ERASMUS UNIVERSITY ROTTERDAM
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MASTER THESIS: FINANCIAL ECONOMICS

ESG Investing
Score changes & Portfolio performance

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Abstract

This thesis examines if stocks that experienced high increases in their ESG and E score compared to decreases, yield abnormal returns over the 2010-2019 horizon for various regions like Global, Europe, North-America and Asia & Pacific. Secondly, the role of size and ESG levels on score changes is examined. This thesis finds evidence for the existence of abnormal returns in the Asia & Pacific sample of 0.281% a month which is amplified to 0.391% a month for the largest firms. In addition, the thesis finds evidence for abnormal returns for the largest firms within the Global Environmental sample of 0.408% a month. Regarding the level of ESG, firms with the highest level of ESG which also experienced an increase in ESG score among the highest globally, outperform the firms with the lowest level of ESG which also experienced an increase in ESG score among the highest. There are indications that portfolios sorts on the highest increases and decrease in ESG score for the Global, European and North-American sample, do not yield the highest difference in expected returns but the more modest increases and decreases in ESG scores do. Throughout the thesis, there is compelling evidence for the positive relation between ESG scores and firm size.

Keywords: ESG investing, ESG score changes, portfolio performance, Environmental scores, ESG, risk factors

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1. Introduction

Nowadays people and businesses struggle with their responsibilities regarding sustainability. For people this might mean that they refrain form products of companies that are regarded as being bad for the environment. For companies this might mean that they try to improve on the use of their resources, protection of human rights or by making their management future proof. Different institutions and people have their own approach in dealing with these sustainable responsibilities, asset managers and investors do so too.

On the 26th of October, the biggest pension fund of the Netherlands, the ABP, quoted that it would no longer have oil and gas companies in their investment portfolio (Groot & Wolzak, 2021). In addition to this decision ING, the largest bank of The Netherlands and also a publicly traded company, issued that they would no longer give or extent loans to companies in the gas and oil drilling business for new projects, essentially restricting credit to stop the expansion of oil and gas companies (Kock, 2022). These kinds of decisions suggest that banks and pension funds take sustainability fairly seriously, at least in The Netherlands. Other examples of taking up sustainability goals by companies, is to create more diversity on the work floor by hiring people from groups that are underrepresented in the firms, paying child support for employees and many other numerous examples.

The new stance of these asset managing firms on oil and gas companies can be placed in a much broader discussion on how these companies affect the climate and society. The new stance on sustainability fits in the western world consciousness that investing in publicly listed companies with a large negative societal footprint might not be ethical. These decisions align with the capital flows into so-called ESG funds over the past years. These funds select companies on several environmental, social and governance criteria. In 2020, capital flows into these funds amounted to 649 billion worldwide compared to only 285 billion in 2019. It can be safely said that there is a profound trend going on that moves capital into ESG funds (Jessop & Kerber, 2021). Blackrock, one of the largest wealth managing firms of the world has also seen large inflows into ESG funds, especially in the iShares ETF part of their business. Blackrock reports that the development of ESG ETF's mainly took place in Europe and that the investments into ESG funds from the U.S. are mainly driven by millennial retail investors. It is also stated that asset managers in the U.S. are pushing the Biden administration for changing laws on the 401k retirement plans, in order to invest pensions in ESG funds which is prohibited at the moment. An article of the Financial Times also describes upcoming ETF's that invest in companies that are targeting zero-emissions which is becoming increasingly popular as well (Temple-West, 2022).

These articles and findings suggest that ESG investing is becoming increasingly popular and that improving your ESG score might matter for a company's performance. This can be reflected

in a company's stocks performance, its profitability but also its possibilities to raise capital like in the ING example. If retail and institutional investors turn to ESG scores as an additional metric to base their investments on, this can have a profound impact on the stock returns of companies that are ESG rated. For example, companies that are included in ESG ETF's, other ESG funds or indices which mean that they have relatively high ESG scores, might lead to more investments in these companies. The inclusion into these ESG products can cause price movements but also affect the investment decisions of these companies as it is able to attract capital more easily.

The aforesaid premises suggest that improving your ESG score becomes increasingly important and may be rewarded by investors, society and banks. As more asset managers, pension funds and retail investors are tilting their portfolios towards stocks with good ESG scores, it is important for companies to get their ESG scores to be improved. Shanaev and Ghimire (2022) find for the U.S market that upgrades do not get rewarded in particular but that the returns of companies which are being downgraded are severely punished. This gives rise to the following question:

Do the stocks of companies that have seen a sharp rise in their ESG scores compared to last year have higher excess returns than the ones with less rising or decreasing ESG scores?

The central theme in this thesis will be whether companies with high increases in their ESG and Environmental score will outperform companies that have experienced decreases and if this is a profitable investment strategy for investors to pursue.

2. Literature

This thesis builds on the debate in the literature about ESG investing and whether forming portfolios on ESG criteria can yield abnormal returns. As more companies get ESG rated, the importance of incorporating these ESG criteria into investments decisions also gets more attention. The influence of ESG is heavily investigated in the last decade by many authors, culminating in an ongoing debate on the possible existence of an ESG factor but also whether specific ESG criteria lead to stock outperformance or are associated with specific risks. In the last decade, the findings are mixed and do not yield a clear and straightforward view of ESG scores on investing performance, especially if portfolios based on ESG criteria are yielding risk-adjusted returns.

Edmans (2011) was one of the first to document the existence of the possible outperformance of a portfolio selected on so-called intangibles. Constructing a portfolio based on employee satisfaction earned a risk-adjusted return of 0.29% a month. Employee satisfaction can be seen as a predecessor of the criteria that feature in the social pillar of ESG. Pomorski et al. (2021) conclude in their paper about incorporating ESG funds in portfolio selection that this can be done by just slightly lowering the Sharpe ratios of the investment portfolio. They also document that the governance pillar is a good predictor for future returns and financial fundamentals which is not evident for the environmental and social pillar of ESG. Therefore, the environmental pillar is a weak predictor of future profits although investor demand is high for these proxies which can lead to insignificant and low returns for these metrics. Pomorski et al. show that different pillars and thereby criteria have different effects on stock performance.

Alda (2020) finds evidence for the outperformance of pension funds in the UK that have a high intensity in ESG screening, these funds attract more capital flows and outperform other funds in terms of return. Madhavan et al. (2020) find that mutual funds with high ESG scores tend to have different factor loading profiles than mutual funds with low ESG scores. Especially for the environmental pillar, the factor loadings were highly correlated with the quality factor. They find a strong positive relationship with high ESG-scores and alpha. Bennani et al. (2018) find ESG investing to be more profitable in Europe than the U.S., they even name ESG investing in Europe a beta strategy, implying that going long in the top 20% of the European ESG stocks and short in the bottom 20%, yields a significant positive excess return.

Contrary to the aforesaid findings, Cornell (2021) argues that although investor demand for high-rated ESG firms may lower the cost of capital for these firms, these firms yield lower expected returns as the demand for these firms drives up the stock prices. Pastor (2021) also finds evidence for the underperformance of the so-called "green" companies which implies that

if the preference for ESG is strong, this results in lower expected returns for green stocks compared to non-green stocks, especially when risk-aversion is low. These findings suggest that ESG stocks are associated with less risk and a hedge against climate risk. Adding to these findings, Hubel & Scholz (2020) find that low-scoring firms on environmental criteria outperform the high scoring ones by an annual return of 2%. They conclude that this is likely because investor demand is high for this particular pillar, lowering the expected return.

The findings show no concise answer to whether and how ESG precisely influence portfolio performance. It appears that different ESG criteria can yield different results as the three pillars all have their distinct influence on the performance of stocks. Other aspects that might influence these findings, are the diverging scoring methodologies of the different vendors as documented by Dimson et al. (2020), the large cap bias in ESG scoring which implies larger companies receive higher ESG scores (Berg et al., 2020) and that ESG scores are reported with a time lag by different vendors (Ehlers et al. 2021).

The scope of this thesis is not whether ESG scores on itself can affect outperformance of stocks but how the changes in these ESG scores influence portfolio performance. This thesis contributes to the existing literature by examining how ESG and environmental score changes affect investing performance. Chen & Yang (2020) find that in the Taiwanese stock market, investors react more positive to news from companies with higher ESG scores and pessimistic to news about companies with lower ESG scores. Shanaev & Ghimire (2022) find that ESG downgrades had a significant impact on stock return performance. Secondly, they conclude that this result was robust when they subtracted the stock returns of downgrades from upgrades in the U.S. market.

The difference between this thesis and the research conducted by Shanaev & Ghimire is that the latter only considers downgrades and upgrades in ESG scores and does not form portfolios on the percentage score change of ESG and E scores. In addition, their research looked at the U.S. market with a sample of 700 companies. The scope of this thesis is much broader as it looks at a global sample and considers different regions like Europe, North-America and Asia & Pacific. The following five hypotheses follow from various findings in the literature and newspaper articles. Hypothesis 1 is based on the research by Shanaev & Ghimire (2022), Chen & Yang (2020) and Pomorski et al. (2021).

Hypothesis 1:

Companies that experienced a large improvement in their ESG score outperform companies with a large deterioration in their ESG scores on the stock market and have a significant difference in average excess returns globally.

Hypothesis 2 is essentially the same as hypothesis 1 but states that the effect is more profound in the European market. First, the hypothesis is based on the findings of Shanaev & Ghimire (2022) who looked into upgrades and downgrades in the U.S. market. Secondly, Bennani et al. (2020) find ESG investing to be more profitable in Europe than the U.S. Thirdly, Temple-West (2022) reports in the Financial Times that investing in ESG funds via 401k plans is not possible in the U.S. due to legal restrictions whereas pension funds like the ABP in The Netherlands are tilting their portfolios towards ESG funds. In short, this means that ESG investing is more popular in Europe, especially with institutional investors. This implies that relatively more capital flows to ESG stocks in Europe than the U.S. These three premises give rise to the belief that an effect like in hypothesis 1 is more profound for the European market compared to the U.S. and Asia & Pacific markets.

Hypothesis 2:
Companies that experienced a large improvement in their ESG score outperform companies with a large deterioration in their ESG score on the stock market and have a significant difference in excess returns which is more pronounced for the European market.

Hypothesis 3 stems from the research of Pomorski, Fitzgibbions & Pedersen (2021) who found that investor demand for the environmental pillar is high although not good at predicting profits. In addition, Hubel & Scholz (2020) find that companies with low E-scores outperform the high ones. These findings do not imply that the same applies for score changes. It might that increasing your E-score leads to outperformance compared to a decreasing score. If investor demand is very high for these proxies, investors will watch the development of E- scores very thoroughly and will also select stocks on this basis. The articles which stated that companies are restricting funding for companies that are heavy polluters which want to start new projects, suggest that the environmental pillar might be important in selecting stocks. Companies that increase their E- score are therefore more interesting to investors and may also attract more investor attention which can alter the stock return of these companies.

Hypothesis 3:
Companies that experienced a large improvement in their E score outperform companies with a large deterioration on the stock market and have a significant difference in excess returns globally.

Hypothesis 4 is based on the research done by Chen & Yang (2020) who found evidence for an overreaction hypothesis. This means that good news for companies with high ESG causes more optimism with investors. On the other hand, bad news causes more pessimism with investors when the ESG score is low. This implies overreaction of investors with high ESG scores and also stock outperformance. Madhavan, Sobczyk & Ang (2021) also mention that stocks try to upgrade their ESG score to be included into ESG mutual funds. The same applies for ETF's as capital flows into ESG products have risen extremely. These findings suggest that the level of ESG after a change in ESG might play a role in portfolio performance.

Hypothesis 4:

An increase in the ESG score of a listed company matters more for the stock's performance than a decrease when the current level of ESG is high compared to low.

The following hypothesis is essentially the opposite of hypothesis 4 as it states that stocks which experience the highest increase in ESG scores perform better in terms of excess returns if their ESG scores is among the highest compared to the lowest.

Hypothesis 5:

A high ESG score of a listed company matters more for the stock's performance than a low score when the increase in ESG score was among the largest compared to the lowest.

