or other harm done to the environment. According to Porter (1991), strict and effective environmental regulation could also induce efficiency and encourage innovations that help commercial competitiveness. Hence, following this so-called Porter hypothesis (PH), climate regulation could be beneficial for both the environment and economic efficiency. Jaffe and Palmer (1997) build on Porters' conclusions, as they state that the PH has three different forms. Firstly, the "weak" hypothesis states that environmental regulation will simulate a certain type of innovation, but that is unclear whether this innovation is beneficial for the company or not taking in consideration the costs of environmental protection. Moreover, the "strong" PH argues that "the improvement of innovation can generate the benefits that exceed the cost brought by the environmental regulation" (Wu et al., 2018, p. 2). Lastly, the "narrow" form of the hypothesis indicates that flexible forms of regulation give companies more incentives to innovate than stricter forms (Ambec et al., 2013). In general, it can be noticed that the theory that environmental regulation could also stimulate innovation and competitiveness, is widely accepted.

Other studies have also focused on the effects of environmental regulation. The observation that climate regulation could very well stimulate innovation, is also emphasised by Perman et al. (2011). Moreover, Jaffe and Palmer (1997) find that environmental regulation has a significant positive impact on research and development (R&D) expenditures. Lastly, Zhu et al. (2022) conclude that, in China, climate regulation has significantly improved environmental governance behaviour, implying that regulation does engender more environmental awareness.

2.1.1 The Paris Agreement

A specific example of environmental regulation where this paper will partly focus on, is the Paris Agreement. Adopted on 12 December 2015, this historic agreement between 195 parties contains far-

reaching measures to battle the problem of climate change. The Agreement was signed on 12 December 2015, meaning that since this date, the Agreement is binding to all 195 parties (United Nations Paris Climate Change Conference, 2015). The long-term goal of the treaty is to limit the rise in global surface temperature to well below 2 °C, and preferably to well below 1.5°C. In practice, this means that by 2030, emissions need to be cut by roughly 50% (ibid.).

The impact of environmental regulation and the attention to climate change have risen significantly over the last few years. A recent example is the lawsuit against oil company Royal Dutch Shell filed by various environmental activist groups collectively. On 26 May 2021, The Hague District Court ordered Royal Dutch Shell to reduce the CO2 emissions of the Shell group by 45% in 2030, compared to 2019 levels, through the Shell group's corporate policy (Milieudefensie et al. v. Royal Dutch Shell, 2021). As main argument, the court stated that the Paris Agreement was also binding for Shell, meaning that the company has a legal obligation to change their production process to comply with the Agreement. For the first time, a court forced a listed company to comply with the Paris Agreement.

2.1.2 The Glasgow Climate Pact

During the 2021 United Nations Climate Change Conference (COP26), the Glasgow Climate Pact was reached between 197 parties (United Nations Glasgow Climate Pact, 2021). This is the first environmental agreement that explicitly aims to reduce unabated coal usage. The pact mainly builds on the Paris Agreement, although the parties additionally recognise that "the impacts of climate change will be much lower at the temperature increase of 1.5 °C compared with 2 °C" (Hunter et al., 2021, p. 5). Moreover, the parties state that more effort is desired and needed to limit global warming to 1.5 °C rapidly. Other aspects of the Glasgow Climate Pact also build on the Paris Agreement, making the pact a stricter and more modern version of the Paris Agreement (ibid.).

Based on recent research, the Glasgow Climate Pact has proven to affect the stock market significantly. Firstly, Pandey et al. (2023) show that after the Pact, firms with higher ESG-scores and larger firm sizes have experienced fewer abnormal returns, as these firms have more stable financial and non-financial fundamentals. Moreover, Kumari et al. (2023) find that the Pact has negatively affected stock prices of oil and gas sector companies, especially in emerging markets. More relevant to this paper, ESG ETFs have shown a positive reaction to climate change events (Fiordelisi, 2022). This is mainly driven by the behaviour of responsible investors, who tend to shift their investments to sustainable funds after such climate change events or new regulations.

2.1.3 The European Corporate Sustainability Reporting Directive

The first Corporate Sustainability Reporting Directive was implemented by the European Union (EU) in January 2023 (Directive 2022/2464). The directive states that EU and non-EU firms that are active in the 27 EU-countries need to disclose on sustainability (Cooley LLP, 2023). The European Commission has set the first mandatory ESG disclosure, the European Sustainability Reporting Standards (ESRS), on 31 July 2023 (Directive 2022/2464). The United Kingdom is excluded from this rule, since it is no longer part of the EU (Cooley LLP, 2023). In short, the Directive mandates that all large companies and listed companies disclose information about their social and environmental risks and opportunities, as well as the impact of their activities on people and the environment (Poulle et al., 2024).

Thus far, little research has been conducted on the effect of such disclosures on ETF performance. However, Xu et al. (2023) conclude that for energy companies, ESG disclosure rules such as the above improve green innovation performance significantly. Therefore, in the long run, reporting information on ESG could very well lead to enhanced firm performance in general. Moreover, accurate ESG information disclosure helps investors to make reasonable economic decisions (Peng, 2023). Although the actual effect of ESG disclosure on financial performance remains ambiguous, it becomes clear that stricter rules on ESG disclosure would presumably be beneficial for many parties.

2.2 Exchange Traded Funds (ETFs) and Environmental, Social and Governance (ESG) ratings

Over nearly a quarter of a century, exchange traded funds (ETFs) have gained massively in popularity as passive investment instruments due to their low transaction costs and high liquidity (Ben-David et al., 2017). In 2011, the total market value of ETFs was $2.96 trillion (Valle et al., 2014). Additionally, by 2016, ETFs represented over 10% of the total market capitalisation traded on United States exchanges (Ben-David et al., 2017).

At about the same time as the introduction of ETFs, a new concept was introduced to the world of investing: environmental, social and governance factors. It was derived from a concept called “People, Planet and Profits”, which argued that organisations should focus on all three “P’s”, and not only on obtaining the highest profits (Cheema & Langa, 2022). ESG refers to the three central factors in measuring the sustainability of an investment. To provide more context on the topic of ESG, Jinga (2022) elucidates on all three ESG-factors separately. Firstly, “environmental” measures the extent to which companies safeguard the environment (Engert, 2023). A company’s environmental score can be assessed by for example its air emission or waste recycling. Secondly, “social” factors encompass how a company navigates its interactions with its workforce, suppliers, customers, communities, and the political landscape in which it operates. Crucial aspects include human rights, combating child labour, improving working conditions, and addressing racial inequalities (Jinga, 2022). Lastly, “governance”

factors are concerned with a company's decision-making, from policymaking to the distribution of rights and responsibilities among different participants (ibid.). This could for instance be measured by the diversity in a firms' board.

2.2.1 ESG-ratings and investment decisions

According to Engert (2023), apart from outlining a company's policy, ESG-ratings also play a remarkably salient role in informing the market about potential financial risks. Moreover, Machmuddah and Wardhani (2020) highlight the importance of ESG-ratings in guiding investment decisions and corporate sustainability initiatives. Mainly, they argue that ESG reporting engenders more transparency about the overall performance of companies, therefore guiding shareholders and investors in their decision-making. Additionally, ESG-ratings play a significant role in socially responsible investment decisions, providing crucial information for asset managers (Laermann, 2016). Combining the above, Hanson et al. (2017) argue that successful investing involves integrating ESG-factors with traditional financial statement analysis, with ESG concerns often seen as risk factors that can impact performance. An example of this is the Value-Driver Adjustment approach, which systematically incorporates ESG-factors into valuation models and investment decisions. This method has been found to lead to more in-depth analysis of companies and better-informed decisions (Schramade, 2016).

2.2.2 ESG-ratings and ETF performance

A series of studies have explored the relationship between ESG-ratings and the performance of ETFs. Rompotis (2022) found that socially responsible bond ETFs in the United States generally underperform the market, with no consistent outperformance. Evlakhova (2022) argued that global ETFs sharing the highest ESG-rating display diversity in terms of systematic risk. This indirectly indicates that risk levels can vary not only between conventional financial instruments and ESG-related ones, but also within the category of ESG-related financial instruments. Zhao (2023) concluded that ESG ETFs with higher green diamond reward ratings had lower liquidity risk, particularly during financial crises. However, Rompotis (2023) found that ESG-ratings did not significantly influence the allocation of assets in ETFs, and higher ESG-ratings did not necessarily lead to higher returns. These studies collectively suggest that while ESG-ratings may influence certain aspects of ETFs, they do not consistently lead to better performance.

