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Can investment strategies with ESG integration explain enhanced financial performance?

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## **Abstract**

There has been a remarkable growth in the alternative investment segment “responsible investing”. Responsible investing can sometimes be described by the acronym ESG, Environmental, Social, and Governance. In spite of the humongous amounts of money invested, research on ESG is still in the nascent stages, currently with equivocal results. This thesis' objective is to utilize traditional asset pricing models to uncover the effect of ESG integration on financial performance. Our results in regards to the risk-adjusted return are statistically weak. We find, however, that ESG is inherently multi-factor, meaning that using ESG scores as investment criteria result in a tilt on style and industry.

## 1.0 Introduction

“Can investment strategies with ESG integration explain enhanced financial performance?” The last decades have been characterized by an increase in non-financial focus on companies, stressing the importance of being sustainable. In an attempt to measure firms' sustainability level, ESG scores have become a central tool. ESG is an acronym for environmental, social and governance, which are factors that are defined to constitute sustainability (UN PRI, 2018). In practice, hundreds of subfactors are measured which in aggregate gives a quantifiable score for relative comparison to other companies. Providers of financial data, such as Bloomberg and Thomson Reuters, now report ESG data for all companies, allowing investors to use comparable scores in their investment decisions.

The broad coverage of ESG puts pressure on companies' reporting and incentivize a focus on "board diversity", "water usage" etc. Furthermore, the media has eagerly covered scandals and controversies related to violation of ESG standards, amplifying the already loud public voice. In response, more companies have started to gauge and report ESG data publicly, despite the extra costs related to compliance and the pursuit of ESG performance. More organizations are signing the UN-supported Principle for Responsible Investment pledge, which means that ESG is taken into consideration by more institutional investors (UN PRI, 2018).

As the market for ESG investing is still developing and rapidly growing, the importance of finding potentially undiscovered anomalies is crucial. Further, few seem to question the presumed truth that high ESG scores equal sustainability, which is a statement that not necessarily is true. We are still in the early stages of ESG integration, and research papers have yet to reach a consensus regarding its financial performance and impact on sustainability.

We examine the impact ESG exposure has on financial performance, measured by risk-adjusted excess return. As previous research papers' findings vary, we will

elaborate more on each side's arguments, and with our own conclusion plausibly provide some insight into the discussion.

So, can investment strategies with ESG integration enhance financial performance? If the case, the investment strategy is thought to beat the market even within traditional financial measures. Typically, the supporters of this view believe that the use of ESG criteria helps identify investment opportunities that will outperform the market in the long-term (Capland et al., 2013). An argument is that the screening process excludes companies in possession of certain risks which will make them future non-performers. Another explanation points to the possibility that investors generally underestimate the value of being sustainable, effectively underpricing the companies.

The critique of ESG investing has its roots in modern portfolio theory which emphasizes the lost diversification effect screening and smart beta strategies have in general (Markowitz, 1952). Namely, that a focus on a limited number of stocks or factors will effectively constrain the investment opportunity, leading to a lower diversification, thereby hampering the risk-adjusted return. In practice, the argument means that the cost of being a sustainable company exceeds the benefits of “doing good”, resulting in weakened results for the investors.

There is also the possibility that ESG has no effect on financial performance. This scenario may have various possible explanations, consisting of a combination of the abovementioned arguments. For instance, the cost and benefit for a company to focus on sustainability may be exactly the same. Alternatively, statistical inference can show to be invalid to draw a conclusion one way or the other, typically as a result of negligible differences in the results.

Lastly, we examine if there are other unintended consequences of integrating ESG into investment decisions. One possibility is that ESG scores are correlated with other factors and industries, which may distort its true effect on financial performance. Furthermore, inheriting such properties would potentially skew one's portfolio in undesirable directions, hampering the overall diversification.

## ***1.1 ESG***

We are observing a trend where responsible investments increase in popularity among investors. With a growth of 32.7% in the US, between 2014 and 2016 (GSIA,2016). The consumers seem more socially aware of the firms they are involved with, where their concerns now exceed the traditional focus on investment return. Topics such as carbon footprint, labor working rights, gender equality, etc., have received lots of attention in the media. As a result, investors have adopted an alternative investment approach where ESG is reflected upon and taken into consideration.

The emerging perspective many investors have gained is often referred to as responsible investment. The United Nations Principles for Responsible investing defines responsible investment as: *“Responsible investment is an approach to investing that aims to incorporate environmental, social and governance (ESG) factors into investment decisions, to better manage risk and generate sustainable, long-term returns..”* (UN PRI,2018). The vast popularity and the fast growth of this segment, influence a large number of investors to alter their portfolio construction. We now find numerous mutual funds, rating agencies, and different sustainability indexes. For example, Morningstar sustainability rating and MSCI ESG indexes. By the increase in popularity, so has its complexity. The multitude of intertwined terms and their frequent misuse complexify the investment space. This itself result in a need for clarification, to grasp and structuralize a sufficient strategy.