3. Data & Methodology

3.1. ESG & sub-pillar scores

ESG scores and the scores of the sub-pillars, Environmental, Social and Corporate Governance, are retrieved from the ESG global coverage database of DataStream/Reuters also known as Refinitiv Eikon which contains 9338 ESG scores of publicly traded companies globally as of the fiscal year 2020. The coverage of ESG scores goes back to the year 2002 but only a few companies had ESG scores back then. In this thesis the focus will be on the ESG and E scores of the 2009-2019 period. The database of Thomson Reuters contains two types of ESG scores, one is named TRESGS and the other TRESGCS. Both are reflecting self-reported information in the Environmental, Social and Corporate Governance pillars but TRESGCS adds a controversy overlay which accounts for negative events in the media. The ESG score that is used in this thesis is the TRESGS score without the controversy overlay as this overlay would affect companies that have had negative media attention which may affect the scores in a subjective way.

The sub-pillar scores form the basis for the final ESG scores. The sub-pillars by itself are constructed to measure important categories within the pillar. The Environmental pillar measures three categories, namely resource use, emissions and environmental innovation. The weighting that these three categories get in the overall environmental scoring is roughly the same and ranging from 11% to 12% of the total ESG score. These categories are measured by 61 scoring indicators that will determine the final Environmental score. The Environmental pillar has an overall weighting in the final ESG score of 34%. The Social pillar consists of four categories, namely workforce, human rights, community and product responsibility, which are measured by 63 indicators. Workforce gets the highest weighting in the Social pillar with 16% compared to a weighting of 4.5% for human rights of the final ESG score. The Social pillar has an overall weighting of 35.5% in the final ESG score. The Corporate Governance pillar is represented by three categories, namely management, shareholders and CSR strategy of which management has the highest weighting of 19% of the final ESG score. The other categories range from 4.5% for CSR strategy and 8% for shareholders. The Corporate Governance pillar is measured by 54 indicators and has an overall weighting of 30.5% in the final ESG score, making it the pillar with the lowest weighting. The final ESG score is measured over the 178 indicators on which a company is scored.

The central variable of interest is the percentage changes of the ESG and E scores and how this affects stock performance over the 2010-2019 horizon. The percentage difference between two years of scores can only be calculated if a company is scored on ESG or its pillars during two consecutive years. This means that the percentage difference belonging to the year 2010 is made

up by the score in 2009 and 2010. The formula for calculating this percentage difference is given by:

$$Percentage\ ESG\ score\ change\ _t = \left(\frac{ESG\ score_t}{ESG\ score_{t-1}} - 1\right) \cdot 100 \qquad \textbf{(1)}$$

The same formula applies for the calculation of the E-score percentage change. Publicly traded companies are sorted into quintile and decile portfolios based on their respective percentage scores change, where the 1st quintile represents the companies that received a percentage score decrease compared to the 5th quintile which contains companies with the highest percentage score increases. The same applies to the decile portfolios where the 10th decile is the portfolio with stocks that experienced the highest percentage score increase.

The number of companies that is considered in this thesis is thereby restricted to companies that have a score in two consecutive years, limiting the number of publicly listed companies in the dataset. As the interest in ESG scoring and investing increased, the availability of scores for listed companies also increased, resulting in 2512 companies having two consecutive years of scoring in 2010 compared to 7115 companies in 2019 for the Global sample. A total of 7233 firms are considered globally which features in Table 3.1. The listing of 118 firms was suspended in 2010-2019 period.

There are several issues with the scoring of companies on ESG metrics that influence the measurement of portfolio performance and the sorting based on ESG and pillar scores.
The first problem arises from the Thomson Reuters/Refinitiv Eikon methodology as this vendor alters scores in retrospect. This means that the scores in the database for the year 2018 are altered on several occasions after the score is reported which affects the sorting into quintiles and deciles as an investor is faced with altered scores (Berg, Fabisik, & Sautner, 2021). The second issue with the scoring methodology is that scoring is done over the last fiscal year and made available only in the months following the fiscal year. This implies that scores for companies over the fiscal year 2019 can become available from March to September 2020. Ehlers et. al (2022) argue that research on the stock performance following from the ESG and pillar scores should account for time lagged scoring. The authors argue that researchers should take the stock returns of companies beginning almost one year later than fiscal year end. The database of ESG scores and all pillar scores that is made available by the EDSC (Erasmus Data Service Centre) contains scores up to the fiscal year 2020 and is updated until 30 September 2021. The latest update has scores for all given companies for the fiscal year 2020 which implies that all scores are made available within nine months. More on the exact time horizon of the stock returns is explained in

section 3.3. It is clear that the methodology and updating of scores has impact on the methodology in this thesis.

3.2. Assignment to a Geographical location and Overarching region.

The ESG and E scores will also be sorted on geographical location. The location where a company is listed on an exchange determines their geographical location. This means that a company listed on the Nasdaq is regarded as belonging to the North American market although their primary location may be somewhere else. If a company is listed on more exchanges around the world than one, the exchange of first listing is used for determining their geographical location. The geographical locations are aggregated into three overarching regions, namely North-America, Europe and Asia & Pacific. Other regions like the Middle-East, South-America and Africa are not on itself examined in this thesis but show up in Global. These regions are excluded as these regions do not have a significant number of firms with ESG scoring.

The assignment of certain exchanges to an overarching region comes with problems as in the case of Russia and Turkey. These two countries belong to two geographical regions, Asia and Europe and are therefore hard to assign. These two exchanges are being considered to belong to the region Europe more than Asia on the basis of trade flows as most of the international trade flows from both countries are to European countries. Europe is considered to be the top trading partner of both countries, although Russia has significant trade flows to the Asia & Pacific region as well.

It is evident from Table 3.1 that in every region the number of companies which received an ESG score is increasing yearly. This is most profound in North-America, namely from 886 in 2010 to 3061 in 2019. Table 3.1 also shows that North-America has the largest share of companies that have an ESG score in 2019, followed by Asia & Pacific and Europe. On average the ESG scores of European listed companies are higher in every year compared to the other geographical regions. This is in line with the articles suggesting that ESG investing is already more common and popular in Europe than in the other regions.

3.3. Returns, Risk-free rates & Market capitalization

The monthly index returns of all listed companies that got an ESG and E score have been retrieved from the DataStream database and were matched on their respective ISIN number. Total index returns are used to account for dividends paid which alter stock prices. As earlier discussed, stock portfolios are formed on the percentage difference in ESG or E score per fiscal year. This implies that there is a score change only once a year, so the portfolios are rearranged into new quintiles and deciles once a year. The top minus bottom portfolio represents a long-

short portfolio of which the excess returns are value weighted. Value weighting of monthly returns implies that the monthly returns of firms are weighted according to their market capitalization in month t-1. The weighting is based on the lagged market capitalization as this is the only information available to an investor before making an investment decision

It is hard to set a final date on which all listed companies have been scored as some scores are made available earlier than others. For example, at the beginning of May 2022 only a few scores were available, suggesting that a later date has to be picked to match returns with. From the dataset of the EDSC we know that all scores are available at the end of September, so this date will be used as the starting point for the monthly value weighted returns. This implies the following, the percentage score changes of 2019 become available at the 30th of September 2020, so the percentage score changes are lagged with 9 months in regard to their fiscal year. To calculate the excess returns for monthly returns, the 3-month U.S. treasury bill is used as the risk-free rate as this rate is considered to be almost without any risk. The data on the 3-month U.S. treasury bill is retrieved from the FED (Federal Reserve Bank) website. The aforesaid reasoning can be expressed in the following formula for the excess returns of these stocks at time t:

$$Excess\ return_t = \left(\frac{Index\ return_t}{Index\ return_{t-1}} - 1\right) - Rf_t \qquad \textbf{(2)}$$

In this formula, t represents the return in the current month whereas t-1 is the prior month. The risk-free rate is being subtracted to calculate the excess return of a stock. The excess returns are matched with the percentage score changes that have a lag of 9 months. Note that the above formula implies the calculation of simple returns which are asset-additive and therefore preferred to log returns as in this thesis, portfolio returns are the weighted average of the individual stock returns in the portfolio. This is in line with the methodology of Fama & French (1992). As earlier described in section 3.1, the listed companies will be sorted on percentage score change into quintiles and deciles. The difference in average excess return between the top and bottom portfolio, the long-short portfolio, will indicate any potential effect of score changes on portfolio performance. The long-short portfolio will also be called the difference portfolio throughout the thesis.

To investigate hypothesis 4 and 5, a double sort is applied on score change quintiles and ESG score quintiles yielding 25 portfolios to investigate whether the level of ESG after the publication of a new ESG score has influence on the average expected monthly value weighted returns of these portfolios. The portfolios of interest are the portfolios with the highest and lowest level of ESG together with the highest and lowest score change. 10 difference portfolios are formed, 5 of

them on score change holding ESG level constant, the other 5 on ESG level holding score change constant. This is only done for the global sample.

Lately a lot of discussion has been going on about the large cap bias in ESG scoring and investing by many vendors of ESG data. Boffo & Patalano (2020) conducted a thorough research on the ESG practices and methodologies commissioned by the OECD that clearly favored large cap companies which have the infrastructure and expertise to disclose their ESG practices. They are also able to invest more time and capital into these ESG practices, resulting in higher overall ESG scores. Akgun, Mudge & Townsend (2021) also find that social responsibility investors tend to favor large cap stocks but find that this may be suboptimal in a period of small cap outperformance. These findings give rise to the question how market capitalization influences ESG scoring and thereby the stock performance. It can be argued that as large cap stocks tend to have higher ESG scores and are more scrutinized by analysts. This may lead to outperformance of large cap stocks compared to small cap stocks. This may also lead large cap stocks which experienced a large percentage increase in their scores to outperform small cap stocks with a low percentage increase or percentage decrease even more.

Therefore, portfolios will also be sorted on size which is done by using the natural logarithm of dollar standardized lagged monthly market capitalizations. So, besides the sorting on score change, the portfolios are sorted on size quartiles resulting in a 5 by 4 sort, resulting in 20 portfolios. Of these portfolios, 5 difference portfolios are calculated for all samples namely the Global, Regional and the Global environmental. The difference portfolios are calculated to assess the influence of size on the average portfolios' expected returns by holding the size quartiles constant, any size effect should show up in the top and bottom quartiles of size, which is explained in the following section. The same is done for the difference portfolio that consists of the portfolio with the largest firms and highest score increases and the smallest firms and highest score decreases. The purpose of this portfolio is to show that there is a size and score change effect in average expected returns. So, 4 portfolios are assessing the size effect and 1 portfolio is controlling for score change and size. Throughout the whole thesis no transaction costs are considered which implies that excess returns are raw returns and transaction costs have to be subtracted. Transaction costs will not play a large role as the portfolio turnover is only once a year when a new score is published.

3.4. Time-Series regressions and Risk factors

In order to assess if any factors like the market, size, value, investment or profitability factors of Fama & French (2015) can explain any of the variation in the cross-section of excess return, time-series regressions of the difference portfolios' returns on the 5 factors is performed. The

time-series regressions show the risk factor exposure of the portfolios formed on the percentage score change and if there is any risk-adjusted expected return from sorting on score changes. If the average excess return of the difference portfolios has any significant exposure to the risk factors, this would suggest that any statistically significant excess return of the difference portfolios is not explained by sorting portfolios on their score change but by tilting the portfolio towards any of the risk factors.

The 5 factors are retrieved from the Kenneth French website. As there is no Global factor returns sample available, both the factor returns for the developed and emerging countries are used. The developed and emerging countries make up almost 99% of all firms considered in the ESG and E samples. The same accounts for the Asia & Pacific sample as Japan is typically excluded from the factor returns of the Asia & Pacific sample. To account for this, the factor returns of both are used as explanatory variables in the time-series regression, in order to capture all the exposures of the portfolios to the factor returns.

Table 3.1: Summary statistics of the number of firms, average excess return, average ESG score and average percentage score change per year and over the whole period for the global sample and regional samples for the period of 2010-2019.