Now, combining the two concepts, it desirable to look into the performance of ESG ETFs over time. Sabbaghi (2011) investigates the performance of fifteen ESG ETFs from their launch in January 2005 through October 2009. The study reveals that although the median returns for these ETFs are positive, they are still vulnerable to significant downside risks seen in for example crises. Meziani (2014) evaluates the potential of ESG ETFs to add value compared to traditional investments. He concludes that while ESG ETFs can outperform the market, their risk-adjusted performance significantly trails

behind that of conventional ETF benchmarks. Conversely, Chakrabarty et al. (2017) show that ESG ETFs generally perform as well as, if not better than, their benchmark indices, with some even surpassing their corresponding benchmarks. Summarising the above, it can be concluded that the discussion on the relative performance of ESG ETFs compared to their benchmarks is far from over.

2.3 Environmental regulation and ESG ETFs

Little research has been conducted on the effect of environmental regulation on ESG ETFs specifically. Yet, within the research that focusses specifically on (ESG) ETFs, mixed results exist for both high- and low-rated ESG ETFs. Wallace and McIver (2018) state that only a limited number of environmental announcements lead to statistically significant abnormal returns. Among these significant announcements, outcomes vary for both polluting and green ETFs.[2] Based on their results, they suggest that environmental announcements only partially succeed in disseminating information to industries affected by the news conveyed in these announcements. However, in some instances, these announcements can actually result in substantial abnormal returns over extended timeframes. This is also emphasised by Chouaibi et al. (2021), who claim that strong environmental disclosure can increase financial performance. They found a significant positive relationship between environmental disclosure and financial performance, implying that a strong environmental disclosure increases financial performance, while a weak one decreases it. In other words: the performance of high-rated ESG ETFs compared to that of lower-rated ones is expected to improve once companies tracked by those ETFs incorporate environmental regulation into their decision-making and behaviour.

2.4 Hypothesis

Summarising the findings above, it can be concluded that the effect of environmental regulation on ESG ETFs specifically remains ambiguous. What does become clear from the literature, is that environmental regulation stimulates innovation, thus possibly improving individual firm performance (Porter, 1991; Perman et al., 2011; Ambec et al., 2013). When looking at ESG-ratings, Hanson et al. (2017), Machmuddah and Wardhani (2020), and Engert (2023) collectively conclude that those ratings are highly salient for measuring financial risks and performances. However, when observing the effect of ESG-ratings on performance, it must be noticed that higher ESG-ratings by themselves do not necessarily engender better ETF performance (Rompotis, 2022).

Examining ESG ETF performance in general, it must be said that although it looks like ESG ETFs have gained in popularity and have relatively improved in performance, it cannot yet be concluded that these ETFs consistently outperform their benchmarks; this outperformance only occurs in limited cases (Sabbaghi, 2011; Meziani, 2014; Chakrabarty et al., 2017). Building on the studies by Wallace

[2] "Polluting ETFs" is a synonym for low-rated ESG ETFs. Similarly, "green ETFs" can be seen high-rated ESG ETFs.

and McIver (2018) and Chouaibi et al. (2021), it is expected that in these limited cases, environmental regulation would at least partly be the cause of the enhanced performance. Therefore, the main hypothesis is formalised as followed:

$\mathbf{H_1}$: *After the introduction of new environmental regulation, ESG ETFs relatively outperform their benchmarks*

As stated by Fahmy (2022), investors' awareness of climate risks and attention to green investments have been on the rise ever since the introduction of the Paris Agreement. Additionally, the recent lawsuit against oil company Shell has made green investing an even more hotly-debated topic. This raises the question if environmental regulation has more impact now than ten years ago. For this reason, the following hypothesis will be tested:

$\mathbf{H_2}$: *The introduction of new environmental regulation has more impact on financial performance of ESG ETFs now than ten years ago*

Lastly, since in some aspects the United States and the Eurozone differ in their vision on climate regulation, I am curious if there are any observable differences in the impact of these regulations between these regions. Therefore, by splitting the sample into US equity and EU equity ESG ETFs, I will test the following hypothesis:

$\mathbf{H_3}$: *The introduction of new environmental regulation has more impact on financial performance of ESG ETFs in the Eurozone than in the United States*

CHAPTER 3 Data

In this paper, I will only focus on equity ESG ETFs that track an index or benchmark of equities. The main reason for excluding other types of ETFs such as leveraged or inverse ETFs, is that the risk profiles of these ETFs differ significantly from those of equity ETFs. Moreover, within the available equity ESG ETFs, I have distinguished between European and North American (United States) equity ESG ETFs. In this way, it is possible to conduct separate analyses on both regions, so that the results can be compared to see whether there are any significant differences between the abnormal returns of both regions. Furthermore, this distinction reduces ambiguity in identifying data for risk factors that are widely recognised as influencing stock prices (Fama and French, 1993).

To construct the sample of equity ESG ETFs, I examined a publicly available list from ETF Database Inc (2024) containing 2,606 environmentally responsible ETFs. From this list, after selecting only ETFs with an inception date earlier than January 2013, I extracted all equity ESG ETFs. From these extracted ETFs, 28 equity ESG ETFs tracked European stock markets, and 29 tracked the United States stock market. Additionally, when scrutinising these ETFs, it was found that the benchmarks of these ETF portfolios were mainly the Europe STOXX 600 and the S&P 500 indices for Europe and the United States respectively. Therefore, for both regions, the benchmark portfolios consist of four different equity ETFs tracking these indices. The final sample covers a ten-year period, with 480 observations in total. From this final sample, four equally weighted portfolios are constructed. For all ETFs, returns and other essential funds characteristics such as Total Net Assets (TNA), fund age and expense ratio are obtained from Refinitiv Eikon. The common risk factors used to compute abnormal returns are retrieved from the Kenneth R. French Data Library.[3]

Table I Sample summary

This table summarises information for all the 65 ETFs in the sample, as well as for the four equally weighted portfolios constructed with ETFs from the sample. The full sample period starts in June 2014 and ends in May 2024. Average fund age is rounded to whole years, and average TNA refers to the average total net assets under management for each ETF portfolio.

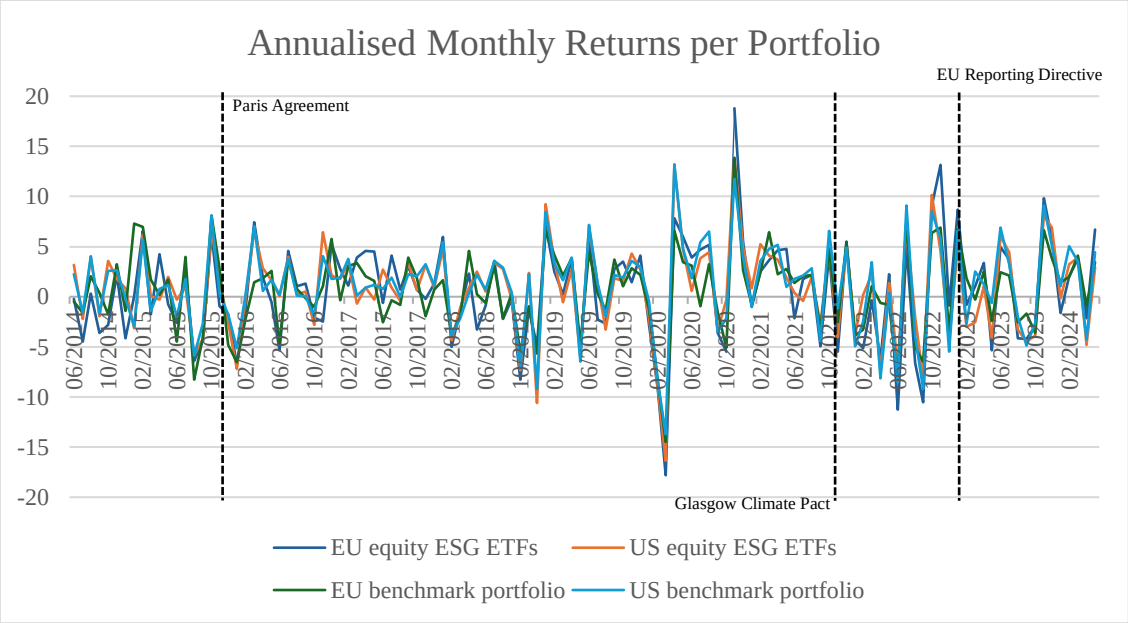
Portfolio	# of ETFs	Average fund age (in years)	Average TNA (in $Mil)	Average expense ratio
			As of 06/01/2024	*As of 06/01/2024*
Full sample	65	19	4,081.24	0.39
EU equity ESG ETF portfolio	28	20	1,723.77	0.52
US equity ESG ETF portfolio	29	18	6,358.80	0.34
EU benchmark portfolio	4	15	4,316.75	0.17
US benchmark portfolio	4	22	3,835.70	0.09

[3] https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

When analysing the sample summary, it stands out that both ESG ETF portfolios have a significantly higher expense ratio than their benchmarks. As stated by Dumitrescu et al. (2023), this could be explained by the fact that while the non-ESG ETFs in the sample track the Europe STOXX 600 or S&P 500, the management of ESG ETFs "may need to be compensated for identifying best possible ESG screens to follow" (p. 17).