The acronym ESG is divided into its respective components, where the environmental, social and governance exposures are measured and categorized for companies (UN PRI, 2018). For our thesis, we decided to use the ESG scores provided by Thomson Reuters. The ESG score is based on 400+ ESG measures, and the categorization is shown in figure 1. The selection of the provider is further discussed in Appendix 1.

Figure 1 – Thomson Reuters ESG Categorization (Thomson Reuters, 2018)



ESG investing involves integrating the three factors into the fundamental investment analysis, to enhance investment performance. In contrast to traditional investment options, ESG investment aims to improve financial performance by taking sustainability into account (Capland et al., 2013). The investors and organizations can apply the ESG factors with ESG integration through a screening of their portfolio. Based on their investment profile they can set thresholds, or limits, regarding the stocks they include. Most common methods applied is ESG exclusion, ESG tilt, and ESG momentum (Nagy et al., 2012). Particularly, a screening of undesirable companies to exclude from investors portfolio has become commonplace (GSIA,2016). Moreover, this enables the investors to potentially avoid risky stocks by excluding the firms with lower ESG scores. For example, by excluding a company with a low score on environmental emissions, the investor can avoid the future risk of a carbon tax or consumer boycott. The main critique of responsible investments is that the investor is giving up higher returns, in favor of maintaining a so-called sustainable investment profile. Mainly two substantial disadvantages have been stressed. First, the lack of diversification by removing stocks from the portfolio, consequently creating negative effects on the risk-adjusted returns. Second, the approach is generating higher costs by being more time-consuming and may affect the returns negatively



(Tharpe, 2017). In addition, the ESG skeptics point to the reporting of ESG, and how this affects scoring differently. Today there is no standardization in the reporting of ESG data and the rating agencies use different methodologies to set an ESG score. The skeptics question the validity of these scores, as they can appear arbitrary in some cases. (Capland et al., 2013). To illustrate this, a scatter plot made by the Japanese pension fund shows the low correlation between ESG scores given by two prominent rating agencies (Appendix 4).

Another aspect of ESG reporting is companies' probity in regards to sustainability. Some firms may have an extensive focus on receiving high scores from ESG rating agencies, rather than truly improving what the parameters should reflect. Ultimately, investors with intentions to fundamentally improve ESG may end up investing in good reporters instead. To answer this further research on ESG investing and its actual effect on sustainability is needed.

### ***1.2 Previous research***

The results from previous studies on the relationship between ESG scores and stock performance differ. A profound meta-study conducted by Clark, Feiner, and Viehs (2014) reviews 41 studies on the relationship between sustainability and financial market performance. The findings show a positive correlation between good sustainability and superior financial market performance for as many as 80% of the papers. Kempf and Osthoff (2007) construct portfolios based on companies' sustainability score, where the highest scoring and lowest scoring are sorted into two separate portfolios. By going long the "best" and short the "bad" they obtain an annual excess return of 8.7%. Statman and Glushkov (2009) also use a Best-in-Class methodology and find that tilted portfolios towards high social responsibility rated firms also outperform conventional portfolios. However, when they add a negative screening, omitting companies associated with tobacco, alcohol, gambling, etc., the out-performance was off-set. This motivates us to not filter out the so-called "sin stocks" in our own analysis, as we do not want to limit our sample by excluding certain industries.

Others point out that ESG scores are positively correlated with the return, due to a systematical overlook of information in markets (Edmans, 2011). Eccles, Ioannou, and Serafeim (2013) research the relationship between aggregated ESG scores and performance. When they compare a portfolio consisting of the best ESG-scoring companies with a portfolio with the worst scoring, they obtain a positive alpha of 4.8% annually. Dunn, Fitzgibbons, and Pomorski (2017) focus on the risk side of incorporating ESG considerations into an investment strategy. Their research suggests that companies with low ESG exposure have a volatility up to 15% higher, and a beta coefficient 3% higher than companies with high ESG exposure. In conclusion, they argue that ESG information should be incorporated in an investment decision. Lee and Faff (2009) support this view on ESG having a risk-lowering effect on stocks.

On the other side, we have authors concluding in the opposite direction. Brammer, Brooks, and Pavelin (2006) thoroughly examine the UK market and finds that ESG has a negative correlation with financial performance. They conclude that corporate social activities will destroy shareholder value, as they are not able to explain the low returns from the highest scoring firms, even when risk-adjusting for industry and with factor models. Numerous studies find mixed or no effect (Baron, Harjoto, and Jo, 2011; Hamilton, Jo, & Statman, 1993; Garcia-Castro, Arino, and Canela, 2009). An explanation of why some studies find no significant alpha when risk-adjusting using factor models is provided by Galema, Plantinga, and Scholtens (2008). They argue that high SRI lowers the book-to-market ratio, thus affecting the stock returns without being explained as alpha in a linear regression. We will further scrutinize this finding by implementing the same methodology and asset pricing models.