Region	Year	Firms	Excess Return (b)	ESG-score	ESG % Diff
Global	2010	2512	0.686%***	43.84	12.31%
	2011	3060	1.701%***	42.52	5.26%
	2012	3239	0.576%***	42.98	8.76%
	2013	3356	-0.845%***	43.11	3.64%
	2014	3498	1.301%***	43.81	8.16%
	2015	3672	0.787%***	45.69	13.02%
	2016	4460	-1.379%***	45.03	14.54%
	2017	5283	-2.352%***	44.68	11.60%
	2018	6329	0.027%	43.77	12.86%
	2019	7115	3.484%***	45.48	15.39%
	Total (a)	7233	0.464%***	44.27	11.30%
North-America	2010	886	1.199%***	42.23	13.87%
	2011	949	1.735%***	42.33	4.85%
	2012	985	1.033%***	42.51	4.20%
	2013	996	-0.710%***	42.83	3.22%
	2014	1026	1.450%***	43.28	5.97%
	2015	1076	0.592%***	45.56	12.79%
	2016	1632	-0.851%***	42.22	17.06%
	2017	2289	-2.307%***	40.04	12.71%
	2018	2888	0.132%	37.98	12.86%
	2019	3061	4.271%***	40.16	15.46%
	Total (a)	3104	0.753%***	41.08	11.74%
Europe	2010	735	0.683%***	50.01	10.10%
	2011	781	2.402%***	50.34	5.09%
	2012	812	2.411%***	50.67	10.76%
	2013	830	-0.401%***	50.87	3.83%
	2014	849	0.335%***	51.86	5.72%
	2015	872	1.278%***	54.29	15.99%
	2016	975	-1.923%***	53.52	7.99%
	2017	1001	-2.573%***	55.93	10.63%
	2018	1127	-0.175%	57.05	9.33%
	2019	1603	3.311%***	54.27	11.08%
	Total (a)	1628	0.447%***	53.26	9.26%
Asia & Pacific	2010	796	0.213%*	39.77	11.33%
	2011	1150	1.494%***	37.23	5.52%
	2012	1229	0.513%***	37.85	10.82%
	2013	1273	-0.806%***	38.10	4.21%
	2014	1357	1.534%***	39.02	11.69%
	2015	1434	0.638%***	40.74	12.52%
	2016	1517	-1.419%***	42.78	14.57%
	2017	1579	-2.392%***	44.92	11.14%
	2018	1875	0.199%**	44.63	12.00%
	2019	1978	2.525%***	46.62	17.49%
	Total (a)	2007	0.277%***	41.78	11.62%

Note: * represents significance at the 10% level, ** at the 5% level and *** at the 1% level

a. Total represents the number of firms that feature in the sample over the 2010-2019 horizon.

b. H0: monthly average excess return = 0 Ha: monthly average excess return ≠ 0

4. Results

4.1. Global ESG score changes

In this section the results of the portfolio sorts on score change for the global sample will be discussed. Table 4.1 shows the results for the quintile sorted portfolios and the difference portfolio which is indicated by subtracting the excess returns of the quintile with the lowest score changes from the portfolio with the highest score changes. The first column shows that none of the quintile portfolios has a monthly expected return that is significantly positive from zero, although the expected returns show a positive linear behavior as the expected return increases in score change quintiles. This implies that portfolio sorts on percentage score changes do not yield a positive expected return on itself. The difference portfolio falls just short of the 10% statistical level with a p-value of 0.14. Therefore, the average monthly excess return of the difference portfolio gives no hard evidence for any difference in expected returns which can be gained by sorting on score changes.

The same evidence comes forth from the results of Table A.1.1 in the Appendix. Table A.4.1 shows the results for the decile portfolios sorted on percentage score changes. All the average monthly expected returns of the decile portfolios are highly statistically insignificant. The same accounts for the difference portfolio which is formed by subtracting the average excess return of the portfolio with the lowest score changes from the highest. Both difference portfolios indicate that there is no positive expected return from sorted portfolios on ESG percentage score changes.

To examine if firm size has an effect on the excess returns of score change portfolios, a double sort on score change quintiles and size quartiles has been conducted. Table A.1.2 of the Appendix show the results of the double sorted portfolios. From the results of Table A.1.2 can be concluded that there is no size effect whatsoever as the difference portfolios for the size quartiles do not yield any statistically significant expected return. The expected returns of the difference portfolios do not follow any linearity in returns over the size quartiles. Only the difference portfolio of the largest firms in the top size quartile shows a positive return although this does not differ from zero. The same accounts for difference portfolio that is constructed by subtracting the lowest score change portfolio with the smallest firms from the highest score change and largest firms' portfolio. So, size seems to play no distinct role in the expected return of portfolios sorted on score changes.

As earlier stated, the decile difference portfolio does not show any statistically significant expected return. When a difference portfolio is constructed by subtracting the average excess returns of the 2nd decile from the 9th decile which are associated with a slightly more modest score

change, the difference portfolio shows a highly significant expected return of 0.32% at the 5% level. This gives rise to the question whether the highest and lowest score changes have any effect on the outperformance of portfolios.

Table 4.1: Global Average Returns, ESG scores, Market cap and Score percentage difference of monthly value weighted quintile portfolios formed on yearly score percentage difference from 2010-2019.

	Excess Return (a)	**ESG-score**	**Market Cap** (c)	**Score % change**
1	0.228%	32.58	8609.25	-16.40%
2	0.308%	50.09	16,497.41	-3.26%
3	0.345%	52.90	16,586.44	2.82%
4	0.366%	46.84	12,152.06	11.56%
5	0.376%	38.07	7880.04	58.00%
5-1	0.148%	5.49*** (b)	-729.21*** (d)	74.39%

Note: * represents significance at the 10% level, ** at the 5% level and *** at the 1% level

a. H0: monthly average excess return = 0 Ha: monthly average excess return ≠ 0
b. H0: monthly difference in average ESG score = 0 Ha: monthly difference in average ESG score ≠ 0
c. Market capitalization is in millions of dollars
d. H0: monthly difference in Market Cap = 0 Ha: monthly difference in Market Cap ≠ 0

What is striking from the results of Table 4.1 and Table A.1.1 in the Appendix, is the distribution of ESG scores among the portfolios. The average ESG scores in the top and bottom portfolios of Table 4.1 and Table A.1.1 are among the lowest of all portfolios. These top and bottom portfolios are also associated with the lowest market capitalizations, the average market capitalizations are the highest for the middle portfolios which experienced modest decreases and increases in score change. This implies that the distribution of the lowest ESG scores manifests in the tails of score changes.

Table A.1.3 shows the distribution of average ESG scores among the double sorted portfolios. The results of Table A.1.3 are in according with the earlier findings in Table 4.1 and A.1.1, namely that lower ESG scores and lower market capitalization are related. In Table A.1.3 of the Appendix, ESG scores are monotonically increasing in size for every quintile of score change. There is a profound significant average difference between the portfolios with the largest firms and smallest firms holding score changes quintiles constant, implying that large firms are associated with higher ESG scores on average. For the difference portfolios with size held constant, the top portfolios consist of firms with on average higher ESG scores for every size quartile. The difference in average ESG score is the largest for the smallest firms and becomes lower when size increases. This adds to the findings in the literature which suggested that there is a large cap bias in ESG scoring.

In Table 4.2, time-series regressions of the expected returns of the difference portfolios on the 5 factor returns of Fama & French (2015) are conducted, to investigate whether the factors are

capable of explaining any variation in the difference portfolios' expected returns. The quintile difference portfolio shows a highly significantly negative exposure to the value factor for developed countries, implying that the expected return on the difference portfolio is on average explained by relatively more growth stocks in the top portfolio compared to the bottom which results in the negative exposure.

Table 4.2: Global Time-Series regressions of the average monthly difference portfolios on the average monthly factors returns from 2010-2019.

	(1)	(2)	(3) (a)	(4) (b)	(5) (b)	(6) (b)	(7) (b)
Factor Returns (c)	**Quintile Diff**	**Decile Diff**	**Size Diff 54-11**	**Size Diff 51-11**	**Size Diff 52-12**	**Size Diff 53-13**	**Size Diff 54-14**
Mrkt_Rf_D	-.004	-.013	-.124	-.003	.023	-.023	.004
	(-.08)	(-.25)	(-1.54)	(-.05)	(.51)	(.53)	(.06)
Mrkt_Rf_E	.009	.016	-.142*	.065	-.025	.013	.002
	(.21)	(.32)	(**-1.82**)	(1.04)	(-.58)	(.32)	(.04)
SMB_D	-.005	-.014	-.815***	.128	.115	.086	-.045
	(-.06)	(-.15)	(**-5.90**)	(1.15)	(1.50)	(1.16)	(-.44)
SMB_E	-.023	-.066	-.159	.142	.059	-.002	-.05
	(-0.34)	(-.81)	(-1.29)	(1.43)	(.86)	(-.04)	(-.55)
HML_D	-.262***	-.009	-.516***	.185	-.03	-.012	-.363***
	(**-3.22**)	(-.09)	(**-3.57**)	(1.59)	(-.38)	(-.16)	(**-3.38**)
HML_E	.073	-.05	-.168	-.207*	.119	-.03	.12
	(.88)	(-.51)	(-1.14)	(**-1.74**)	(1.44)	(-.38)	(1.09)
RMW_D	-.109	.069	-.157	.254*	.209**	.142	-.218
	(-1.05)	(.57)	(-.85)	(**1.72**)	(**2.05**)	(1.43)	(-1.60)
RMW_E	-.175*	.126	.149	.066	.053	.075	-.261**
	(**-1.77**)	(1.09)	(.85)	(.47)	(.54)	(.79)	(**-2.01**)
CMA_D	.157	-.077	-.128	-.281	-.068	-.057	.249
	(1.21)	(-.51)	(-.56)	(-1.52)	(-.53)	(-.46)	(1.46)
CMA_E	-.168	-.089	-.169	.22	-.044	-.022	-.243*
	(-1.65)	(-.74)	(-.94)	(1.51)	(-.44)	(-.23)	(**-1.81**)
Alpha	.159%	-.115%	-.036%	-.080%	-.161%	-.036%	.227%
	(1.53)	(-.94)	(-.20)	(-.54)	(-1.58)	(-.36)	(1.66)
Observations	120	120	120	119	119	119	119
R-squared	.213	.115	.711	.118	.111	.09	.218

Note: * represents significance at the 10% level, ** at the 5% level and *** at the 1% level, T-statistics are in parentheses.

a. Column 3 is the portfolio difference in excess returns between the largest cap firms with the highest percentage score change and the smallest cap firms with the smallest percentage score change.
b. Column 4, 5, 6 and 7 are the portfolio differences in excess returns based on size, keeping size constant. 4 represents the largest firm quartile and 1 the smallest. The score changes quintiles range from quintile 1 with the highest score decreases to 5 with the highest increases.
c. Factor variables with a "D" in the name imply factor returns for developed countries whereas a "E" imply emerging countries.
d. The regression results of alpha are presented in percentages.

On average, more stocks in the difference portfolio resemble the firms in the developed countries value factor on which the portfolio return has a negative loading.

The quintile difference portfolio also shows a slightly significantly negative exposure to the profitability factor for emerging countries, suggesting that the top portfolio on average consists of firms with less robust profitability compared to the bottom portfolio. The decile difference portfolio does not show any significant exposure to a factor whatsoever, but both the quintile and decile difference portfolios do not yield any significant alpha which implies that the 5 factors explain all the variation in expected returns.

The difference portfolio that is sorted on size and score change and is constructed by subtracting the portfolio with the smallest firms and lowest score changes from the portfolio with the largest and highest score change firms, shows a highly significant exposure to the size factor of developed countries. This implies that the difference in expected return is mainly explained by size which is logical as this portfolio is sorted on size. Besides this, the value factor also loads highly statistically negative on the difference portfolio which indicates that the top portfolio just as in the quintile difference portfolio, consists on average more of growth stocks than the bottom portfolio. This effect is also present in the difference portfolio of the largest firms as in column 7 although with a lower magnitude, implying that large firms which experienced large increases in their ESG score are negatively exposed to the value factor and are therefore on average more related to growth stocks.

At the same time, the smallest firms with the highest score increases, indicated by the first two size quartiles, are exposed to the profitability factor. This indicates that these portfolios are on average consisting of more firms with robust profitability compared to the smaller firms with the highest decreases. This effect disappears in size as the last two size quartiles do not show this exposure.

In short, the difference portfolios do not show any risk-adjusted return different from zero as indicated by alpha in Table 4.2. The expected returns of the difference portfolios on score changes are mainly explained by the exposure to the value factor and slightly by the profitability factor.