Figure I Annualised Monthly Returns

This figure plots the historical rolling performance of each portfolio. Performance is measured in annualised net monthly returns. Vertical lines are added for each introduction of environmental regulation.



Interpreting the figure above, it cannot be concluded that any constant increase or decrease in returns occurs after the introduction of new environmental regulation. Moreover, when looking at annualised monthly returns rather than abnormal performance, it does not seem that any significant difference exists between equity ESG ETF portfolios and benchmark portfolios.

Table II shows the detailed summary statistics of the annualised net monthly returns for each equally weighted portfolio. Each panel contains the summary statistics for a specific portfolio for all periods, including the full sample period. What stands out, is that there exists few consistency in average returns per portfolio. This can mainly be attributed to the fact that monthly returns are displayed here; daily returns would presumably yield less widened observations. The extremely high values displayed in the columns 'Min' and 'Max' for the full sample period can be explained by the fact that the COVID-crisis falls in the sample period, as well as the Russian-Ukraine war and the Hamas-Israel conflict. The lowest (Min) and highest (Max) values in those columns represent the collapse of March 2020 and the peak of November 2020, respectively, both being result of the COVID-crisis. Lastly, the means of each period do not differ enormously, except the period before the Glasgow Climate Pact. The above-average

high means for this period can be attributed to the November 2020 peak, which will be controlled for later.

Table II Portfolio returns

This table presents the descriptive statistics of the annualised monthly net returns for each portfolio, expressed in percentage units. Along with the mean and standard deviation (SD), the extreme values (i.e., Min and Max) and higher order moments (kurtosis and skewness represented by Kurt and Skew respectively) are reported. For each portfolio, these statistics are reported for seven different periods. The full sample period starts in June 2014 and ends in May 2024. 'Before PA' and 'After PA' represent the periods before and after the Paris Agreement, lasting from December 2014 to November 2015 and from December 2015 to November 2016 respectively. Moreover, 'Before GP' begins in November 2020 and ends in October 2021, and 'After GP' starts in November 2021 and ends in October 2022. These time ranges are the periods before and after the Glasgow Climate Pact. Similarly, 'Before' and 'After' EU-RD are the periods before and after the European Reporting Directive, ranging from January 2022 to December 2022 and January 2023 to December 2023 respectively.

Panel A: EU equity ESG ETFs							
	Obs	**Min**	**Max**	**Mean**	**SD**	**Kurt**	**Skew**
Full period	120	-17.8059	18.7975	0.5335	5.1094	4.4931	-0.0739
Before PA	12	-6.3876	6.5964	-0.0889	4.2325	1.9570	0.3105
After PA	12	-6.7624	7.4505	-0.3363	3.9433	2.7247	0.3107
Before GP	12	-4.9156	18.7975	3.3324	5.7999	5.5324	1.4123
After GP	12	-11.2400	9.0166	-2.3434	6.5275	1.9206	0.3387
Before EU-RD	12	-11.2400	13.1703	-1.3182	7.5539	2.3051	0.5149
After EU-RD	12	-5.3204	9.7970	1.6542	5.1715	1.7177	0.1081
Panel B: US equity ESG ETFs							
	Obs	**Min**	**Max**	**Mean**	**SD**	**Kurt**	**Skew**
Full Period	120	-16.3607	13.8855	0.8485	4.5706	4.4409	-0.3972
Before PA	12	-5.7904	6.6458	0.3732	3.6936	2.5158	0.1356
After PA	12	-7.2029	6.5670	0.7879	3.9377	2.7390	-0.2848
Before GP	12	-2.7535	13.8855	3.2249	4.1578	4.8128	1.2258
After GP	12	-8.1142	10.1794	-0.5144	5.9365	1.9966	0.3332
Before EU-RD	12	-8.1142	10.1794	-0.5988	5.8925	2.0427	0.3502
After EU-RD	12	-4.4515	8.0787	0.8453	4.9069	1.3391	0.2529
Panel C: EU benchmark portfolio							
	Obs	**Min**	**Max**	**Mean**	**SD**	**Kurt**	**Skew**
Full period	120	-14.4829	13.8360	0.6554	4.0884	4.2353	-0.3276
Before PA	12	-8.2471	8.0738	1.2105	5.1010	2.1469	-0.3068
After PA	12	-6.5719	3.7118	-0.6859	3.2662	2.0447	-0.5267
Before GP	12	-3.2518	13.8360	3.0490	4.1689	5.0869	1.2879
After GP	12	-8.0294	7.7604	-0.8422	5.1188	2.0025	0.4179
Before EU-RD	12	-8.0294	7.7604	-0.7935	5.3256	1.9425	0.4692
After EU-RD	12	-3.6395	6.7317	1.2985	3.4698	1.9265	0.1692
Panel D: US benchmark portfolio							
	Obs	**Min**	**Max**	**Mean**	**SD**	**Kurt**	**Skew**
Full period	120	-13.7184	13.2099	1.0505	4.4777	3.7205	-0.3607
Before PA	12	-5.8739	8.1223	0.2337	3.8146	2.9953	0.6167
After PA	12	-5.1352	7.0484	0.7363	3.1749	3.0085	0.2349
Before GP	12	-4.4398	11.7705	3.1786	3.9980	3.6089	0.2351
After GP	12	-9.2191	9.0794	-1.0126	6.3980	1.8268	0.2741
Before EU-RD	12	-9.2191	9.0794	-1.2946	6.6165	1.7273	0.3901
After EU-RD	12	-4.8529	9.1225	1.8306	4.4678	1.7735	0.1200

Table III Portfolio returns per MSCI ESG-rating

This table presents the descriptive statistics of the annualised monthly net returns for three additional portfolios, expressed in percentage units. These portfolios are constructed based on their MSCI ESG-rating. Along with the mean and standard deviation (SD), the extreme values (i.e., Min and Max) and higher order moments (kurtosis and skewness represented by Kurt and Skew respectively) are reported. For each portfolio, these statistics are reported for seven different periods. The periods presented in the table below are the same periods as in Table II.

Panel A: AAA-/AA-rated ETFs							
	Obs	**Min**	**Max**	**Mean**	**SD**	**Kurt**	**Skew**
Full period	120	-16.7548	17.4722	0.5780	4.7550	4.5088	-0.1436
Before PA	12	-6.7633	6.7876	0.1904	4.2118	2.1370	0.1315
After PA	12	-6.4709	6.2017	-0.3146	3.6165	2.4668	0.0885
Before GP	12	-4.6802	17.4722	3.2468	5.3658	5.4710	1.3564
After GP	12	-10.2638	8.2638	-1.9455	6.1641	1.8713	0.3428
Before EU-RD	12	-10.2638	11.5419	-1.1791	6.9005	2.1748	0.4768
After EU-RD	12	-4.9079	9.1065	1.4674	4.7486	1.7626	0.1352
Panel B: A-rated ETFs							
	Obs	**Min**	**Max**	**Mean**	**SD**	**Kurt**	**Skew**
Full Period	120	-16.7775	14.3783	0.8192	4.6050	4.5787	-0.3965
Before PA	12	-5.5682	6.8638	0.0833	3.6000	2.7449	0.4832
After PA	12	-6.6160	6.9916	0.6412	3.5258	3.1081	-0.1718
Before GP	12	-3.1670	14.3783	3.3194	4.3314	4.8067	1.1654
After GP	12	-9.0026	10.3177	-0.8311	6.2730	1.9857	0.2759
Before EU-RD	12	-9.0026	10.3177	-0.7322	6.3779	1.9215	0.2708
After EU-RD	12	-4.9174	8.2798	1.1280	4.8651	1.3835	0.1632
Panel C: BBB-/BB-rated ETFs							
	Obs	**Min**	**Max**	**Mean**	**SD**	**Kurt**	**Skew**
Full period	120	-15.9723	15.1844	0.8900	5.0856	3.5514	-0.2608
Before PA	12	-6.6634	6.5373	1.1792	4.3874	1.9265	-0.4704
After PA	12	-10.4910	9.1081	0.7618	5.5768	2.5513	-0.3734
Before GP	12	-3.5148	15.1844	2.9504	4.8550	4.5201	1.1389
After GP	12	-8.8879	9.9278	-0.9306	5.4192	2.5784	0.4160
Before EU-RD	12	-8.8879	9.9278	-1.0578	5.4748	2.5365	0.4400
After EU-RD	12	-6.7912	11.3232	1.0966	6.1913	1.7296	0.3866