Our thesis fits into the literature as it analyzes the relationship between returns and ESG. We will in the same manner as Kampf and Osthoff (2007), investigate the effects of ESG on a portfolio level. We will apply the same portfolio criteria of best- and worst in class based on ESG scores. In addition, we will also investigate the performance of ESG on a stock level by applying the same methodology as

Brammer, et al. (2006), and use the Fama-Macbeth regression. We will further investigate the ESG score and look at the individual scores of E, S, and G.

There has not been conducted a lot of research on the ESG score itself and the effects of implementing an ESG investment strategy. This is particularly interesting since our thesis is based on Thomson Reuters' new rating system. We will investigate if the ESG score holds a factor structure, resulting in a tilt towards certain firms and industries.

### ***1.3 Methodology***

When determining the scope of our thesis, our research started by looking at individual stocks listed in the US market. As we wanted to investigate the effects of ESG, we selected the S&P500 index as a sample to ensure stock liquidity, accessibility for investors, and consistency in the reporting. Based on the constituents of the index, we collected financial data and the ESG scores for each stock. After conducting the screening, we ended up with the sample period 01.01.07 – 31.12.17. The collection of data is described in Appendix 2.

For the first part, we investigated the relationship between stock returns and ESG scores. We compared the top 30% with the bottom 30% performing companies, solely based on ESG score given. This was done by constructing two portfolios, hereafter referred to as "Top" and "Bottom". In addition, we formed a long-short portfolio, where we went long "Top" and shorted "Bottom".

To further investigate the effects of ESG, we looked at ESG on a stock level by performing a Fama-Macbeth regression. We integrated the ESG as an individual factor in our model, and also look at the separate scores for E, S, and G. Finally, we examined the overall ESG score as the dependent variable, to check for a potential factor structure and industry tilt in the variable.

Throughout our analysis, we applied Fama-French-3-factor and Carhart to control for risk-adjusted returns. In addition, we controlled for industry effects by including dummy variables. In the next section, we elaborate on the theoretical framework we use.

## 2.0 Theory

### 2.1 CAPM

The Capital Asset Pricing Model is a single factor model for expected return developed by Sharpe (1964), Lintner (1965), and Mossin (1966). Their work is based on the Modern Portfolio Theory by Markowitz, thus only considering the market exposure of a given asset as the explanatory variable for the expected return (Bodie et al., 2014).

$$E[R_i] = R_f + \beta_{im}(E[R_m] - R_f)$$

Where:

$R_i$  is the return of asset i

$R_f$  is the return of the risk free asset

$\beta_{im}$  is the beta of asset i with the market m

$R_m$  is the return of the market portfolio

From the classical way to express CAPM above, one can see that the expected return is the sum of the risk-free interest rate, and a stock's beta multiplied with the market risk premium. The beta measures the individual stock's sensitivity to changes in market risk.

As an alternative to CAPM, the Arbitrage Pricing Theory (APT) was introduced. It was argued that investors cannot perfectly diversify their portfolios, hence hampering portfolio performance (Ross, 1976). Moreover, the market beta alone was not sufficient to derive prices from, hence multiple factors were needed to explain assets' returns. APT lay the foundation for the financial models we apply in our thesis.

### 2.2 Fama-French three-factor model

One of the most popular approaches to specifying a firm's exposure to systematic risk is based on by Fama and French (1993). They constructed a three-factor model that can account better for cross-sectional stock returns than the one-factor CAPM model. The model can be expressed as follow:

$$R_{it} = \alpha_i + \beta_{iM}R_{Mt} + \beta_{iSMB}SMB_t + \beta_{iHML}HML_t + e_{it}$$

Where:

$R_{it}$  is the return on security  $i$  in period  $t$ , in excess of the risk-free rate

$\alpha_i$  is the return of security  $i$  not explained by the factors

$\beta_{iM}$ ,  $\beta_{iSMB}$  and  $\beta_{iHML}$  is security  $i$ 's sensitivity to the market-, SMB- and HML factor respectively

$R_{Mt}$  is the return on the market factor in period  $t$ , in excess of the risk-free rate

$SMB_t$  and  $HML_t$  is the return on the SMB and HML factor respectively in period  $t$

$e_{it}$  is the error-term, which incorporates the nonsystematic risk of security  $i$  in period  $t$

The SMB-factor stands for "Small Minus Big" and is the return of a portfolio of small stocks in excess of the return on a portfolio of large stocks. SMB captures the anomaly of "size" effects, where small stocks outperform large stocks. The HML-factor stands for "High Minus Low", and HML is the return of a portfolio of stocks with a high book-to-market ratio in excess turn on a portfolio of stocks with a low book-to-market ratio (Bodie et al., 2014).