4.2. Regional ESG score changes

This section discusses the results of the portfolio sorts on score change for the European, North-American and Asia & Pacific region. Table 4.3 shows the results for the quintile portfolios sorted on ESG score changes for the European region. The same pattern arises as for the global dataset as there is no significantly positive difference in expected returns between the top and bottom portfolio. The same accounts for the decile portfolio in Table A.2.1 of the Appendix. The only difference with the global sample is that the expected return of the European difference

portfolios becomes more negative as the portfolios are sorted in deciles, implying that more extreme expected returns manifest in the tails of the score change distribution.

Secondly Table A.2.1 shows another interesting finding in accordance with the global sample, namely that portfolios which had modest average increases and decreases in their ESG score, show a positive significant difference in excess returns as the difference between decile 8 and decile 3 shows a positive significant expected return at the 10% level of 0.201% a month. This adds to the evidence that the difference in excess returns between the top and bottom portfolios may not contribute to outperformance in terms of return but that the difference in return between portfolios with more modest changes may do.

Table A.2.2 in the Appendix shows the results of the double sorted portfolios on score change and size. The same pattern as in the global sample arises from the difference portfolios of the European sample as the difference portfolio of the smallest size quartile yields a negative expected return compared to the largest size quartile which yields a positive expected return. The relation between expected returns and score changes is more likely to be negative than positive although the expected returns do not differ significantly from zero.

Regarding the ESG scores and market capitalizations, the portfolios also show resemblance with the global sample as the lowest ESG scores and market capitalizations manifest in the top and bottom portfolios. The distribution of score changes among size portfolios in Table A.2.3 of the appendix also show monotonically increasing ESG scores in size. In addition, the difference in ESG scores between the difference portfolios on size show a monotonically decreasing difference in size. The only difference is that the European region contains firms with higher ESG scores on average which contributes to the findings in the literature and newspapers that ESG scoring is more sophisticated in Europe compared to other regions although this does not yield higher expected returns when portfolios are sorted on score change.

Table 4.3: European Average Returns, ESG scores, Market cap and Score percentage difference of monthly value weighted quintile portfolios formed on yearly score percentage difference from 2010-2019.

	Excess Return (a)	**ESG-score**	**Market Cap** (c)	**Score % change**
1	0.144%	43.18	8022.96	-13.58%
2	0.092%	59.31	17,327.66	-2.47%
3	0.160%	61.41	17,614.61	2.68%
4	0.206%	55.58	10,759.14	9.84%
5	0.127%	45.04	6024.73	48.87%
5-1	-0.017%	1.86*** (b)	-1998.24*** (d)	62.45%

Note: * represents significance at the 10% level, ** at the 5% level and *** at the 1% level

a. H0: monthly average excess return = 0 Ha: monthly average excess return ≠ 0

b. H0: monthly difference in average ESG score = 0 Ha: monthly difference in average ESG score ≠ 0

c. Market capitalization is in millions of dollars

d. H0: monthly difference in Market Cap = 0 Ha: monthly difference in Market Cap ≠ 0

In Table 4.4, the time-series regressions of the expected returns of the difference portfolios on the factor returns for the European region are analyzed. The quintile portfolio difference shows a significantly negative exposure to the investment factor which implies that the top quintile portfolio on average is more exposed to aggressively investing firms compared to the bottom quintile. The decile difference portfolio shows no significant exposure to any factor.

Consistent with the global sample, the difference portfolio on size and score change in column 3 shows a highly significant exposure to the size factor which is logical as sorting on size is applied. The negative exposure to the value factor suggests that the portfolio with the largest firms and highest ESG score increases consists on average more of growth stocks than the portfolio with the smallest stocks and lowest score changes. This implies that portfolios on score changes and size are likely related with a negative exposure to the value factor as the negative exposure to the value factor in column 5 also gives an indication for this finding.

The variation in the expected returns of all difference portfolios is explained by the 5 factors as there remains no positive significant alpha.

Table 4.4: Time-Series regressions of the average monthly difference portfolios on the average monthly factors returns from 2010-2019 for the European region.

Factor Returns	(1) **Quintile Diff**	(2) **Decile Diff**	(3) (a) **Size Diff 54-11**	(4) (b) **Size Diff 51-11**	(5) (b) **Size Diff 52-12**	(6) (b) **Size Diff 53-13**	(7) (b) **Size Diff 54-14**
Mkt_RF	-.001	.055	-.087	-.022	.012	-.075	.011
	(-.04)	(1.06)	(-1.23)	(-.39)	(.29)	(-1.62)	(.18)
SMB	.124	.078	-.86***	-.196	.038	.046	.089
	(1.54)	(.68)	(**-5.54**)	(-1.60)	(.43)	(.45)	(.65)
HML	.009	-.223	-.577***	-.144	-.222*	.105	.008
	(.08)	(-1.44)	(**-2.75**)	(-.87)	(**-1.82**)	(.76)	(.04)
RMW	.155	-.246	.15	.104	.044	.148	.246
	(-1.11)	(-1.24)	(.56)	(.49)	(.28)	(.83)	(1.05)
CMA	-.261*	-.352	-.11	-.083	.102	-.152	-.365
	(**-1.71**)	(1.62)	(-.38)	(-.36)	(.60)	(-.78)	(-1.42)
Alpha (c)	-.153%	-.287%	-.294%	-.158%	-.078%	-.031%	-.183%
	(-1.14)	(-1.49)	(-1.13)	(-.77)	(-.52)	(-.18)	(-.81)
Observations	120	120	120	119	119	119	119
R-squared	.147	.141	.493	.113	.115	.037	.102

Note: * represents significance at the 10% level, ** at the 5% level and *** at the 1% level, T-statistics are in parentheses.

a. Column 3 is the portfolio difference in excess returns between the largest cap firms with the highest percentage score change and the smallest cap firms with the smallest percentage score change.
b. Column 4, 5, 6 and 7 are the portfolio differences in excess returns based on size, keeping size constant. 4 represents the largest firms and 1 the smallest. The score changes quintiles range from quintile 1 with the lowest score decreases to 5 with the highest increases.
c. The regression results of alpha are presented in percentages.

Table 4.5 shows the results for the quintile portfolios in the North-American sample which shows roughly the same pattern as the Global and European sample as the expected return on the quintile difference portfolio does not yield expected returns different from zero. The striking result from Table A.2.4 in the Appendix is that the decile difference portfolio shows a significantly negative expected return of -0.305% a month on average, implying that the lowest score change portfolio outperforms the portfolio with the highest score changes. The exact opposite of what was hypothesized.

The second finding adds to the evidence that was already suggested from the results of the Global and European sample, namely that portfolios who experienced a more modest increase in ESG score compared to a more modest decrease may provide a significant difference in expected returns. Subtracting the excess returns of the 2nd decile from the 9th decile yields a significant positive difference in excess return at the 5% level of 0.398% a month on average.

The difference portfolios sorted on score changes and size for the North-American region show resemblance with the Global and European sample results as well. None of the difference portfolios on size yields an expected return different from zero whereas there is an indication that the smallest size quartile has negative expected returns and the largest size quartile positive ones. The only difference with the Global and European sample is that the expected returns on the portfolios for the North-American sample are on average higher and differing significantly from zero for some portfolios.

The distribution of ESG scores and market capitalizations among the portfolios show the same pattern as in the other samples, namely ESG scores are positively related to market capitalizations.

Table 4.5: North-American Average Returns, ESG scores, Market cap and Score percentage difference of monthly value weighted quintile portfolios formed on yearly score percentage difference from 2010-2019.

	Excess Return (a)	**ESG-score**	**Market Cap** (c)	**Score % change**
1	0.545%	32.20	11,476.76	-16.19%
2	0.560%	46.83	23,905.57	-3.41%
3	0.649%*	48.73	21,709.71	2.99%
4	0.735%*	44.28	17,419.24	12.03%
5	0.675%*	37.53	9763.57	56.03%
5-1	0.129%	5.33*** (b)	-1713.19 (d)	72.22%

Note: * represents significance at the 10% level, ** at the 5% level and *** at the 1% level

a. H0: monthly average excess return = 0 Ha: monthly average excess return ≠ 0

b. H0: monthly difference in average ESG score = 0 Ha: monthly difference in average ESG score ≠ 0

c. Market capitalization is in millions of dollars

d. H0: monthly difference in Market Cap = 0 Ha: monthly difference in Market Cap ≠ 0

Table 4.6 shows the time-series regressions results for the North-American sample. The factor exposure of the quintile and decile difference portfolios are differing in their exposures to the 5 factors, compared to Europe and Global. Both the quintile and decile difference portfolio show a significantly positive exposure to the size factor implying that the top portfolios constituting the difference portfolios is on average more exposed to small stocks than the bottom portfolios. The decile difference portfolio also shows that the expected returns of the difference portfolio is explained by positive exposure to the value factor and negative exposure to the investment factor, implying that the top decile portfolio on average is more exposed to value stocks and aggressively investing firms, although the negative exposure to the investment offsets the exposure to the size and value factor in magnitude, the factor exposure cause the risk-adjusted return of the decile difference portfolio to be insignificant.

Regarding the difference portfolios with a size component, column 3 shows the same factor exposures as the Global and European sample, indicating negative exposure to the size and value factor.

Table 4.6: Time-Series regressions of the average monthly difference portfolios on the average monthly factors returns from 2010-2019 for the North-American region.

Factor Returns	(1) **Quintile Diff**	(2) **Decile Diff**	(3) (a) **Size Diff 54-11**	(4) (b) **Size Diff 51-11**	(5) (b) **Size Diff 52-12**	(6) (b) **Size Diff 53-13**	(7) (b) **Size Diff 54-14**
Mrkt_RF	.063	-.016	-.055	.008	.072	.027	.078
	(1.61)	(-.39)	(-.84)	(.13)	(1.37)	(.77)	(1.50)
SMB	.187**	.285***	-.651***	.297**	-.063	.08	.181*
	(**2.38**)	(**3.43**)	(**-5.02**)	(**2.58**)	(-.60)	(1.14)	(**1.74**)
HML	-.044	.137*	-.375***	.115	.178*	.057	-.103
	(-.59)	(**1.77**)	(**-3.10**)	(1.07)	(**1.82**)	(.87)	(-1.06)
RMW	-.093	.088	.215	.358**	.013	.143	-.121
	(-.83)	(.74)	(1.16)	(**2.17**)	(.09)	(1.42)	(-.81)
CMA	-.182	-.413***	-.494**	-.226	-.24	-.116	-.203
	(-1.40)	(**-3.00**)	(**-2.30**)	(-1.18)	(-1.38)	(-.99)	(-1.17)
Alpha (c)	.064%	-.234%	-.176%	.012%	-.246%	-.153%	.098%
	(.44)	(-1.52)	(-.74)	(.05)	(-1.27)	(-1.17)	(.51)
Observations	120	120	120	119	119	119	119
R-squared	.204	.206	.582	.098	.048	.048	.166

Note: * represents significance at the 10% level, ** at the 5% level and *** at the 1% level, T-statistics are in parentheses.

a. Column 3 is the portfolio difference in excess returns between the largest cap firms with the highest percentage score change and the smallest cap firms with the smallest percentage score change.
b. Column 4, 5, 6 and 7 are the portfolio differences in excess returns based on size, keeping size constant. 4 represents the largest firms and 1 the smallest. The score changes quintiles range from quintile 1 with the lowest score decreases to 5 with the highest increases.
c. The regression results of alpha are presented in percentages.

Interestingly, the second and third column with difference portfolios show a highly significant negative exposure to the investment factor which suggest that the difference in expected return on these portfolios is explained by firms with large score increases investing more aggressively on average compared to firms with decreasing scores.

The difference portfolio of firms in the smallest size quartile presented in column 4, shows a significantly positive exposure to size and profitability which implies that the smallest firms in the highest score change quintile consists on average of companies that are smaller and have more robust profitability.

The results in Table 4.7 for the Asia & Pacific region show completely different results regarding the average expected returns of the quintile and decile difference portfolios. The difference in expected returns between the top and bottom quintile portfolio shows a significantly positive return of 0.325% a month and a 0.480% a month return for the decile portfolio which is presented in Table A.2.7 of the Appendix.