Lastly, when evaluating the sample, it was decided that it would be highly relevant to additionally construct portfolios based on ESG-ratings, rather than only on ESG and non-ESG. In this way, it is possibly to study whether there is a difference in performance of higher-rated ESG ETFs compared to lower-rated ones after the introduction of new environmental regulation. Table III presents a summary of the descriptive statistics for each equally weighted portfolio. Portfolios are constructed based on ETF ESG-scores, which are measured via MSCI ESG-ratings. Since some ratings occur less often than other ones, some ratings are combined into one portfolio. In total, there are thirty AAA-/AA-rated ETFs, thirty-five A-rated ETFs and five BBB-/BB-rated ETFs.

When inspecting the descriptive statistics, it stands out that the occurring irregularities are similar to those in the descriptive statistics of the four original portfolios. Again, these market peaks and

collapses can be attributed to the fact that monthly net returns are presented rather than daily returns, as well as to certain events having a substantial impact on financial markets.

CHAPTER 4 Method

To test the performance of ESG ETFs relative to that of their benchmarks, I will estimate the abnormal returns for each equally weighted portfolio. To obtain the risk-adjusted abnormal performance for each portfolio, five different factor models will be used: the Capital Asset Pricing Model (1), the Fama-French (1993) three-factor model (2), the Carhart (1997) four-factor model (3), the Fama-French (2015) five-factor model (4), and the Fama-French five-factor model plus momentum factor (5). Furthermore, dummy variables for all periods will be incorporated into each factor model:

$$R_{i,t} - R_{ft} = \alpha_{BP}D_{BP,t} + \alpha_{AP}D_{AP,t} + \alpha_{BG}D_{BG,t} + \alpha_{AG}D_{AG,t} + \alpha_{BE}D_{BE,t} + \alpha_{AE}D_{AE,t} + \beta_1(R_{mt} - R_{ft}) + \varepsilon_{i,t} \quad \textbf{(1)}$$

$$R_{i,t} - R_{ft} = \alpha_{BP}D_{BP,t} + \alpha_{AP}D_{AP,t} + \alpha_{BG}D_{BG,t} + \alpha_{AG}D_{AG,t} + \alpha_{BE}D_{BE,t} + \alpha_{AE}D_{AE,t} + \beta_1(R_{mt} - R_{ft}) + \beta_2(SMB_t) + \beta_3(HML_t) + \varepsilon_{i,t} \quad \textbf{(2)}$$

$$R_{i,t} - R_{ft} = \alpha_{BP}D_{BP,t} + \alpha_{AP}D_{AP,t} + \alpha_{BG}D_{BG,t} + \alpha_{AG}D_{AG,t} + \alpha_{BE}D_{BE,t} + \alpha_{AE}D_{AE,t} + \beta_1(R_{mt} - R_{ft}) + \beta_2(SMB_t) + \beta_3(HML_t) + \beta_4(WML_t) + \varepsilon_{i,t} \quad \textbf{(3)}$$

$$R_{i,t} - R_{ft} = \alpha_{BP}D_{BP,t} + \alpha_{AP}D_{AP,t} + \alpha_{BG}D_{BG,t} + \alpha_{AG}D_{AG,t} + \alpha_{BE}D_{BE,t} + \alpha_{AE}D_{AE,t} + \beta_1(R_{mt} - R_{ft}) + \beta_2(SMB_t) + \beta_3(HML_t) + \beta_4(RMW_t) + \beta_5(CMA_t) + \varepsilon_{i,t} \quad \textbf{(4)}$$

$$R_{i,t} - R_{ft} = \alpha_{BP}D_{BP,t} + \alpha_{AP}D_{AP,t} + \alpha_{BG}D_{BG,t} + \alpha_{AG}D_{AG,t} + \alpha_{BE}D_{BE,t} + \alpha_{AE}D_{AE,t} + \beta_1(R_{mt} - R_{ft}) + \beta_2(SMB_t) + \beta_3(HML_t) + \beta_4(RMW_t) + \beta_5(CMA_t) + \beta_6(WML_t) + \varepsilon_{i,t}, \quad \textbf{(5)}$$

where $R_{i,t}$ is the equally weighted net return in month *t* for each portfolio *i*, $R_{mt} - R_{ft}$ is the excess market return and R_{ft} is the risk-free rate. SMB_t and HML_t are the size and value factors, respectively, and WML_t denotes the momentum factor. The profitability factor is indicated by RMW_t, and CMA_t represents the investment factor. According to Pavlova and De Boyrie (2022), these last two factors can be defined as the "differences between the returns of portfolios of stocks with robust and weak profitability and the stocks of low and high investment firms, respectively" (p. 2).

Each model contains six different dummy variables, all representing a period before or after an introduction of environmental regulation. The periods before and after the Paris Agreement are represented by the dummy variables D_{BP} and D_{AP}, respectively. Moreover, D_{BG} and D_{AG} represent the periods before and after the Glasgow Climate Pact, and D_{BE} and D_{AE} denote the periods before and after

the European Reporting Directive. All dummy variables take value 1 if the month lies within the period, and 0 otherwise. For overlapping periods, the regressions are run separately in order to be able to make a clear distinction between the alphas of all periods.

Table IV Definition of periods
This table reports the duration of each period, as well as their corresponding dummy variables.

	Duration	
Period	Start	End
Before Paris Agreement (D_{BP})	December 2014	November 2015
After Paris Agreement (D_{AP})	December 2015	November 2016
Before Glasgow Climate Pact (D_{BG})	November 2020	October 2021
After Glasgow Climate Pact (D_{AG})	November 2021	October 2022
Before EU Reporting Directive (D_{BE})	January 2022	December 2022
After EU Reporting Directive (D_{AE})	January 2023	December 2023

Before testing the models with an ordinary least squares (OLS) regression, it is highly salient to test for heteroskedaciticty in the data set. Based on the performed Breusch-Pagan Test, it was found that heteroskedaciticty exists in the data, which would engender unfit OLS regressions and invalid estimates of the parameters. Moreover, after running the Durbin-Watson Test for each period, it was concluded that autocorrelation was present for almost all periods. In the remaining periods, where the Durbin-Watson Test yielded invalid results, a Breusch-Godfrey Test was run to test for autocorrelation. Combining the results of both tests, it was concluded that autocorrelation is present in all periods. Because of the presence of heteroskedacticity and autocorrelation in the data, standard errors are estimated via the Newey-West procedure.

CHAPTER 5 Results & Discussion

To estimate abnormal returns, alphas for each portfolio are estimated via five different factor models before and after an introduction of new environmental regulation. All models are run via OLS regressions and as has been mentioned before, the Newey-West procedure has been used to estimate standard errors. All alphas in the tables below are presented in percentage terms, meaning that an alpha of 1% would imply a positive abnormal return of 1% for a certain portfolio in the reported period. In order to maintain a clear structure, each event will be discussed separately.