### 2.3 Carhart Four-factor model

After the introduction of the research done by Fama and French, a fourth factor was added to the model by Mark Carhart (1997). Carhart discovered that high performing stocks had a tendency to continue performing well, and the other way around with underperformers. Hence, Carhart suggested buying recent winners and sell recent losers, would generate an excess return (Carhart, 1997). The four-factor model with the momentum variable (MOM) can be expressed in the following way:

$$R_{it} = \alpha_i + \beta_{iM}R_{Mt} + \beta_{iSMB}SMB_t + \beta_{iHML}HML_t + \beta_{iMOM}MOM_t + e_{it}$$

Where:

$\beta_{iMOM}$  is security  $i$ 's sensitivity to the momentum factor

$MOM_t$  is the return on the momentum factor at time  $t$

The remaining components are as in the Fama-French three-factor model

## 2.4 Fama-Macbeth Regression

The Fama-MacBeth regression (Fama & Macbeth, 1973) is a two-step regression to test the explanatory power of different risk factors on asset returns. The regression can estimate the betas and risk premium for any risk factor, thus frequently used to deal with financial panel data. The regression is done in the two following steps:

1. Regress each asset against the different risk factors and determine the asset's betas for each factor.
2. Secondly, estimate the cross-sectional regressions of assets return for each time step against the estimated betas from step 1. In the end, these coefficients are averaged to get risk premium to each factor. The equation in part 2 is formulated in the following way:

$$R_{i,T} = \gamma_{T,0} + \gamma_{n,1}\hat{\beta}_{i,F_1} + \gamma_{n,2}\hat{\beta}_{i,F_2} + \dots + \gamma_{n,m}\hat{\beta}_{i,F_m} + \varepsilon_{i,T}$$

### 3.0 Data

In the previous sections, we have laid out a framework which we now will apply to answer our research question. In the search of the effect ESG integration has on financial performance, we are going to use the asset pricing models presented in the previous section. These models do not fully capture the ESG effects, thus require modification to answer our thesis question. We will elaborate on how we collect the required data to conduct our analysis and exactly how we evaluate the impact of ESG.

As our scope is limited to the US, we require a selection of stocks that both report ESG data and reflect the US market. The S&P 500 is an adequate representation of the US Market, and its eligibility criteria ensure liquidity and accessibility. When looking at all firms in the US, we faced a challenge that a large proportion of the companies did not report ESG data or was not covered by Thomson Reuters. As we wanted to ensure a complete dataset, we limited our scope to companies on the S&P500 index, as these mostly had consistent ESG reporting.

#### *3.1 Stock Selection*

To collect the data for our time period, we required ESG scores and financial data for the constituents of S&P500 for the period 01.01.07 – 31.12.17. We required continuous financial data for the constituents. Hence, for simplicity, we exclude companies that are not part of the index for the full year. The list of constituents of the S&P500 was downloaded through the Eikon terminal for each of the respective years in our sample period. Furthermore, based on the constituents, we downloaded the stock return data through Eikon.

The challenge with ESG is the lack of reporting by some of the companies included in the dataset. By selecting the 500 largest stocks in the US, we still faced several stocks with no ESG reporting at all or incomplete reporting for some years in our sample. These stocks were removed from our data sample. Furthermore, due to infrequent reporting, we were forced to use annual ESG data

Consequently, we ended up with a data sample where every stock was part of the S&P500 and reported ESG score for the whole sample period.

### 3.2 Setting up the Models

After the stock selection process had been made, we retrieved daily return data for the sample in the period 01.01.2007 – 31.12.2017. In order to take height for firms' different payout policies, we used the Total Return Index in DataStream to retrieve the accumulated growth in the value of capital that was invested in each of the company. The Total Return Index is calculated as follows:

$$RI_t = RI_{t-1} * \frac{PI_t}{PI_{t-1}} * \left(1 + \frac{DY_t}{100 * N}\right)$$

Where:

$RI_t$  and  $RI_{t-1}$  is the return index in period t and t-1 respectively

$PI_t$  and  $PI_{t-1}$  is the price index in period t and t-1 respectively

$DY_t$  is the dividend yield in period t

$N$  is the number of working days each year

As can be seen, the return index incorporates the dividend, so it should reflect the total return an investor who invests in the stock will experience, given that the dividends are reinvested in the stock returns.