Table A.2.8 of the Appendix shows that the average expected returns for the difference portfolios is linearly increasing in size with the largest size quartile difference portfolio yielding a 0.443% a month, which is mainly caused by the relative underperformance of large cap stocks with large decreases in ESG score. The significant positive expected returns of these difference portfolio imply that there might indeed be a premium to be gained by sorting on score changes for the Asia & Pacific region.

As for all other regions, the ESG scores is increasing in market capitalizations and vice versa as is shown in Table A.2.9 of the Appendix. The dispersion in ESG scores among the difference portfolios also becomes smaller when the size of the firms increases.

Table 4.7: Asia & Pacific Average Returns, ESG scores, Market cap and Score percentage difference of monthly value weighted quintile portfolios formed on yearly score percentage difference from 2010-2019.

	Excess Return (a)	**ESG-score**	**Market Cap** (c)	**Score % change**
1	-0.102%	28.81	7540.34	-17.43%
2	0.168%	47.00	11,849.95	-3.48%
3	0.129%	50.35	11,659.01	2.90%
4	0.147%	44.15	9740.63	12.39%
5	0.223%	35.59	7442.46	61.39%
5-1	0.325%**	6.78*** (b)	-97.87 (d)	78.82%

Note: * represents significance at the 10% level, ** at the 5% level and *** at the 1% level

a. H0: monthly average excess return = 0 Ha: monthly average excess return ≠ 0

b. H0: monthly difference in average ESG score = 0 Ha: monthly difference in average ESG score ≠ 0

c. Market capitalization is in millions of dollars

d. H0: monthly difference in Market Cap = 0 Ha: monthly difference in Market Cap ≠ 0

In comparison to the European and North-American sample, the time-series regressions of the Asia & Pacific sample show a completely different picture of the factor exposures. Especially the quintile and decile difference portfolios show different results. Table 4.8 shows that none of the factors helps explaining the variation in expected return of the quintile difference portfolio. After controlling for these factors, a significantly positive alpha of almost 0.291% a month remains. This implies that none of these Fama & French factors is capable of explaining the variation in expected return.

Table 4.8: Time-Series regressions of the average monthly difference portfolios on the average monthly factors returns from 2010-2019 for the Asia & Pacific region.

Factor Returns (c)	(1) **Quintile Diff**	(2) **Decile Diff**	(3) (a) **Size Diff 54-11**	(4) (b) **Size Diff 51-11**	(5) (b) **Size Diff 52-12**	(6) (b) **Size Diff 53-13**	(7) (b) **Size Diff 54-14**
Mrkt_RF	.022	.042	-.2**	.048	.024	.008	.037
	(.47)	(.63)	(**-2.50**)	(.72)	(.52)	(.17)	(.62)
Mrkt_RF_J	-.05	.018	-.121	-.068	-.107*	-.093	-.039
	(-.86)	(.22)	(-1.21)	(-.82)	(**-1.82**)	(-1.61)	(-.52)
SMB	-.045	-.105	-.468***	.074	-.065	-.097	-.027
	(-.59)	(-.94)	(**-3.49**)	(.66)	(-.83)	(-1.26)	(-.26)
SMB_J	-.089	-.066	-.214	.059	.043	-.007	-.127
	(-1.09)	(-.56)	(-1.52)	(.51)	(.52)	(-.08)	(-1.20)
HML	-.083	-.105	-.315*	.066	-.069	-.039	-.113
	(-.79)	(-.69)	(**-1.72**)	(.44)	(-.65)	(-.37)	(-.82)
HML_J	-.024	-.004	-.267	-.013	.028	-.021	-.037
	(-.26)	(-.03)	(-1.65)	(-.10)	(.29)	(-.23)	(-.31)
RMW	.113	.169	-.605***	-.029	.085	-.046	.158
	(.97)	(1.00)	(**-3.00**)	(-.17)	(.72)	(-.39)	(1.04)
RMW_J	.215	.419**	-.28	-.027	.108	.122	.261
	(1.47)	(**1.98**)	(-1.11)	(-.13)	(.73)	(.84)	(1.38)
CMA	-.047	-.017	-.126	-.045	.126	-.15	-.007
	(-.42)	(-.11)	(-.64)	(-.28)	(1.10)	(-1.32)	(-.04)
CMA_J	.127	.096	.163	.126	.04	-.016	.2
	(.95)	(.49)	(.70)	(.65)	(.29)	(-.12)	(1.14)
Alpha (d)	.291%*	.294%	.383%	.022%	-.044%	.166%	.381%*
	(**1.76**)	(1.23)	(1.34)	(.09)	(-.26)	(1.00)	(**1.77**)
Observations	120	120	120	119	119	119	119
R-squared	.114	.142	.302	.028	.103	.094	.102

Note: * represents significance at the 10% level, ** at the 5% level and *** at the 1% level, T-statistics are in parentheses.

a. Column 3 is the portfolio difference in excess returns between the largest cap firms with the highest percentage score change and the smallest cap firms with the smallest percentage score change.
b. Column 4, 5, 6 and 7 are the portfolio differences in excess returns based on size, keeping size constant. 4 represents the largest firms and 1 the smallest. The score changes quintiles range from quintile 1 with the lowest score decreases to 5 with the highest increases.
c. Factor variables with a "J" in the name imply factor returns for Japan.
d. The regression results of alpha are presented in percentages.

The same applies for the difference portfolio of the largest size firms as this portfolio also yields a risk-adjusted return of 0.381% a month, implying that score changes matter for large cap stocks and that improving your ESG score heavily as a large cap stock is on average rewarded with more expected return than large decreases in score. For the Asia & Pacific region there is possible premium to be gained by sorting stocks on percentage score changes from high to low.

The persistence of this effect is partly offset by the results of the decile difference portfolio as the difference in expected returns between the top and bottom portfolio is on average explained by the positive exposure to the Japanese profitability factor. This result implies that the variation in expected return on average is explained by the top decile portfolio loading more on stocks with higher profitability than the bottom portfolio which is associated with Japanese firms.

In addition to the aforesaid findings, the difference portfolio with the size and score change component in column 3 shows the same behavior as in the analysis of the other regions, except that this portfolio also has a negative exposure to the market factor. This implies that the largest cap stocks with the highest increases in their ESG scores are having lower market betas on average than the small cap stocks with the highest decreases.

In short, the Asia & Pacific sample appears to behave differently regarding the difference portfolios sorted on score changes as the difference in expected return between the top and bottom quintile cannot be explained by any of the factors. This implies that investors can exploit this difference in return by not exposing themselves to any risk associated with the Fama & French 5 factors. The results from this section suggest that there is no evidence for European firms with large score increases outperforming the ones with decreases in score. There is evidence that this only the case for firms in the Asia & Pacific region. For the European and North-American region there are indications that firms with more modest increases in their ESG scores can outperform the ones with more modest decreases. Going long in a portfolio of stocks with the highest ESG score increases and largest market capitalizations and going short in the highest decreases and smallest market capitalizations, might be a viable investing strategy to pursue. This strategy yields the highest abnormal returns which cannot be explained by taking exposure to any of the risk factors.

4.3. Global E-score changes

The same analysis as in the previous two sections is repeated for changes in the E scores of firms globally. Table 4.9 shows the results for the quintile portfolio which have a comparable pattern as the global sample of ESG scores in section 4.1. The quintile difference is positive after it switches to negative for the decile difference. The quintile portfolios do not yield a statistically significant return from zero on their own. The difference portfolio just falls short on statistical significance

at the 10% level with a p-value of 0.13. The results for the decile portfolios are shown in Table A.3.1 of the Appendix which shows that there is no significant difference in the expected return between the top and bottom portfolio. Interestingly as in the case of the Global, European and North-American ESG sample, the difference portfolio of deciles with a more modest increase and modest decrease yields a significant positive expected return of 0.315% a month on average.

Table A.3.2 in the Appendix exhibits the results for the portfolios sorted on E score quintiles and size quartiles as in the previous analyses. The difference portfolio of the largest size quartile shows a statistically significant positive expected return of 0.268% a month at the 10% level. The difference portfolio constituting the portfolio with the largest firms and highest score increases and the portfolio with the smallest firms and the highest score decreases show no statistically significant difference in expected returns as do the other difference portfolios with the size quartile held constant.

Higher E scores just like the previous cases are related to higher market capitalizations and vice versa, which is supported by the evidence from Table A.3.3 in the Appendix. The difference with the ESG sample arises from the average increase in score change of the top quintile and decile portfolio. The changes in the top quintile and decile portfolio are much higher with average score increases of 240% and 400%. This implies that the E scores of the firms in these portfolios at t-1 were much lower on average. Table A.3.1 also shows monotonically increasing ESG scores in size as was documented in the previous samples. Besides this, the dispersion in ESG scores among the difference portfolios with size quartiles held constant, shows a monotonically declining behavior which culminates in an almost insignificant difference in ESG scores for the largest size quartile.

Table 4.9: Global Average Returns, E scores, Market cap and Score percentage difference of monthly value weighted quintile portfolios formed on yearly score percentage difference from 2010-2019.

	Excess Return (a)	**E-score**	**Market Cap** (c)	**Score % change**
1	0.235%	27.77	9171.90	-23.97%
2	0.310%	53.29	18,892.40	-3.16%
3	0.310%	57.54	20,382.31	2.10%
4	0.292%	47.31	13,152.29	11.92%
5	0.417%	34.84	8704.28	216.63%
5-1	0.182%	7.08*** (b)	-467.62*** (d)	240.60%

Note: * represents significance at the 10% level, ** at the 5% level and *** at the 1% level

a. H0: monthly average excess return = 0 Ha: monthly average excess return ≠ 0

b. H0: monthly difference in average ESG score = 0 Ha: monthly difference in average ESG score ≠ 0

c. Market capitalization is in millions of dollars

d. H0: monthly difference in Market Cap = 0 Ha: monthly difference in Market Cap ≠ 0

Table 4.10 shows the results for the time-series regressions analyses as in the previous sections. The results indicate that after controlling for the 5 factors, a significant positive alpha for the quintile difference portfolio is left which becomes significantly positive after controlling for the risk factors. This is caused by the negative exposures to the profitability and investment factors as these negative exposures do not decrease the alpha but increase the alpha by loading on less risk associated with the opposite of these factors. The market factor for developed and emerging countries seems to offset each other in magnitude.

Table 4.10: Time-Series regressions of the average monthly difference portfolios on the average monthly factors returns from 2010-2019 for E scores globally.

	(1)	(2)	(3) (a)	(4) (b)	(5) (b)	(6) (b)	(7) (b)
Factor Returns (c)	**Quintile Diff**	**Decile Diff**	**Size Diff 54-11**	**Size Diff 51-11**	**Size Diff 52-12**	**Size Diff 53-13**	**Size Diff 54-14**
Mrkt_Rf_D	-.122**	-.165**	-.224**	.013	-.072*	-.03	-.138**
	(**-2.52**)	(**-2.50**)	(**-2.34**)	(.26)	(**-1.70**)	(-.73)	(**-2.07**)
Mrkt_Rf_E	.105**	.069	-.131	.012	.042	-.005	.13**
	(**2.24**)	(1.09)	(-1.42)	(.24)	(1.02)	(-.12)	(**2.02**)
SMB_D	-.101	-.103	-.88***	.097	-.05	.043	-.149
	(-1.22)	(-.91)	(**-5.36**)	(1.09)	(-.69)	(.61)	(-1.30)
SMB_E	-.057	-.056	-.208	.054	.035	-.091	-.078
	(-.77)	(-.55)	(-1.42)	(.69)	(.55)	(-1.44)	(-.77)
HML_D	-.03	-.097	-.423**	-.026	.054	.012	-.048
	(-.35)	(-.83)	(**-2.46**)	(-.28)	(.71)	(.17)	(-.40)
HML_E	-.059	-.019	-.232	.081	-.003	-.06	-.053
	(-.66)	(-.16)	(-1.31)	(.85)	(-.04)	(-.79)	(-.43)
RMW_D	.118	.028	.031	.48***	.253***	.19**	.057
	(1.07)	(.19)	(.14)	(**4.06**)	(**2.63**)	(**2.01**)	(.37)
RMW_E	-.218**	-.101	-.017	.035	-.072	-.156*	-.252*
	(**-2.08**)	(-.71)	(-.08)	(.31)	(-.78)	(**-1.71**)	(**-1.74**)
CMA_D	-.061	-.038	-.048	-.099	-.073	.108	-.102
	(.138)	(-.20)	(-.17)	(-.67)	(-.61)	(.91)	(.54)
CMA_E	-.393***	-.367**	-.536**	-.037	.001	-.177*	-.506***
	(**-.361**)	(-2.49)	(**-2.49**)	(-.32)	(.01)	(**-1.90**)	(**-3.38**)
Alpha	.297%***	.063%	.254%	-.160%	-.019%	.016%	.408%***
	(**2.69**)	(.42)	(1.16)	(-1.35)	(-.20)	(.001)	(**2.68**)
Observations	120	120	120	119	119	119	119
R-squared	.396	.277	.698	.236	.114	.161	.354

Note: * represents significance at the 10% level, ** at the 5% level and *** at the 1% level, T-statistics are in parentheses.

a. Column 3 is the portfolio difference in excess returns between the largest cap firms with the highest percentage score change and the smallest cap firms with the smallest percentage score change.
b. Column 4, 5, 6 and 7 are the portfolio differences in excess returns based on size, keeping size constant. 4 represents the largest firms and 1 the smallest. The score changes quintiles range from quintile 1 with the lowest score decreases to 5 with the highest increases.
c. Factor variables with a "D" in the name imply factor returns for developed countries whereas a "E" imply emerging countries.
d. The regression results of alpha are presented in percentages.