5.1 Empirical results

For each portfolio, the alphas obtained via the five different factor models before and after the Paris Agreement are reported in Table V. After scrutinising the alphas of the sustainable ETF portfolios and comparing them those of their benchmarks, it can surprisingly be observed that they are significantly lower than those of their benchmarks after the introduction of the Paris Agreement. For the European equity ESG ETF portfolio, the alpha estimated by the Fama-French five-factor plus momentum factor model drops from 0.44% ($p \leq 0.05$) to -0.79% ($p \leq 0.01$). Similarly, the alpha of the US equity ESG ETF portfolio drops to, although insignificant, -0.10% after introduction of the agreement, where it was 0.22% ($p \leq 0.05$) before. Although the benchmark portfolios also suffer from a deterioration in performance, their alphas decrease relatively less than those of the ESG ETF portfolios. This would imply that although all of the first four portfolios perform worse than before the introduction of the Paris Agreement, benchmark portfolios outperformed the ESG ETF portfolios in the period after the agreement.

Moreover, when comparing different MSCI ESG-rated ETF portfolios, a similar surprising effect can be noticed. The highest-rated MSCI ESG portfolio, the AAA-/AA-rated portfolio, has highly negative alphas in each of the models after the agreement. Apart from the Fama-French five-factor plus momentum factor model, all of these alphas are significant at the 1% level. Although the alphas of the lowest-rated portfolio, the BBB-/BB-rated portfolio, show few significance, we do observe a significant increase in performance when looking at the last column of Table V: alpha increases from 0.92% to 1.24% ($p \leq 0.10$ for both). Hence, interpreting the last rows from Panel A and B of Table V, we discover that lower-rated ESG ETFs outperformed the highest-rated ESG ETFs after the introduction of the Paris Agreement.

Table V Abnormal Returns Before and After the Paris Agreement

This table reports the alphas obtained via five different factor models for the EU equity ESG ETF portfolio, the US equity ESG ETF portfolio and their benchmark portfolios. Moreover, the alphas of portfolios based on MSCI ESG-ratings are presented. Panel A displays the period before the introduction of the Paris Agreement (December 2014 – November 2015), and Panel B shows the alphas for the period after the Paris Agreement (December 2015 – November 2016). Significance levels of 10%, 5% and 1% are indicated by *, **, and *** respectively. The t-statistics are reported in the brackets.

Paris Agreement					
Panel A: Before the Paris Agreement					
	CAPM α	FF3 α	CH4 α	FF5 α	FF5 + MOM α
EU equity ESG ETFs	0.0367	0.401**	0.403**	0.475***	0.441**
	[0.67]	[3.74]	[3.81]	[5.93]	[3.20]
EU benchmark portfolio	1.327*	1.796	1.789	2.605	2.826
	[2.22]	[1.78]	[1.63]	[1.48]	[1.24]
US equity ESG ETFs	0.261*	0.233***	0.178***	0.264***	0.222**
	[1.88]	[5.94]	[6.41]	[4.08]	[2.81]
US benchmark portfolio	0.114	0.062	0.018	0.250***	0.203***
	[1.36]	[0.86]	[0.32]	[3.78]	[5.71]
AAA-/AA-rated	0.126	-0.013	0.028	-0.267	-0.282
	[0.73]	[-0.04]	[0.09]	[-1.67]	[-1.60]
A-rated	0.027	-0.171	-0.152	0.080	0.273*
	[0.25]	[-0.87]	[-0.71]	[0.42]	[2.45]
BBB-/BB-rated	1.130***	-0.334	-0.393	0.743**	0.919*
	[3.59]	[-0.63]	[-0.68]	[2.62]	[2.30]
Panel B: After the Paris Agreement					
	CAPM α	FF3 α	CH4 α	FF5 α	FF5 + MOM α
EU equity ESG ETFs	0.141*	-0.035	-0.148	-0.473	-0.792**
	[1.83]	[-0.70]	[-1.17]	[-1.40]	[-3.97]
EU benchmark portfolio	-0.374	-0.385	-0.150	-0.219	-0.530
	[-0.57]	[-1.09]	[-0.22]	[-0.62]	[-1.39]
US equity ESG ETFs	-0.051	-0.082	-0.064	-0.131	-0.103
	[-0.50]	[-0.86]	[-0.62]	[-0.98]	[-0.78]
US benchmark portfolio	0.046	0.073	0.077	0.025	0.047
	[0.50]	[0.90]	[0.87]	[0.40]	[0.72]
AAA-/AA-rated	-0.692***	-0.825***	-0.549**	-0.683***	-0.198
	[-4.09]	[-4.24]	[-2.69]	[-4.84]	[-1.34]
A-rated	0.271	0.183	0.076	0.294	0.323
	[1.36]	[1.03]	[0.45]	[1.78]	[1.99]
BBB-/BB-rated	0.224	-0.222	-0.416	0.880	1.241*
	[0.34]	[-0.37]	[-0.67]	[1.60]	[2.40]

Table VI reports the alphas for all portfolios before and after the Glasgow Climate Pact, again calculated via five different factor models. For the EU equity ESG ETF portfolio, we observe a similar worsened performance as after the Paris Agreement with a reported alpha of -0.31% ($p \leq 0.05$). Additionally, the EU benchmark portfolio performs better after the Glasgow Climate Pact, with the CAPM, Fama-French three-factor and the Carhart four-factor models reporting alphas of 1.04%, 1.14% and 1.20% respectively ($p \leq 0.01$ for all). Hence, again, the EU equity ESG ETF portfolio is outperformed by its benchmark. Contrarily, US equity ESG ETFs did outperform their benchmarks after

the introduction of the Glasgow Climate Pact. For the sustainable US ETFs, alpha increases from -0.09% ($p \leq 0.01$) to 0.16% ($p \leq 0.10$) after the pact, where the alpha of the benchmark portfolio has decreased to -0.06% ($p \leq 0.05$).

Table VI Abnormal Returns Before and After the Glasgow Climate Pact

This table reports the alphas obtained via five different factor models for the EU equity ESG ETF portfolio, the US equity ESG ETF portfolio and their benchmark portfolios. Moreover, the alphas of portfolios based on MSCI ESG-ratings are presented. Panel A displays the period before the introduction of the Glasgow Climate Pact (November 2020 – October 2021), and Panel B shows the alphas for the period after the Glasgow Climate Pact (November 2021 – October 2022). Significance levels of 10%, 5% and 1% are indicated by *, **, and *** respectively. The t-statistics are reported in the brackets.

Glasgow Climate Pact					
Panel A: Before the Glasgow Climate Pact					
	CAPM α	FF3 α	CH4 α	FF5 α	FF5 + MOM α
EU equity ESG ETFs	0.323	-0.091	-0.037	0.048	0.008
	[0.61]	[-1.23]	[-0.62]	[0.67]	[0.10]
EU benchmark portfolio	0.941***	1.021***	1.182***	0.968**	1.280**
	[4.41]	[5.40]	[8.52]	[3.26]	[4.15]
US equity ESG ETFs	0.518	-0.039	-0.028	-0.088	-0.091***
	[1.36]	[-0.92]	[-0.98]	[-1.57]	[-6.81]
US benchmark portfolio	0.034	-0.083	-0.004	-0.004	-0.005
	[0.34]	[-1.79]	[-0.10]	[-0.09]	[-0.35]
AAA-/AA-rated	-0.229	-0.463**	-0.578**	-0.522***	-0.769***
	[-1.41]	[-2.61]	[-3.35]	[-5.01]	[-9.43]
A-rated	0.334*	0.029	0.049	0.029	0.083*
	[1.97]	[0.72]	[0.86]	[0.53]	[2.14]
BBB-/BB-rated	0.477	0.069	-0.171	0.122	0.043
	[0.53]	[0.19]	[-0.54]	[0.29]	[0.10]
Panel B: After the Glasgow Climate Pact					
	CAPM α	FF3 α	CH4 α	FF5 α	FF5 + MOM α
EU equity ESG ETFs	0.174	-0.151	-0.181	-0.181**	-0.306**
	[0.92]	[-0.68]	[-0.79]	[-2.71]	[-2.85]
EU benchmark portfolio	1.040***	1.141***	1.197***	0.945	1.040
	[6.36]	[5.84]	[4.78]	[1.82]	[1.55]
US equity ESG ETFs	0.658**	0.156	0.186	0.183*	0.258*
	[2.84]	[1.76]	[1.34]	[2.12]	[2.25]
US benchmark portfolio	0.303	0.142	0.168	-0.061**	-0.020
	[1.67]	[1.42]	[1.53]	[-3.41]	[-0.67]
AAA-/AA-rated	-0.333	-0.295***	-0.026***	-0.454***	-0.558**
	[-1.42]	[-5.21]	[-5.01]	[-3.86]	[-3.44]
A-rated	0.863***	0.391***	0.255**	0.448***	0.169
	[3.75]	[3.51]	[3.31]	[3.88]	[1.14]
BBB-/BB-rated	0.385	0.640	0.390	0.144**	0.170
	[0.48]	[1.60]	[1.22]	[2.53]	[0.69]

However, when examining the difference in performance of high-rated ESG ETFs compared to lower-rated ones, we again cannot conclude that these higher-rated ETFs have performed significantly better than lower-rated ESG ETFs after the introduction of the pact. When looking at the alphas in the Fama-French five-factor plus momentum factor model for the highest-rated portfolio, we observe a

small increase in alpha from -0.77% ($p \leq 0.01$) to -0.56% ($p \leq 0.05$). The lowest-rated portfolio also has a higher alpha (0.14%, significant at the 5% level), but it increased relatively less than that of the AAA-/AA-portfolio. Lastly, it must be noticed that the A-rated portfolio is the best performing one with an alpha of 0.45% ($p \leq 0.01$) in the Fama-French five-factor model after the pact.