The ESG data is retrieved by the code "TREESG" in Datastream, which gives us the overall ESG-rating for the individual stocks. The scores range from 0-100, where 100 is the best score. We also get each company's "SIC01"-code which allows us to identify which industry it belongs to. For classification, we use the "10-industry" categorization found on Kenneth French's website (French, 2018).

#### 3.2.1 Portfolio Analysis on Return & Tilt

For the first part, we look at the relationship between financial performance (stock returns) and ESG scores. We here compare the 30% best scoring companies on ESG, with the 30% lowest scoring. This was done by constructing the two portfolios: "Top" and "Bottom", and comparing these against each other. We also



created a long-short portfolio which was long "Top" and short "Bottom". Irregular reporting of ESG data enforced a yearly re-balance of the portfolios. This is done on January 1st every year. All of the portfolios are equally weighted.

Constructing the actual model, we run "excess return" as the dependent variable. Since the excess return is here defined as the stock return minus the risk-free rate, we need data for rf. The daily measure of rf is calculated from the 1-month T-bill by Kenneth French and available on his website. This is also where we get daily data on excess market return, SMB, HML, MOM which is needed when running our portfolios on CAPM, FF3 and Carhart 4 factor.

The data sets are imported to STATA, where we ran the regressions. The regressions were tested on daily data. The independent variables are added to their respective models, which gives the following regressions:

$$R_i - R_f = \alpha_i + \beta_{iM}R_{Mt} + \beta_{iSMB}SMB_t + \beta_{iHML}HML_t + \beta_{iMOM}MOM_t + \epsilon_i$$

### 3.2.2 Stock Analysis on Return

In this part, we look at single stocks and not portfolios. We want to see if we can increase the explanatory power of the traditional financial models by adding ESG as an exogenous variable.

For our stock analysis on return, we required the same data as in the portfolio approach. However, the infrequent reporting of ESG data constrained our sample to be on an annual basis. In addition, we got the individual factors "E", "S" and "G", with the Datastream codes "ENVSCORE", "SOCSCORE" and "CGOVSCORE".

The Fama-Macbeth regression requires the panel data to vary between firms and time steps. Hence, the Fama-French and Carhart factors could not be used in this regression. In the same manner as Brammer et al (2006), the variables were replaced by stock-specific variables, which represents the risk-factors from Fama-French and Carhart. The excess market return was replaced by the firm-specific beta, SMB with Market Cap, HML with P/B, and MOM with last year's stock return. In addition, we took the natural logarithm of the lagged Market Cap and lagged P/B to normalize the variables and mitigate big outliers. A small number of

stocks reported negative price-to-book values, which prevented us from taking the natural logarithm of P/B. We solved this minor issue rather pragmatically by taking the log of the absolute value and thereafter adding a negative sign.

Setting up the model, we also run the regression on excess return in this part. As mentioned before, we include the overall ESG score as an explanatory variable, and not as a screening tool to form a portfolio. Additionally, we do the same procedure as before, separating "E", "S" and "G". In the same manner as described under part 1, we gradually include more factors with respect to the models we use. In addition, we control for potential industry effects by including industry dummies. We omit one industry to avoid perfect multicollinearity. To run the regression, we use the "XTFMB" model in STATA (Daniel Hoechle, 2006). The final regression is illustrated below:

$$R_i - R_f = \alpha + \gamma_{i,ESG}ESG_{i,t} + \gamma_{i,beta}Beta_{i,t} + \gamma_{i,im.cap}Ln(Market\ Cap)_{t-1} + \gamma_{i,PTBV}Ln(P/B)_{t-1} \\ + \gamma_{i,MOM}Momentum_{t-1} + \gamma_{i,d1}Industry\ dummy\ 1_{i,t} \dots \gamma_{i,d9}Industry\ dummy\ 9_{i,t} \\ + \epsilon_i$$

$$R_i - R_f = \alpha + \gamma_{i,E}E_{i,t} + \gamma_{i,S}S_{i,t} + \gamma_{i,G}G_{i,t} + \gamma_{i,beta}Beta_{i,t} + \gamma_{i,im.cap}Ln(Market\ Cap)_{t-1} \\ + \gamma_{i,PTBV}Ln(P/B)_{t-1} + \gamma_{i,MOM}Momentum_{t-1} \\ + \gamma_{i,d1}Industry\ dummy\ 1_{i,t} \dots \gamma_{i,d9}Industry\ dummy\ 9_{i,t} + \epsilon_i$$