Investing in the quintile difference portfolio yields a positive return accounted for the risk of 0.297% a month.

Interestingly, the difference portfolio with the largest cap stocks yields a significant positive alpha of 0.408% after controlling for the factor exposures. The same applies as in the case of the quintile difference portfolio as taking opposite exposures to the factors increases the alpha. From Table 4.10 it becomes evident that the difference portfolio in column 3 shows the same factor exposures as the same difference portfolios in the ESG samples. The other difference portfolios on size behave differently in terms of their exposure to the risk factors.

The difference portfolio with the smallest cap stocks load heavily positive on the profitability factor for developed countries. The factor exposure of the difference portfolio to this factor decreases in magnitude with size quartiles and becomes insignificant for the large cap difference portfolio. The opposite applies to the profitability factor for emerging countries as the exposure to this factor increases negatively in magnitude with size quartiles. This implies that stocks in the difference portfolio which resemble the firms in the developed countries profitability factor, show exposure to this factor in the lowest size quartile. The portfolio with the highest score increases on average consists more of stocks with robust profitability than the portfolio with the highest score decreases. The opposite applies for the difference portfolios with the larger cap stocks.

In short, there is a profound positive effect of sorting portfolios on E-score changes for large cap firms as this yields a risk-adjusted return of around 0.4% a month. The same applies to the quintile difference portfolio with a risk-adjusted return of around 0.3% a month. These risk-adjusted returns are higher than the raw expected returns as the negative loadings of the factors increase the expected return as less risk associated with the factors is taken by the aforesaid difference portfolios. An investor could profit from a long-short strategy in these two difference portfolios even after controlling for the risk factor exposures. The result for the quintile difference portfolio is slightly undermined by the decile difference portfolio which does not yield any abnormal returns. This is an indication that the difference in expected return for portfolios sorted on E-score changes is not caused by returns in the tails of the E-score change distribution.

4.4. Global ESG score changes & The level of ESG scores

Firstly, the purpose of this section is to investigate whether an increase in ESG scores means the same for the expected returns among different levels of ESG. Secondly, this section investigates whether the highest increases in ESG scores make a difference in stock performance if firms are in the highest ESG quintile compared to the lowest. In short this implies that companies that end

up in the highest ESG quintile after experiencing a large increase in their ESG scores, perform better than stocks which end up in the lowest ESG quintile but also experienced a large increase in ESG scores. It is hypothesized that the largest increases in ESG scores are rewarded more in terms of excess returns for higher levels of ESG compared to low levels.

Table 4.11 shows the results of a double sort on score change quintiles and ESG scores. From Table 4.11 can be concluded that there is no evidence for a difference in expected returns for the first 4 quintiles of score changes. In this case the level of ESG scores with holding the score increase quintiles constant, does not yield significantly positive abnormal returns. The opposite is true for the quintile of interest as the quintile with the highest ESG score increases, yields a statistically positive return for the difference portfolio between high and low ESG scores. This result implies that on average companies with the largest increases in their ESG scores and with the highest levels of ESG outperform companies with the largest increases and lowest level of ESG. The difference portfolio yields 0.475% a month on average. Secondly, Table 4.11 shows that the difference portfolios formed on score change difference among various levels of ESG does not yield any significant abnormal returns different from zero, although the difference portfolios go from negative to positive expected returns when the level of ESG increases.

In Table A.4.1 of the Appendix, the distribution of the market capitalizations among the double sorted portfolios on score changes and ESG score levels is displayed. Table A.4.1 adds to the overwhelming evidence in this thesis that higher ESG scores are associated with larger market capitalizations as the market capitalizations are monotonically increasing in ESG score levels.

Table 4.11: Global monthly average excess returns by percentage score and ESG score quintiles and difference portfolios for the period 2010-2019

	1 low ESG (a)	2 (a)	3 (a)	4 (a)	5 high ESG (a)	**Diff** (c)
1 low change	0.320%	0.096%	0.303%	0.149%	0.363%	0.044%
2	0.350%	0.148%	0.381%	0.398%	0.257%	-0.093%
3	0.568%	0.307%	0.312%	0.237%	0.383%	-0.186%
4	0.348%	0.398%	0.412%	0.547%	0.217%	-0.131%
5 high change	0.173%	0.380%	0.359%	0.250%	0.648%*	0.475%**
Diff (d)	-0.146%	0.283%	0.056%	0.101%	0.285%	0.329% (b)

Note: * represents significance at the 10% level, ** at the 5% level and *** at the 1% level

a. H0: monthly average excess return = 0 Ha: monthly average excess return ≠ 0
b. Monthly average excess return difference portfolio, portfolio 55 minus 11: H0: monthly average excess return = 0 Ha: monthly average excess return ≠ 0 is 0.329% with p-value of 0.14.
c. Monthly value weighted difference portfolios on ESG score, keeping score change constant.
d. Monthly value weighted difference portfolios on score change, keeping ESG score constant.

Secondly, Table A.4.1 shows somewhat mixing results for the difference portfolios when ESG levels are held constant as the first three portfolios have a minor difference in market capitalizations. The portfolios with the two highest levels of ESG show much more discrepancy in market capitalizations as the difference between the lowest score increases and highest score increases becomes significantly negative, implying that companies with the lowest score changes have higher market capitalizations than the highest score changes for the highest levels of ESG score quintile.

Table 4.12 shows the time-series regressions of the excess returns of the difference portfolios on the factor returns.

Table 4.12: Time-Series regressions of the average monthly difference portfolios with score change constant on the average monthly factors returns from 2010-2019 globally.

Factor Returns (c)	(1) (a) **ESG Diff 55-11**	(2) (b) **ESG Diff 15-11**	(3) (b) **ESG Diff 25-21**	(4) (b) **ESG Diff 35-31**	(5) (b) **ESG Diff 45-41**	(6) (b) **ESG Diff 55-51**
Mrkt_Rf_D	.142	.209**	.234**	.22**	.25**	.165*
	(1.39)	(**2.08**)	(**2.52**)	(**2.14**)	(**2.50**)	(**1.78**)
Mrkt_Rf_E	-.179*	-.179*	-.284***	-.27***	-.306***	-.16*
	(**-1.81**)	(**-1.85**)	(**-3.16**)	(**-2.72**)	(**-3.17**)	(**-1.79**)
SMB_D	-.464***	-.495***	-.291*	-.488***	-.136	-.452***
	(**-2.65**)	(**-2.88**)	(**-1.83**)	(**-2.77**)	(.79)	(**-2.85**)
SMB_E	.08	.385**	.257*	-.098	.043	-.019
	(.51)	(**2.52**)	(**1.81**)	(-.62)	(.28)	(-.13)
HML_D	-.042	.326*	-.027	.403**	.28	-.052
	(-.23)	(**1.81**)	(-.16)	(**2.19**)	(1.56)	(-.31)
HML_E	.326*	.054	.419**	.334*	-.079	.232
	(1.73)	(.29)	(**2.45**)	(**1.77**)	(-.43)	(1.36)
RMW_D	.295	.627***	.301	.262	.15	-.079
	(1.26)	(**2.74**)	(1.42)	(1.12)	(.66)	(-.37)
RMW_E	-.134	.225	.07	.363	.101	-.003
	(-.60)	(1.03)	(.35)	(1.63)	(.46)	(-.02)
CMA_D	-.081	.228	.578**	.032	.132	.052
	(-.28)	(.80)	(**2.18**)	(.11)	(.46)	(.20)
CMA_E	-.257	.25	-.266	.007	-.158	-.264
	(-1.12)	(1.11)	(-1.27)	(.03)	(-.70)	(-1.27)
Alpha	.141%	-.248%	-.296%	-.375%	-.144%	.364%*
	(.60)	(-1.08)	(-1.39)	(-1.60)	(-.63)	(**1.72**)
Observations	119	120	120	120	120	120
R-squared	.197	.398	.326	.364	.204	.141

Note: * represents significance at the 10% level, ** at the 5% level and *** at the 1% level, T-statistics are in parentheses.

a. Column 1 is the portfolio difference in excess returns between high ESG score firms with the highest percentage score change and low ESG firms with the smallest percentage score change.
b. Column 2, 3, 4, 5, 6 are the portfolio differences in excess returns based on ESG, keeping percentage score change constant. 5 represents the highest ESG firms and 1 the smallest. This accounts for all columns, only the percentage score quintiles change between the columns as 1 indicates the lowest percentage score change quintile and 5 the highest.
c. Factor variables with a "D" in the name imply factor returns for developed countries whereas a "E" imply emerging countries.
d. The regression results of alpha are presented in percentages.

The most striking result from Table 4.12 is that the significantly positive difference in returns between the highest level of ESG and lowest level ESG for the quintile with the highest score increase, is not explained by any of the factors. The factor exposure to the market factor of the developed and emerging countries offset each other and after accounting for the other 4 factors the expected return of the difference portfolio is around 0.364% a month.

The negative loadings of the difference portfolio on the size factor for developed countries is in accordance with the results that higher ESG scores are associated with larger firm sizes. Positive exposures to the value factor of developed countries, indicate that firms with higher ESG scores are on average more related to firms with higher book-to-market ratios for portfolios which experienced with modest increases or decreases on average, documented by columns 2 and 4.

Table 4.13 shows the time-series regressions of the difference portfolios on ESG score changes with ESG levels held constant on the factor returns. The difference portfolio with the lowest level of ESG loads significantly positive on the profitability factor for developed countries. This loading implies that the difference in returns between the top and bottom portfolio is largely explained by companies that resemble stocks in the developed countries' factor as companies with the highest score change is on average more exposed to the profitability factor than the lowest score changes firms.

The middle difference portfolio shows two opposing factor loadings in the sense that the developed and emerging factor returns for the value and investment offset each other. The last difference portfolio which contains the top and bottom portfolio based on score change with the highest levels of ESG scores, shows all negative exposures to the size, value and investment factors. The difference in portfolio returns is explained by the top portfolio having more exposure to large firms which are comparable to the firms in the size factor of developed countries, to growth stocks and to aggressively investing firms that are comparable with firms in the emerging factor returns. The 5 factors explain all the variation in the stock returns on the difference portfolio as none of the portfolios yields a statistically significant positive alpha.

In short, these results confirm the hypothesis that large increases in ESG scores mean more in terms of excess returns for firms with higher levels of ESG than low levels of ESG. Investors can exploit the difference in expected return by tilting their portfolios more to firms with high levels of ESG after they have experienced a large upgrade in their ESG score.

Table 4.13: Time-Series regressions of the average monthly difference portfolios with ESG level constant on the average monthly factors returns from 2010-2019 globally.