Lastly, the alphas of each portfolio before and after the EU Reporting Directive are reported in Table VII. When comparing the alphas of EU equity ESG ETFs before and after the introduction of the directive, it can be observed that there is a significant increase in alpha. In the Fama-French five-factor model with and without momentum factor, alphas increase from -0.67% ($p \leq 0.01$) to 0.15% ($p \leq 0.05$) and from -0.55% ($p \leq 0.01$) to 0.12% ($p \leq 0.05$), respectively. Although alphas for the EU benchmark portfolio are mainly insignificant, we do also observe an increase in these alphas. However, apart from the fact that the alphas are statistically insignificant, it must be pointed out that this increase is smaller than the increase in alphas of the EU ESG ETF portfolio. Hence, it can be concluded that since the sustainable EU ETF portfolio has higher abnormal returns, this sustainable portfolio outperformed its benchmark after the introduction of the EU Reporting Directive.

However, when analysing the alphas for both US portfolios, an opposite result is found. After the directive, the alpha for the US equity ESG ETF portfolio decreases from 0.24% ($p \leq 0.05$) to -0.28% ($p \leq 0.01$). Moreover, even though the alpha of the benchmark portfolio also decreases significantly, this decrease is remarkably smaller than the decrease in alpha of the US ESG ETF portfolio. Hence, there is little to no reason to believe that US equity ESG ETFs have performed better than their benchmarks after the EU Reporting Directive; on the contrary.

Now, when examining the performance of different rated ESG portfolios, it stands out that the AAA-/AA-rated portfolio experiences a substantial increase in alpha. In the Fama-French five-factor model with and without momentum factor, the reported alphas after the directive are 0.81% and 0.68% ($p \leq 0.05$ for both), respectively. Before the directive, these alphas were negative and insignificant. For the A-rated portfolio, all alphas are significant and negative after the directive, implying negative abnormal returns. For the BBB-/BB-rated portfolio, alphas are ambiguous with relatively few significance. However, looking at the alpha obtained via the Fama-French five-factor model, it can be concluded that the AAA-/AA-rated portfolio outperformed the BBB-/BB-rated portfolio with an alpha of 0.81% compared to 0.37% ($p \leq 0.05$ for both).

All findings above combined, it can be concluded that after the introduction of the EU Reporting Directive, European ESG ETFs, contrarily to US ESG ETFs, outperformed their benchmarks. Moreover, it becomes evident that the highest-rated ESG ETFs significantly outperformed lower-rated ESG ETFs.

Table VII Abnormal Returns Before and After the EU Reporting Directive

This table reports the alphas obtained via five different factor models for the EU equity ESG ETF portfolio, the US equity ESG ETF portfolio and their benchmark portfolios. Moreover, the alphas of portfolios based on MSCI ESG-ratings are presented. Panel A displays the period before the introduction of the EU Reporting Directive (January 2022 – December 2022), and Panel B shows the alphas for the period after the EU Reporting Directive (January 2023 – December 2023). Significance levels of 10%, 5% and 1% are indicated by *, **, and *** respectively. The t-statistics are reported in the brackets.

EU Reporting Directive					
Panel A: Before the EU Reporting Directive					
	CAPM α	FF3 α	CH4 α	FF5 α	FF5 + MOM α
EU equity ESG ETFs	0.120	-0.163	-0.206	-0.553***	-0.671***
	[1.38]	[-1.39]	[-1.37]	[-9.19]	[-12.29]
EU benchmark portfolio	0.103	0.282	0.414	-0.594	-0.518
	[0.23]	[0.48]	[0.73]	[-0.71]	[-0.62]
US equity ESG ETFs	0.710***	0.230**	0.179*	0.239**	0.206
	[4.06]	[2.87]	[2.28]	[2.82]	[1.73]
US benchmark portfolio	0.220**	0.121	0.126	-0.035	-0.024
	[3.03]	[1.68]	[1.47]	[-1.93]	[-0.76]
AAA-/AA-rated	0.278	-0.220	-0.211	-0.952	-0.939
	[0.46]	[-0.33]	[-0.26]	[-1.39]	[-0.95]
A-rated	0.661***	0.142	-0.024	0.234	-0.155
	[3.48]	[0.96]	[-0.10]	[1.69]	[-0.43]
BBB-/BB-rated	-0.024	0.276	-0.126	0.732*	-0.467
	[-0.06]	[0.69]	[-0.20]	[2.17]	[-0.62]
Panel B: After the EU Reporting Directive					
	CAPM α	FF3 α	CH4 α	FF5 α	FF5 + MOM α
EU equity ESG ETFs	0.139	0.070	0.070	0.116**	0.148**
	[0.88]	[0.62]	[0.58]	[2.75]	[3.05]
EU benchmark portfolio	0.186	0.169	0.169	0.183	0.181
	[1.01]	[0.55]	[0.52]	[0.62]	[0.54]
US equity ESG ETFs	-1.166**	-0.308***	-0.278***	-0.153*	-0.121*
	[-2.54]	[-4.41]	[-3.60]	[-2.18]	[-2.02]
US benchmark portfolio	-0.168**	-0.143***	-0.140***	-0.143*	-0.136
	[-2.74]	[-4.17]	[-4.21]	[-2.21]	[-1.79]
AAA-/AA-rated	0.307	0.185	0.328	0.812**	0.675**
	[1.21]	[0.44]	[0.88]	[2.83]	[2.86]
A-rated	-0.701*	-0.668***	-0.576***	-0.588*	-0.493*
	[-2.06]	[-4.78]	[-5.12]	[-2.41]	[-2.04]
BBB-/BB-rated	-0.844	0.448	0.456***	0.369**	0.249
	[-1.06]	[1.60]	[6.48]	[2.56]	[1.57]

Finally, for the full sample period, Table VIII presents the factor loadings and adjusted R^2 values for each portfolio. To include all factors in the analysis, it was chosen to display the Fama-French five-factor model with momentum factor. What stands out, is that most of the adjusted R^2 values are relatively high. This could be explained by the fact that nearly all ETFs in the sample track market portfolios, which engenders high explanatory power for each portfolio (Dumitrescu et al., 2023). Furthermore, for all portfolios, the market beta coefficients (for *RMRF*) are significant at the 1% level and have a value close to 1, implying that all portfolios behave similar to the market. Apart from for the US benchmark portfolio, the size factor coefficients (*SMB*) are positive, implying positive correlations

between sample portfolios and the size factor. When comparing the high-rated ESG ETF portfolio (AAA-AA) to the lower-rated one (BBB-BB), it must be highlighted that both the profitability (*RMW*) and investment (*CMA*) factor are positive for the higher-rated portfolio, and negative for the lower-rated one. This implies that these factors positively influence higher-rated ESG ETFs in the sample, and have a negative effect on lower-rated sample ESG ETFs.

Table VIII Factor Loadings per Portfolio

This table shows each of the coefficient estimates of the Fama-French five-factor model plus momentum factor per portfolio. The factors are estimated over the whole sample period (June 2014 – May 2024). Additionally, the adjusted R^2 is reported for each portfolio. Significance levels of 10%, 5% and 1% are indicated by *, **, and *** respectively. The t-statistics are reported in the brackets.