### 3.2.3 Stock Analysis on ESG score

In the final analysis, we use the same data as for the previous part. Additionally, the same methodology is used for setting up models, although the ESG score is now set as the dependent variable. In the first stage, hence the simplest model, we only run the stock-specific beta on the ESG score. Gradually we increase the number of variables, first adding measures for size and value, then including momentum. The risk factors are the firm-specific variables used in the previously described regression, namely the market capitalization and the Price-to-Book ratios. Finally, we add industry dummies, and the model ends up like this:

$$ESG_i = \alpha + \gamma_{i,beta}Beta_{i,t} + \gamma_{i,im.cap}Ln(Market\ Cap)_{t-1} + \gamma_{i,PTBV}Ln(P/B)_{t-1} \\ + \gamma_{i,MOM}Momentum_{t-1} + \gamma_{i,d1}Industry\ dummy\ 1_{i,t} \dots \gamma_{i,d9}Industry\ dummy\ 9_{i,t} \\ + \epsilon_i$$

## 4.0 Analysis & Results

### 4.1 Portfolio Analysis on Return & Tilt

#### 4.1.1 Analysis

Table 1 – ESG portfolios

	Portfolio	ALPHA	MARKET	SMB	HML	MOM	R-SQUARED
CAPM	Top 30%	0,0000748**	1,03744 ***				0,981487
	Bottom 30%	0,000122*	1,156655 ***				0,963569
	Long-short	-0,0000659	-0,118461***				0,210667
FF3	Top 30%	0,0000827***	1,028905***	-0,066424***	0,058365***		0,983394
	Bottom 30%	0,000153***	1,104407***	0,116826***	0,188532***		0,970918
	Long-short	-0,000086	-0,073736***	0,188532***	-0,136522***		0,363431
Carhart	Top 30%	0,0000836***	1,01469***	-0,063665***	-0,002443	-0,082948***	0,986051
	Bottom 30%	0,000154***	1,085188***	0,128136***	0,096176***	-0,122277***	0,975172
	Long-short	-0,0000864	-0,068253***	0,191903***	-0,11017***	0,034889***	0,37065

\*\*\* indicates significance on a 1% confidence level

\*\* indicates significance on a 5% confidence level

\* indicates significance on a 10% confidence level

The portfolio approach is our introductory analysis on how ESG scores affect financial performance and portfolio tilt. We evaluate the three portfolios using CAPM, the Fama-French three-factor model, and the Carhart four-factor model. Finally, we compare the portfolios' composition with respect to market capitalization and industry.

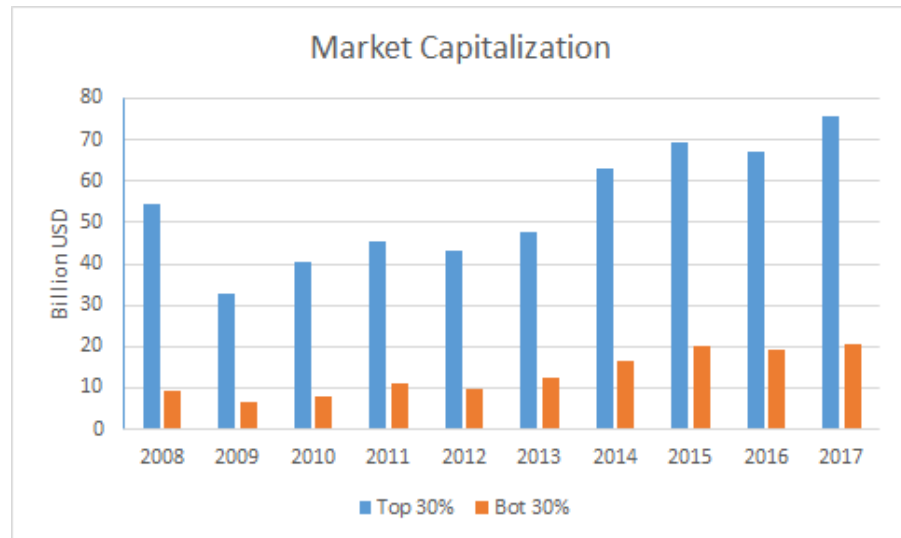
Starting with the CAPM, we spot a negative alpha on the long-short portfolio, which indicates that “Bottom” outperforms “Top”. However, the alpha is not statistically significant on any conventional level, thus cannot be used to draw any conclusions. “Bottom” has a higher beta than “Top”, which can indicate that the firms with low ESG scores have a higher market risk on average than the companies with high ESG scores. The betas are significant on a 1% level.

Adding the SMB and HML factors, the long-short portfolio's alpha remains negative and statistically insignificant. The SMB of "Bottom" is positively correlated with the return at a 1% level, which is consistent with the Fama-French Three-factor Model. On the other hand, "Top" has a negative correlation with SMB on a 1% level, meaning that the big firms should yield higher than the smaller firms on average. This may indicate that "Top" consists of larger companies, thus explaining the diminishing return. Proceeding to the HML factor, we find it to be positive for both portfolios here, where the coefficient is higher for "Bottom" than "Top". The interpretation of this is that more value stocks are held in "Bottom".