	(1) (a)	(2) (b)	(3) (b)	(4) (b)	(5) (b)	(6) (b)
Factor Returns (c)	**ESG Diff 55-11**	**ESG Diff 51-11**	**ESG Diff 52-12**	**ESG Diff 53-13**	**ESG Diff 54-14**	**ESG Diff 55-15**
Mrkt_Rf_D	.142	-.023	.102	-.099	.073	-.067
	(1.39)	(-.31)	(1.07)	(-1.40)	(.69)	(-.60)
Mrkt_Rf_E	-.179*	-.018	-.015	-.026	.035	0
	(**-1.81**)	(-.25)	(-.17)	(-.38)	(.34)	(.00)
SMB_D	-.464***	-.012	.163	-.078	.104	.03
	(**-2.65**)	(-.10)	(1.00)	(-.65)	(.57)	(.16)
SMB_E	.08	.098	.016	.002	-.046	-.306*
	(.51)	(.86)	(.11)	(.02)	(-.29)	(**-1.78**)
HML_D	-.042	.009	-.356**	-.34***	-.191	-.369*
	(-.23)	(.07)	(**-2.09**)	(**-2.69**)	(-1.00)	(**-1.83**)
HML_E	.326*	.094	-.052	.396***	-.068	.272
	(1.73)	(.68)	(-.30)	(**3.05**)	(-.35)	(1.32)
RMW_D	.295	.374**	-.26	-.143	.084	-.332
	(1.26)	(**2.18**)	(-1.20)	(-.89)	(.35)	(-1.29)
RMW_E	-.134	-.131	.026	.048	-.437*	-.359
	(-.60)	(-.80)	(.13)	(.31)	(**-1.90**)	(-1.47)
CMA_D	-.081	-.133	.162	.54***	.302	-.309
	(-.28)	(-.62)	(.60)	(**2.68**)	(1.00)	(-.96)
CMA_E	-.257	.007	.627***	-.567***	-.446*	-.508**
	(-1.12)	(.04)	(**2.94**)	(**-3.58**)	(**-1.87**)	(**-2.01**)
Alpha	.141%	-.223%	.123%	.129%	.139%	.389%
	(.60)	(-1.30)	(.56)	(.80)	(.57)	(1.54)
Observations	119	119	119	119	119	119
R-squared	.197	.107	.154	.232	.156	.251

Note: * represents significance at the 10% level, ** at the 5% level and *** at the 1% level, T-statistics are in parentheses.

a. Column 1 is the portfolio difference in excess returns between high ESG score firms with the highest percentage score change and low ESG firms with the smallest percentage score change.
b. Column 2, 3, 4, 5, 6 are the portfolio differences in excess returns based on score change, keeping ESG level constant. 5 represents the highest score change firms and 1 the lowest, whereas the second number represents the ESG level. 5 represents the highest ESG level and 1 the lowest. ESG score change quintiles differ as ESG level is kept constant.
c. Factor variables with a "D" in the name imply factor returns for developed countries whereas a "E" imply emerging countries.
d. The regression results of alpha are presented in percentages.

5. Discussion

This thesis examines the portfolio performance of firms that are sorted on their ESG and E percentage score changes and whether there is an abnormal return to be made on sorting stocks on their change in score by forming a long-short portfolio on the highest score change minus the lowest score change. It is hypothesized that the highest increases in ESG and E scores culminate in higher excess returns compared to the highest decreases, following the announcement of these new scores. Long-short portfolios are formed on size quartiles to examine any relationship between size and score changes.

This thesis finds that there are risk-adjusted returns for large cap stocks which experienced the largest increases in E-scores compared to the largest decreases globally as the abnormal return amounts to 0.408% a month. The same accounts for stocks formed on E-score change quintiles as the long-short portfolio yields a risk-adjusted return of 0.297% a month. This abnormal return is not robust to sorting on deciles which implies that the abnormal return does not manifest itself in the top and bottom deciles of score change. This thesis found no evidence for the existence of any abnormal returns in the global sample of ESG score changes. The Fama & French factors control for all the variation in expected returns which leave insignificant alphas for all the difference portfolios.

On the regional level, the monthly value weighted returns show a different picture. It is hypothesized that European firms yield higher abnormal returns than the other regions when portfolios are formed on the difference in ESG score change with the top portfolio consisting of stocks with the largest increase in score and the bottom with the largest decreases. Interestingly, the Asia & Pacific sample showed a significant alpha for the quintile difference portfolio of 0.291% a month as does the difference portfolio for the large cap stocks with an alpha of 0.381% a month. This implies that stocks with the largest increases in ESG scores outperform the ones with the largest decreases but that this outperformance is greater for large cap stocks. The difference in expected returns for the decile difference portfolio was significantly positive but after risk-adjustment largely explained by exposure to the Japanese profitability factor which implies that stocks in the top decile portfolio were on average firms with more robust profitability than the bottom portfolio. This also meant that the stocks in this difference portfolio were more related to companies in the Japanese profitability factor.

Abnormal returns were not present in the European and North-American sample as none of the difference portfolios yields a significant risk-adjusted return that is not explained for by the 5 factors. The relationship between score changes and expected return is more likely to be negative than positive for these samples. The findings suggest that European stocks do not outperform

stocks from other regions when stocks experienced the largest increases in ESG score compared to the lowest decreases. This thesis finds an indication for the existence of an anomaly based on the risk-adjusted return of the Asia & Pacific sample as the difference in expected return between the largest increases and decreases is not priced by the Fama & French factors.

Lastly, this thesis finds abnormal returns for stocks with the highest level of ESG compared to the lowest level ESG after they experienced an increase in their ESG scores among the highest in the global dataset, the risk-adjusted return on this portfolio amounted to 0.389% a month on average. The results suggest that there is no abnormal return for stocks with the highest increases in ESG scores compared to highest decreases among different levels of ESG.

There is undeniable evidence in all the results that market capitalization is positively associated with ESG scores and vice versa. This comes forth in every sample and is robust to different sorting techniques.

From the results another interesting finding comes forward as the Global, European and North-American ESG samples and the Global E sample showed that more modest increases and decreases show significant differences in expected returns. This was done by not taking the difference between the top and bottom decile portfolios but of the 9th and 2nd deciles. For Europe, this was done by subtracting the expected returns of the 3rd decile portfolio from the 8th decile portfolio. This gives rise to the question whether the top and bottom portfolios of scores changes are an appropriate measure for assessing a score change effect in excess returns or that one should employ a slightly different methodology. In following research, it is interesting to investigate this finding even more. This gives rise to new research questions about the behavior of percentage score changes in ESG and E. It may that different methodologies yield different results.

One of the limitations regarding the data on ESG, is the methodology of scoring that is used among the different vendors. Refinitiv Eikon, the vendor that is used in this thesis, updates ESG scores with time lag and infrequently in time. It is therefore hard to pinpoint the exact time of publication for the different companies. Besides this flaw, the ESG scores get updated in retrospect according to new scoring methodologies which essentially means that the scores differ from the scores that investors faced in 2012.

The second limitation is that the vendors have different methodologies which can lead to different scores among the vendors. Investors might use ESG metrics from other vendors more actively which can lead to differences in percentage score changes and in this way affect the results of this thesis.

Thirdly, the timing of investing on ESG score changes might be playing an enormous role in the portfolio performance in this thesis. For example, when institutional investors are able to

access new ESG data earlier or approximate new scores themselves. This can lead to price movements earlier than the publication of scores by Refinitiv Eikon and so any price movement may have already been taken place. For these aforesaid reasons, new research should be focused on collecting data on score changes without time lag which are as up-to-date as possible. Besides this, any price movements before or just after ESG updates should be investigated thoroughly to see how markets react to these changes for different regions as Shanaev & Ghimire (2022) have done this research for only the U.S. market.

Appendix

Table A.1.1: Global monthly average excess returns, ESG scores, Market cap and Score percentage difference of value weighted decile portfolios formed on yearly percentage score difference from 2010-2019.

	Excess Return (a)	**ESG-score**	**Market Cap** (c)	**Score % change**
1	0.33%	25.33	6483.85	-23.23%
2	0.16%	39.84	10,737.67	-9.55%
3	0.30%	47.91	15,330.62	-4.85%
4	0.32%	52.26	17,665.23	-1.67%
5	0.24%	53.64	17,638.97	1.21%
6	0.46%	52.15	15,489.96	4.43%
7	0.27%	48.50	13,131.39	8.56%
8	0.47%	45.18	11,172.08	14.57%
9	0.49%	41.15	8442.77	25.37%
10	0.24%	34.99	7316.30	90.67%
10-1	-0.09%	9.66*** (b)	832.45*** (d)	113.90%

Note: * represents significance at the 10% level, ** at the 5% level and *** at the 1% level

a. H0: monthly average excess return = 0 Ha: monthly average excess return ≠ 0
b. H0: monthly difference in average ESG score = 0 Ha: monthly difference in average ESG score ≠ 0
c. Market capitalization is in millions of dollars
d. H0: monthly difference in Market Cap = 0 Ha: monthly difference in Market Cap ≠ 0

Table A.1.2: Global Average Returns of monthly value weighted quintile portfolios formed on yearly percentage score difference and size quartiles from 2010-2019.

	1 (a)	**2** (a)	**3** (a)	**4** (a)
1	0.514% (b)	0.346%	0.203%	0.224%
2	0.495%	0.435%	0.305%	0.305%
3	0.532%	0.323%	0.317%	0.349%
4	0.502%	0.359%	0.295%	0.384%
5	0.506%	0.291%	0.198%	0.419% (b)
Diff	-0.008%	-0.055%	-0.005%	0.195%

Note: * represents significance at the 10% level, ** at the 5% level and *** at the 1% level

a. H0: Average excess returns = 0 Ha: Average excess returns ≠ 0.
b. Average excess return difference portfolio, portfolio 45 minus 11: H0: Average excess return = 0 Ha: Average excess return ≠ 0 is -0.10% which does not differ from 0.
c. Monthly difference portfolios on score change and size held constant where 1 represents the smallest firms and 4 the largest. The differences feature in Table 4.2.

Table A.1.3: Global average ESG scores of monthly value weighted quartile portfolios formed on size and quintile portfolios on score percentage difference from 2010-2019.

	1	**2**	**3**	**4**
1	25.35 (a)	30.88	35.17	44.72
2	37.42	43.28	50.41	62.50
3	39.00	45.65	53.19	65.74
4	36.03	42.84	48.47	59.38
5	31.84	36.85	41.01	46.38 (a)
Diff	6.50***	5.98***	5.85***	1.65**

Note:

a. Monthly ESG score difference portfolio, portfolio 54 minus 11: H0: Average ESG score difference = 0 Ha: Average ESG score difference ≠ 0 is 21.03***

b. Monthly average ESG score difference portfolio, portfolio 54 minus 14 is only portfolio with no significant difference different from 0.

c. Monthly difference portfolios on size with percentage score change held constant where 1 represents the smallest firms and 4 the largest.

Table A.2.1: European monthly average excess returns, ESG scores, Market cap and Score percentage difference of value weighted decile portfolios formed on yearly percentage score difference from 2010-2019.

	Excess Return (a)	**ESG-score**	**Market Cap** (c)	**Score % change**
1	0.209%	35.66	5450.86	-19.61%
2	0.116%	50.76	10,614.05	-7.51%
3	-0.005%	57.59	15,517.18	-3.87%
4	0.168%	61.04	19,143.46	-1.16%
5	0.130%	62.03	19,673.34	1.32%
6	0.180%	60.78	15,564.38	4.04%
7	0.224%	57.17	11,317.56	7.42%
8	0.196%	54.00	10,197.90	12.26%
9	0.167%	48.85	7260.55	20.56%
10	0.047%	41.22	4785.39	77.26%
10-1	-0.163%	5.56*** (b)	-665.48*** (d)	96.86%

Note: * represents significance at the 10% level, ** at the 5% level and *** at the 1% level

a. H0: monthly average excess return = 0 Ha: monthly average excess return ≠ 0

b. H0: monthly difference in average ESG score = 0 Ha: monthly difference in average ESG score ≠ 0

c. Market capitalization is in millions of dollars

d. H0: monthly difference in Market Cap = 0 Ha: monthly difference in Market Cap ≠ 0

Table A.2.2: European average returns of monthly value weighted quintile portfolios formed on yearly percentage score difference and size quartiles from 2010-2019.