	Factor Loadings							
Portfolio	*Alpha*	*RMRF*	*SMB*	*HML*	*RMW*	*CMA*	*WML*	*Adj. R^2*
EU ESG ETFs	-0.253	1.04***	0.03**	0.15***	0.05*	-0.07***	0.01*	0.992
	[-0.98]	[150.72]	[2.46]	[9.89]	[1.77]	[-3.28]	[1.72]	
EU benchmark	0.245	0.93***	-0.30	0.11	0.28*	-0.07	-0.11***	0.786
	[1.85]	[22.91]	[-1.59]	[0.97]	[1.78]	[-1.00]	[-3.78]	
US ESG ETFs	0.008	0.94***	0.25***	0.09*	-0.13***	0.16***	0.05***	0.974
	[0.12]	[55.74]	[8.70]	[1.86]	[-3.90]	[5.19]	[3.05]	
US benchmark	-0.004	0.99***	-0.06***	0.03	0.09***	0.06***	0.00	0.996
	[-0.13]	[223.47]	[-6.81]	[1.49]	[8.73]	[3.76]	[-0.27]	
AAA-/AA-rated	-0.257**	1.06***	0.08	0.10*	0.14***	0.27**	-0.03	0.913
	[-2.63]	[70.06]	[0.90]	[1.81]	[2.98]	[2.14]	[-0.98]	
A-rated	0.011	1.07***	0.06***	0.13	-0.06	0.17*	0.05	0.962
	[0.11]	[113.80]	[2.74]	[1.44]	[-1.26]	[1.89]	[1.47]	
BBB-/BB-rated	0.470***	0.96***	0.62***	0.08	-0.76***	-0.31	0.13*	0.817
	[3.04]	[26.27]	[16.84]	[0.32]	[-3.77]	[-1.24]	[1.68]	

5.2 Hypotheses and Discussion

Lastly, after having analysed all events separately, it is highly salient to combine all findings above to provide answers to the three formulated hypotheses. Firstly, I will elucidate on the findings related to the first hypothesis, which was phrased as followed:

H_1: *After the introduction of new environmental regulation, ESG ETFs relatively outperform their benchmarks*

Primarily, two ESG ETF portfolios and corresponding benchmark portfolios for each of them were constructed to answer the hypothesis above. Secundarily, however, it was found later in the analysis that it would be desirable to construct three more portfolios and rank them by MSCI ESG-rating. In this way, the highest-rated ETFs of both regions would be combined and could be compared to the lowest-rated ones.

When focussing on the abnormal returns of the European ESG ETF portfolio and comparing it to its benchmark portfolio, ambiguous results were found. Even after the introduction of the Paris Agreement and the Glasgow Climate Pact, European ESG ETFs were still outperformed by their benchmarks. These findings contradict those of Fiordelisi (2022), who argued that ESG ETFs react positively to climate change events such as those regulations. These findings do however match the study by Meziani (2014), who found that the risk-adjusted performance of ESG ETFs in that period still trailed behind that of their benchmarks. Conversely, when looking at more recent years, I found that European ESG ETFs did outperform their benchmarks after the introduction of the EU Reporting Directive in January 2023. This result is in line with that of Dumitrescu et al. (2023), who stated that in more recent years, there were more cases in which ESG ETFs were able to outperform their benchmarks.

Similarly, much ambiguity was found when interpreting the abnormal returns of the US equity ESG ETF portfolio before and after certain climate regulations. Although this portfolio outperformed its benchmark portfolio after the introduction of the Glasgow Climate Pact, opposite results were found after the introductions of the Paris Agreement and the EU Reporting Directive. However, the fact that US ESG ETFs were outperformed by their benchmarks after the Paris Agreement is not that surprising, since Meziani (2014) already concluded that the risk-adjusted performance of those ETFs lagged behind that of their benchmarks in that period. Moreover, the EU Reporting Directive is not binding to the United States, which could be an explanation as to why the performance of US ESG ETFs did not improve after the directive.

Summarising the findings above, it cannot be concluded that ESG ETFs consistently outperform their benchmarks after the introduction of new environmental regulation. This is in line with the findings of Wallace and McIver (2018), who found that environmental announcements lead to higher abnormal returns of ESG ETFs only in limited cases. Although some ESG ETF portfolios outperformed their benchmarks after certain environmental regulations, no consistent outperformance was found. Therefore, the first hypothesis must be rejected.

When studying previous literature, it soon became evident that the performance of ESG ETFs has significantly improved over the years (Chakrabarty, 2017; Dumitrescu et al., 2023). Therefore, the second hypothesis was formulated as followed:

$\mathbf{H_2}$: *The introduction of new environmental regulation has more impact on financial performance of ESG ETFs now than ten years ago*

The most obvious way to test the hypothesis above, is to compare the abnormal returns per portfolio over time. Therefore, in order to provide a more substantiated answer to the second hypothesis, the historical alphas of each portfolio are plotted in Figures II and III.

Figure II Abnormal Returns per Period
This figure plots the alphas for the EU equity ESG ETF portfolio, the US equity ESG ETF portfolio and their benchmarks for each period. Due to significance levels, alphas obtained via the Fama-French five-factor model are displayed here. Values of alpha are reported in percentage terms.

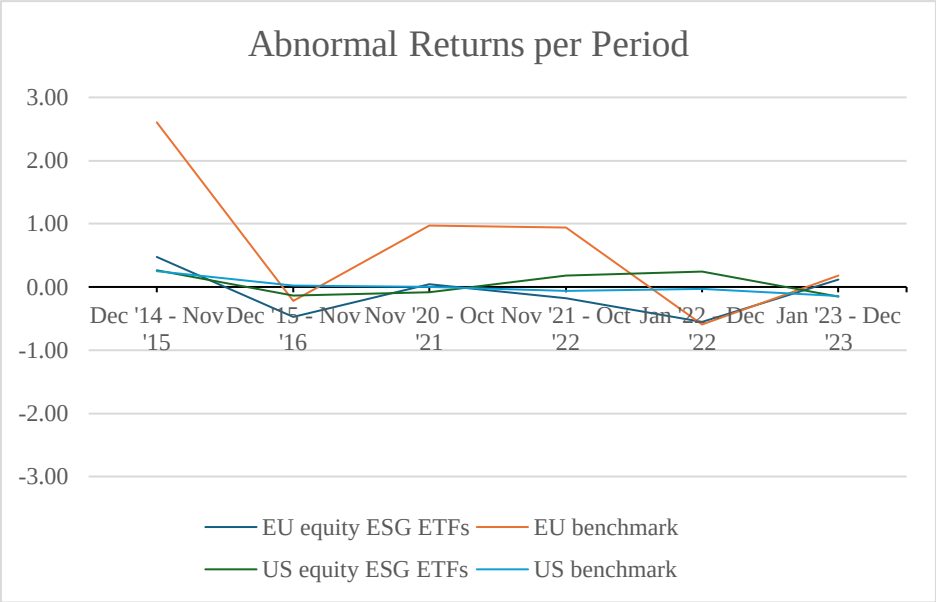
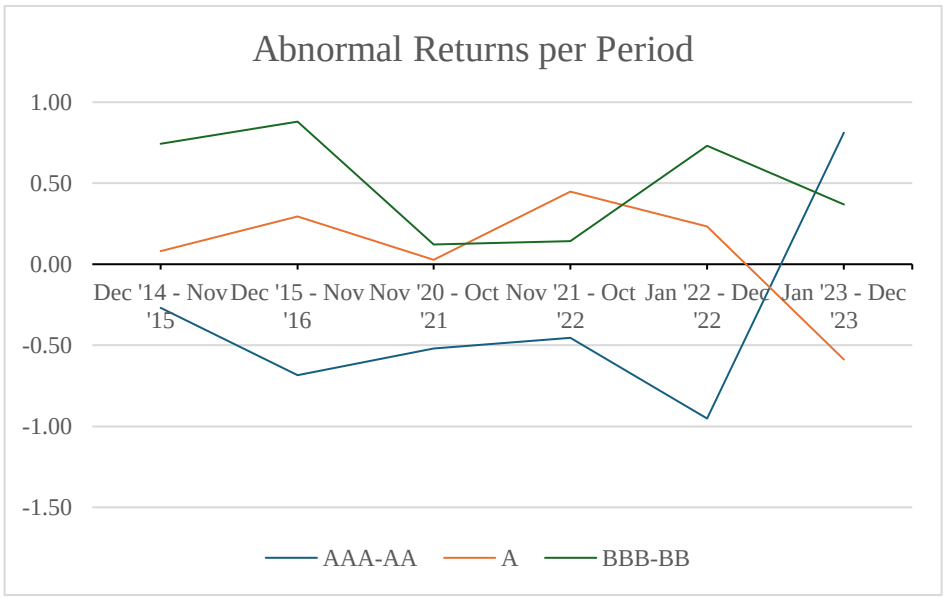


Figure III Abnormal Returns per Period; MSCI ESG-ratings
This figure plots the alphas for the AAA-/AA-, the A-, and the BBB-/BB-rated portfolios for each period. Due to significance levels, alphas obtained via the Fama-French five-factor model are displayed here. Values of alpha are reported in percentage terms.