Applying the Carhart four-factor model, no changes are detected on the long-short portfolio's alpha. The momentum factor is negative for both portfolios at a 1%-level, with a slightly more negative coefficient for the top performer. The negative correlation between return and momentum oppose the extended model's conclusion. The other factors remain unaffected on all conventional levels when introducing MOM,

Since we see a significant difference in the SMB coefficient for "Top" and "Bottom", we want to compare the average market capitalization of firms in each portfolio. As "Top" has a lower exposure to SMB, we suggest it consist of bigger firms.

Graph 1 – Markt Capitalization



From graph (1), we observe a distinct difference between the two portfolios. “Top” has an average market capitalization ranging from \$32 billion to \$75 billion between 2008 and 2017, while “Bottom” lies between \$6 billion to \$20 billion in the same period. From these findings, we suspect a relationship between the ESG scores and the size of the firms, which we will scrutinize in a later stage of the analysis.

Lastly, we examine the ESG portfolios for any structural differences with regards to industry. We want to identify if a tilt towards top scoring ESG stocks results in higher exposure towards specific industries. Therefore, we compare which industries the two portfolios consist of. When examining table (2), we identify a few revealing differences between “Top” and “Bottom”. The top portfolio has a substantially higher proportion invested in “Manufacturing” and “Hitec”, compared to “Bottom”. In addition, there is also a noteworthy difference in the exposure to the industries “Durables”, “Non-Durables”, and “Telecom”. Another mentionable difference is the weighting of “Other industries”, which are 22% and 37% for “Bottom” and “Top” respectively. In conclusion, the industry allocation between the two portfolios seems to differ enough that ESG screening may cause

an industry tilt. Further investigation ought to be conducted to draw any conclusions.

**Table 2 – Portfolio industries**

Industry	Top portfolio	Bot Portfolio
NonDurables	7,70 %	5,26 %
Durables	0,61 %	3,48 %
Manufactuering	14,24 %	7,78 %
Energy	6,20 %	5,80 %
Hitec	18,05 %	13,38 %
Telecom	2,79 %	4,23 %
Shops	12,19 %	11,26 %
Health	8,79 %	7,65 %
Utils	6,74 %	4,16 %
Other	22,68 %	37,00 %
<b>SUM</b>	<b>100,00 %</b>	<b>100,00 %</b>

- NoDurables = Consumer NonDurables -- Food, Tobacco, Textiles, Apparel, Leather, Toys
- Durables = Consumer Durables -- Cars, TV's, Furniture, Household Appliances
- Manufacturing = Machinery, Trucks, Planes, Chemicals, Off Furn, Paper, Com Printing
- Energy = Oil, Gas, and Coal Extraction and Products
- Hitec = Business Equipment -- Computers, Software, and Electronic Equipment
- Telecom = Telephone and Television Transmission
- Shops = Wholesale, Retail, and Some Services (Laundries, Repair Shops)
- Health = Healthcare, Medical Equipment, and Drugs
- Utils = Utilities
- Other = Mines, Constr, BldMt, Trans, Hotels, Bus Serv, Entertainment, Finance

#### 4.1.2 Summary “Portfolio Analysis on Return &Tilt”

In conclusion, our findings suggest that a strategy to invest in companies with high ESG scores result in a tilt towards large, value stocks. Additionally, one would be more exposed to the industries "Manufacturing" and "Hitec", and have relatively low exposure to "Durables", "Non-Durables", "Telecom" and "Other industries" compared to the bottom portfolio. The implication for the ESG investor would be a loss of diversification and unintended exposure to other risk factors than ESG. Our analysis could not conclude with any statistically significant difference in risk-adjusted return between the two portfolios. Therefore, we will take another approach where we isolate the ESG effect at a firm level and see how changes in ESG score affect the financial performance. In addition, we examine if the exposure to the abovementioned factors and industries prevails, also when using a more sophisticated multi-factor model.

## 4.2 Stock analysis on return

### 4.2.1 Combined ESG Factor

Table 3 – Fama-MacBeth ESG

ESG	Alpha	ESG	Beta	Market Cap	PTBV	Momentum	Durbl	HiTec	Hlth	Manuf	NoDur	Other	Shops	Telcom	Utils
(5)	0.42950076 (0.1343728)**	0.0003094 (0.000416)	-0.0098313 (0.0599348)	-0.0370669 (0.0126884)**	-0.008977 (0.0061746)	-0.0951958 (0.1014391)	0.0527706 (0.0691137)	0.0423026 (0.0578367)	0.0473542 (0.0654498)	0.0263129 (0.0405357)	0.0287199 (0.0705339)	0.0003359 (0.0694112)	0.0663081 (0.0673806)	0.0537662 (0.0619122)	-0.0407752 (0.0558091)
(4)	0.4532196 (0.4532196)***	0.0004056 (0.0003934)	-0.0210976 (0.0605933)	-0.0374209 (0.122122)**	-0.0025538 (0.0057339)	-0.1087453 (0.1102443)									
(3)	0.486346 (0.1156485)***	0.0007864 (0.0006293)	0.12768 (0.64366)	-0.425804 (0.0150335)**	-0.0104217 (0.0054797)*										
(2)	0.1313875 (0.5158)**	-0.0005363 (0.0002939)	0.0539985 (0.731567)												
(1)	0.1682034 (0.07504)*	-0.0055994 (0.0055994)**													