	1 (a)	**2** (a)	**3** (a)	**4** (a)
1	0.431% (b)	0.311%	0.195%	0.059%
2	0.542%	0.364%	0.346%	0.054%
3	0.339%	0.198%	0.382%	0.131%
4	0.345%	0.168%	0.344%	0.177%
5	0.293%	0.301%	0.173%	0.064% (b)
Diff	-0.138%	-0.011%	-0.022%	0.005%

Note: * represents significance at the 10% level, ** at the 5% level and *** at the 1% level

a. H0: Average excess returns = 0 Ha: Average excess returns ≠ 0.
b. Monthly average excess return difference portfolio, portfolio 54 minus 11: H0: monthly average excess return = 0 Ha: monthly average excess return ≠ 0 is -0.367% which does not differ from 0.
c. Monthly difference portfolios on size with percentage score change held constant where 1 represents the smallest firms and 4 the largest. The differences feature in Table 4.4.

Table A.2.3: European average ESG scores of monthly value weighted quartile portfolios formed on size and quintile portfolios on score percentage difference from 2010-2019.

	1	**2**	**3**	**4**
1	34.37 (a)	41.03	47.00	57.43
2	46.51	51.15	58.87	71.01
3	46.98	53.82	60.56	73.24
4	45.19	51.41	57.10	68.67
5	39.61	43.29	49.10	55.72 (a)
Diff	5.24***	2.25***	2.10***	-1.72***

Note:

a. Monthly ESG score difference portfolio, portfolio 54 minus 11: H0: Average ESG score difference = 0 Ha: Average ESG score difference ≠ 0 is 21.34***
b. Monthly difference portfolios on size with percentage score change held constant where 1 represents the smallest firms and 4 the largest.

Table A.2.4: North-American monthly average excess returns, ESG scores, Market cap and Score percentage difference of value weighted decile portfolios formed on yearly percentage score difference from 2010-2019.

	Excess Return (a)	**ESG-score**	**Market Cap** (c)	**Score % change**
1	0.692%*	26.79	9120.62	-22.40%
2	0.467%	37.64	13,845.35	-9.94%
3	0.594%*	44.71	21,939.69	-5.05%
4	0.530%	48.95	25,871.27	-1.77%
5	0.491%	49.59	22,792.80	1.34%
6	0.754%**	47.88	20,627.89	4.65%
7	0.509%	46.13	18,719.59	8.90%
8	0.940%**	42.43	16,122.51	15.15%
9	0.865%**	39.45	10,677.26	26.11%
10	0.387%	35.60	8858.40	86.06%
10-1	-0.305%**	8.81*** (b)	-262.229 (d)	108.46%

Note: * represents significance at the 10% level, ** at the 5% level and *** at the 1% level

a. H0: monthly average excess return = 0 Ha: monthly average excess return ≠ 0
b. H0: monthly difference in average ESG score = 0 Ha: monthly difference in average ESG score ≠ 0
c. Market capitalization is in millions of dollars
d. H0: monthly difference in Market Cap = 0 Ha: monthly difference in Market Cap ≠ 0

Table A.2.5: North-American average returns of monthly value weighted quintile portfolios formed on yearly percentage score difference and size quartiles from 2010-2019.

	1 (a)	**2** (a)	**3** (a)	**4** (a)
1	0.688% (b)	0.734%	0.569%	0.536%
2	0.791%	0.636%	0.533%	0.559%*
3	0.521%	0.682%	0.562%	0.671%**
4	0.833%	0.565%	0.584%	0.765%**
5	0.682%	0.536%	0.441%	0.739%* (b)
Diff	-0.006%	-0.199%	-0.127%	0.203%

Note: * represents significance at the 10% level, ** at the 5% level and *** at the 1% level

a. H0: Average excess returns = 0 Ha: Average excess returns ≠ 0.
b. Monthly average excess return difference portfolio, portfolio 54 minus 11: H0: monthly average excess return = 0 Ha: monthly average excess return ≠ 0 is 0.051% which does not differ from 0.
c. Monthly difference portfolios on size with percentage score change held constant where 1 represents the smallest firms and 4 the largest. The differences feature in Table 4.6.

Table A.2.6: North-American average ESG scores of monthly value weighted quartile portfolios formed on size and quintile portfolios on score percentage difference from 2010-2019.

	1	**2**	**3**	**4**
1	25.34 (a)	29.25	34.17	46.14
2	33.99	38.55	46.16	60.85
3	35.10	39.23	48.62	64.25
4	33.32	38.38	46.26	57.96
5	31.14	35.34	40.16	48.33 (a)
Diff	5.80***	6.09***	5.98***	2.20***

Note:

a. Monthly ESG score difference portfolio, portfolio 54 minus 11: H0: Average ESG score difference = 0 Ha: Average ESG score difference ≠ 0 is 22.99***

b. Monthly difference portfolios on size with percentage score change held constant where 1 represents the smallest firms and 4 the largest.

Table A.2.7: Asia & Pacific monthly average excess returns, ESG scores, Market cap and Score percentage difference of value weighted decile portfolios formed on yearly percentage score difference from 2010-2019.

	Excess Return (a)	**ESG-score**	**Market Cap** (c)	**Score % change**
1	-0.165%	21.20	6333.80	-24.70%
2	0.009%	36.44	8751.92	-10.13%
3	0.110%	44.77	11,013.85	-5.17%
4	0.235%	49.24	12,688.14	-1.79%
5	0.113%	51.32	12,323.01	1.18%
6	0.166%	49.38	10,995.88	4.62%
7	0.097%	45.42	10,430.88	9.10%
8	0.239%	42.89	9051.64	15.67%
9	0.164%	38.65	7866.99	27.69%
10	0.315%	32.52	7014.49	95.27%
10-1	0.480%**	11.32*** (b)	680.70*** (d)	119.98%

Note: * represents significance at the 10% level, ** at the 5% level and *** at the 1% level

a. H0: monthly average excess return = 0 Ha: monthly average excess return ≠ 0

b. H0: monthly difference in average ESG score = 0 Ha: monthly difference in average ESG score ≠ 0

c. Market capitalization is in millions of dollars

d. H0: monthly difference in Market Cap = 0 Ha: monthly difference in Market Cap ≠ 0

Table A.2.8: Asia & Pacific average returns of monthly value weighted quintile portfolios formed on yearly percentage score difference and size quartiles from 2010-2019.

	1 (a)	**2** (a)	**3** (a)	**4** (a)
1	0.372% (b)	0.239%	-0.045%	-0.190%
2	0.228%	0.363%	0.208%	0.149%
3	0.542%	0.204%	0.156%	0.114%
4	0.430%	0.133%	0.128%	0.147%
5	0.352%	0.192%	0.070%	0.252% (b)
Diff	-0.020%	-0.047%	0.116%	0.443%**

Note: * represents significance at the 10% level, ** at the 5% level and *** at the 1% level

a. H0: Average excess returns = 0 Ha: Average excess returns ≠ 0.
b. Monthly average excess return difference portfolio, portfolio 54 minus 11: H0: monthly average excess return = 0 Ha: monthly average excess return ≠ 0 is -0.120% which does not differ from 0.
c. Monthly difference portfolios on size with percentage score change held constant where 1 represents the smallest firms and 4 the largest. The differences feature in Table 4.8.

Table A.2.9: Asia & Pacific average ESG scores of monthly value weighted quartile portfolios formed on size and quintile portfolios on score percentage difference from 2010-2019.

	1	**2**	**3**	**4**
1	22.01 (a)	28.02	31.32	38.43
2	34.00	42.53	48.70	57.91
3	36.63	45.20	51.95	61.34
4	33.56	41.63	45.04	55.86
5	29.24	34.51	38.75	41.84 (a)
Diff	7.23***	6.49***	7.44***	3.41***

Note:

a. Monthly ESG score difference portfolio, portfolio 54 minus 11: H0: Average ESG score difference = 0 Ha: Average ESG score difference ≠ 0 is 19.83***
b. Monthly difference portfolios on size with percentage score change held constant where 1 represents the smallest firms and 4 the largest.

Table A.3.1: Global monthly average excess returns, E scores, Market cap and Score percentage difference of value weighted decile portfolios formed on yearly percentage score difference from 2010-2019.

	Excess Return (a)	**E-score**	**Market Cap** (c)	**Score % change**
1	0.398%	17.86	6850.95	-37.31%
2	0.147%	37.72	11,500.22	-10.57%
3	0.203%	47.67	14,370.18	-4.69%
4	0.365%	58.92	23,418.02	-1.63%
5	0.216%	59.25	21,686.75	0.71%
6	0.414%	55.84	19,096.36	3.50%
7	0.282%	49.71	14,442.61	7.82%
8	0.300%	44.92	11,861.82	16.03%
9	0.462%	39.07	9269.56	37.03%
10	0.315%	30.62	8135.97	396.68%
10-1	-0.083%	12.76*** (b)	1285.02*** (d)	433.99%

Note: * represents significance at the 10% level, ** at the 5% level and *** at the 1% level

a. H0: monthly average excess return = 0 Ha: monthly average excess return ≠ 0
b. H0: monthly difference in average E score = 0 Ha: monthly difference in average E score ≠ 0
c. Market capitalization is in millions of dollars
d. H0: monthly difference in Market Cap = 0 Ha: monthly difference in Market Cap ≠ 0

Table A.3.2: Global Average Returns of monthly value weighted quintile portfolios formed on yearly E percentage score difference and size quartiles from 2010-2019.

	1 (a)	2 (a)	3 (a)	4 (a)
1	0.479% (b)	0.282%	0.252%	0.237%
2	0.478%	0.405%	0.236%	0.315%
3	0.632%	0.344%	0.265%	0.315%
4	0.373%	0.268%	0.184%	0.320%
5	0.498%	0.264%	0.191%	0.506% (b)
Diff	0.018%	-0.018%	-0.061%	0.268%*

Note: * represents significance at the 10% level, ** at the 5% level and *** at the 1% level

a. H0: Average excess returns = 0 Ha: Average excess returns ≠ 0.
b. Monthly average excess return difference portfolio, portfolio 54 minus 11: H0: monthly average excess return = 0 Ha: monthly average excess return ≠ 0 is 0.027% which does not differ from 0.
c. Monthly difference portfolios on size with percentage score change held constant where 1 represents the smallest firms and 4 the largest. The differences feature in Table 4.10.

Table A.3.3: Global average E scores of monthly value weighted quartile portfolios formed on size and quintile portfolios on score percentage difference from 2010-2019.

	1	**2**	**3**	**4** (b)
1	20.39 (a)	25.73	30.65	41.93
2	38.60	46.69	54.93	65.86
3	42.36	51.41	57.94	69.16
4	36.87	42.51	50.15	59.26
5	29.00	33.52	37.25	43.04 (a)
Diff	8.60***	7.80***	6.60***	1.11*

Note:

a. Monthly E score difference portfolio, portfolio 54 minus 11: H0: Average E score difference = 0 Ha: Average E score difference ≠ 0 is 22.65***

b. Average E score difference portfolio, portfolio 45 minus 41 is only portfolio with no significant difference different from 0.

c. Monthly difference portfolios on size with percentage score change held constant where 1 represents the smallest firms and 4 the largest.

Table A.4.1: Global monthly average market capitalizations by percentage score and ESG score quintiles for the period 2010-2019.

	1 low ESG (a)	2 (a)	3 (a)	4 (a)	5 high ESG (a)	**Diff** (c)
1 low change	4166.90	6177.50	9027.89	16,010.44	28,741.47	24,574.57***
2	4921.25	6234.62	8605.76	13,744.80	34,263.62	29,342.37***
3	4355.66	5503.37	8110.04	12,682.37	31,942.50	27,586.84***
4	4130.98	5305.26	8570.32	13,182.38	25,894.32	21,763.34***
5 high change	4371.69	5501.57	8481.41	10,705.01	18,353.65	13,981.95***
Diff (d)	204.79**	-675.93***	-546.48*	-5305.43***	-10,387.83***	14,186.75***(b)

Note:

a. Market capitalizations are in millions of dollars.

b. The difference portfolio represents the portfolio that consists of the portfolio with the highest ESG score change and highest ESG score compared to the lowest change and lowest score. This implies portfolio 55 – portfolio 11.

c. Difference portfolios of ESG scores keeping score change quintiles constant. So, the difference between ESG levels for different score change quintiles.

d. Difference portfolios of ESG score changes keeping ESG quintiles constant. So, the difference between ESG score changes for different levels of ESG scores.

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