Taking the obtained results and all other relevant factors in consideration, it was chosen to focus on the differences between alphas of the AAA-/AA- and BBB-/BB-rated portfolio. In this way, the best-rated ETFs are compared to lower-rated ones without differentiating between the United States and the Eurozone. Examining Figure III, it can be observed that until 2022, the abnormal returns of the AAA-/AA-rated portfolio were constantly negative. Contrarily, although the abnormal returns of the BBB-/BB-rated portfolio showed less consistency, abnormal returns were higher before and after each introduction of environmental regulation in that same period.

However, comparing the alphas before and after the most recent regulation, the EU Reporting Directive, it can be noticed that the impact on the AAA-/AA-rated portfolio is significantly positive and higher, with alpha jumping from -0.95% to 0.81% in just over a year. Contrarily, the BBB-/BB-rated portfolio yielded negative abnormal returns in this period. Moreover, when comparing the two portfolios in the very beginning of the sample period, it is remarkable to see that the alpha of the AAA-/AA-rated portfolio declined even more, while the BBB-/BB-rated portfolio saw an increase in its already positive abnormal returns. These findings collectively argue that the introduction of new environmental regulation has more impact on the financial performance of (higher-rated) ESG ETFs now than in the beginning of the sample period. Hence, the second hypothesis is accepted.

Lastly, the third hypothesis states that new climate regulation has more impact on ESG ETFs in the Eurozone than in the United States:

H_3: *The introduction of new environmental regulation has more impact on financial performance of ESG ETFs in the Eurozone than in the United States*

Figure II plots the alphas for both the European and the US equity ESG ETF portfolios, as well as for their benchmarks. As the hypothesis regards the impact on financial performance of ESG ETFs, I will only compare the abnormal returns of the European and US equity ESG ETF portfolios. As can be observed in Figure II, the abnormal returns for both portfolios are relatively close to 0 for the entire sample period. Although some small differences between the alphas of both portfolios exist, no consistent and statistically significant divergence is observed. Since abnormal returns for both portfolios are approximately similar before and after each introduction of environmental regulation, it cannot be argued that the impact of these regulations is higher in the Eurozone than in the United States. Therefore, the third and last hypothesis is rejected.

CHAPTER 6 Conclusion

In this thesis, I studied the effect of new environmental regulation on ESG ETF performance. As ETFs are still rising in popularity and sustainability is becoming an even more salient factor in the contemporary investing environment, I decided to combine both topics. As little research has yet been conducted on the effect of environmental regulation on ESG ETF performance specifically, I conducted this research with the goal to answer the following question: *is there an observable difference in sustainable investment performance between ESG ETFs and their benchmarks after new impactful environmental regulation*?

To answer this question, I calculated the abnormal returns for seven different portfolios via five different factor models. After having compared the performance of European and US equity ESG ETFs to their benchmark portfolios, ambiguous results were found. Over the whole sample period, no consistent outperformance by ESG ETFs existed. Moreover, I did not discover major differences in abnormal performance between European and US ESG ETFs. However, after constructing three additional portfolios based on MSCI ESG-rating, it was found that the highest-rated portfolio significantly outperformed the lowest-rated one in the last few years.

This study therefore concludes that over the past few years, the impact of environmental regulation on ESG ETF performance has risen significantly. However, as the previous sentence already suggests, this phenomenon has only started to become present in the past few years. In the beginning of the sample period, little to no effect was found after the introduction of new environmental regulation. Furthermore, it must be mentioned that this study does not take transaction costs or management fees into account. As proven by Dumitrescu et al. (2023), these costs do influence ETF performance, meaning that the exact percentages of (out)performance in this study in all probability do not measure the complete and accurate magnitude of real-world ETF (out)performance.

Potentially, future researchers could exploit extra, more up-to-date data to examine the effect of more recent regulations on ESG ETF performance. An example could be the United State Disclosure Rule, implemented on 6 March 2024. However, at this point in time, insufficient data exists to obtain valid and all-encompassing conclusions on the effect of these regulations on ESG ETF performance.

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APPENDIX A List of sample ETFs

Panel A: EU equity ESG ETFs	
Ticker	Name
EWO	iShares MSCI Austria ETF
EDEN	iShares MSCI Denmark ETF
EWK	iShares MSCI Belgium ETF
ENOR	iShares MSCI Norway ETF
NORW	Global X MSCI Norway ETF
EFNL	iShares MSCI Finland ETF
IEUS	iShares MSCI Europe Small-Cap ETF
DFE	WisdomTree Europe SmallCap Dividend Fund
EWG	iShares MSCI Germany ETF
EWQ	iShares MSCI France ETF
FGM	First Trust Germany AlphaDEX Fund
EWP	iShares MSCI Spain ETF
EZU	iShares MSCI Eurozone ETF
SPEU	SPDR Portfolio Europe ETF
VGK	Vanguard FTSE Europe ETF
HEDJ	WisdomTree Europe Hedged Equity Fund
FEP	First Trust Europe AlphaDEX Fund
EWD	iShares MSCI Sweden ETF
DBEF	Xtrackers MSCI EAFE Hedged Equity ETF
FEZ	SPDR EURO STOXX 50 ETF
IEV	iShares Europe ETF
EWN	iShares MSCI Netherlands ETF
EPOL	iShares MSCI Poland ETF
FSZ	First Trust Switzerland AlphaDEX Fund
FDD	First Trust STOXX European Select Dividend Index Fund
EWL	iShares MSCI Switzerland ETF
EWI	iShares MSCI Italy ETF
EIRL	iShares MSCI Ireland ETF
Panel B: US equity ESG ETFs	
Ticker	Name
ILCB	iShares Morningstar U.S. Equity ETF
EUSA	iShares MSCI USA Equal Weighted ETF
IWD	iShares Russell 1000 Value ETF
VONV	Vanguard Russell 1000 Value ETF
IYE	iShares U.S. Energy ETF
FPX	First Trust US Equity Opportunities ETF
PRF	Invesco FTSE RAFI US 1000 ETF
SCHV	Schwab U.S. Large-Cap Value ETF
EQWL	Invesco S&P 100 Equal Weight ETF
SPLV	Invesco S&P 500¬Æ Low Volatility ETF

SCHD	Schwab US Dividend Equity ETF
IYZ	iShares U.S. Telecommunications ETF
QQXT	First Trust Nasdaq-100 Ex-Technology Sector Index Fund
IGE	iShares North American Natural Resources ETF
PSCC	Invesco S&P SmallCap Consumer Staples ETF
IYK	iShares U.S. Consumer Staples ETF
ITA	iShares U.S. Aerospace & Defense ETF
IHF	iShares U.S. Healthcare Providers ETF
IYT	iShares US Transportation ETF
IAI	iShares U.S. Broker-Dealers & Securities Exchanges ETF
IAK	iShares U.S. Insurance ETF
IAT	iShares U.S. Regional Banks ETF
IHE	iShares U.S. Pharmaceuticals ETF
IHI	iShares U.S. Medical Devices ETF
IYG	iShares U.S. Financial Services ETF
QABA	First Trust NASDAQ ABA Community Bank Index Fund
XBI	SPDR S&P Biotech ETF
XHE	SPDR S&P Health Care Equipment ETF
XHS	SPDR S&P Health Care Services ETF

Panel C: EU benchmark portfolio

Ticker	Name
MEUD	Amundi Stoxx Europe 600 UCITS ETF A
SDJ600	Invesco STOXX Europe 600 UCITS ETF Acc
STOXXIEX	iShares STOXX Europe 600 UCITS ETF (DE)
XSX6	Xtrackers Stoxx Europe 600 UCITS ETF 1C

Panel D: US benchmark portfolio

Ticker	Name
SPY	SPDR S&P 500 ETF Trust
IVV	iShares Core S&P 500 ETF
VOO	Vanguard 500 Index Fund;ETF
RSP	Invesco S&P 500 Eql Wght ETF