Alpha is the return which is not explained by the other variables

ESG is the score of each company given by Asset4

Beta is the exposure to the market factor

MarketCap is the natural logarithm of the market capitalization

PTBV is the natural logarithm of the Price-to-Book value of the firm

Momentum is the exposure to the momentum factor

Durbl is a dummy variable, which gives a company "1" if the company is in the "Consumer Durables" industry and "0" if not

HiTec is a dummy variable, which gives a company "1" if the company is in the "Business Equipment" industry and "0" if not

Hlth is a dummy variable, which gives a company "1" if the company is in the "Health care" industry and "0" if not

Manuf is a dummy variable, which gives a company "1" if the company is in the "Manufacturing" industry and "0" if not

NoDur is a dummy variable, which gives a company "1" if the company is in the "Consumer NonDurables" industry and "0" if not

Other is a dummy variable, which gives a company "1" if the company is in the "Other" industry and "0" if not

Shops is a dummy variable, which gives a company "1" if the company is in the "Shops" industry and "0" if not

Telcom is a dummy variable, which gives a company "1" if the company is in the "Telecommunications" industry and "0" if not

Utils is a dummy variable, which gives a company "1" if the company is in the "Utilities" industry and "0" if not

The number in parentheses is the standard error of the coefficient

\*\*\* indicates significance on a 1% confidence level

\*\* indicates significance on a 5% confidence level

\* indicates significance on a 10% confidence level

To study the isolated effects of ESG on performance, we applied the Fama-Macbeth methodology to price the different risk factors on stock level. ESG is included in the model as an independent variable, and the risk factors are now calculated based on stock-specific values.

By introducing our first and simplest model (1), we identify a negative relationship between ESG and stock return. The ESG coefficient is negative and significant on a 5%-level. Hence, indicating that a stock with high ESG score would have lower performance than a stock with a low ESG score. This result is in accordance with the critics of ESG, where ESG investing arguably reduces the return on investment for the investor.

When we expand our model by including the market beta for each stock (2), the coefficient for ESG score was still negative. However, it is not significant at any conventional levels. The change of significance could be an indication of the robustness of our model. Furthermore, implying that ESG effects from (1) could be due to a factor structure and not ESG itself. The beta coefficient is positive, a result which aligns with the CAPM theory.

By including the Fama-French firm-specific factors in the regression (3), the ESG coefficient changes to a positive value, but is not significant at any level. The market Cap has a negative effect on stock return, which represents that small companies outperform large companies. The result is in line with the Fama-French theory. Both the P/B and the market cap factor are negatively priced in the extended model. This indicates that firms with high price-to-book-value have underperformed stocks with low price-to-book value. Namely, that value stocks have outperformed growth stocks which are in accordance with theory.

In regression (4), the firm-specific momentum factor is priced negatively in our model, though not statistically significant. Furthermore, the P/B changes from significant to non-significant when introducing the momentum factor.

In the last and final model (5), we have included dummies to control for industry effects. We want to control for specific industry effects and secure that none of the variables of interest is influenced by this effect. In order to avoid the dummy variable trap, the industry "Energy" is used as the base value in the regression, meaning that all the differential intercept coefficients are relative to this one. This was chosen based on the result from the ESG portfolios, where we observed



"Energy" as the industry that had the most equal representation in the two portfolios. When including the industry dummy variables, there are no significant changes to our model.

4.2.2 Separate E, S, G Scores

Table 4 – Fama-MacBeth E, S, G

E, S, G	Alpha	Env	Soc	Gov	Beta	Market Cap	PTBV	Momentum	Durbl	HTec	Hlth	Manuf	NoDur	Other	Shops	Telcom	Utils
(5)	0.04325153 (0.0890764)	0.000081 (0.000263)	-0.0003485 (0.000226)	-0.0001057 (0.000646)	-0.0095527 (0.059778)	-0.0325192 (0.0112533)**	-0.0095014 (0.0063823)	-0.0598265 (0.1041908)	0.0488792 (0.0648907)	0.0437178 (0.0580851)	0.0197426 (0.0657061)	0.0324223 (0.0381556)	0.0332273 (0.070136)	-0.0042225 (0.0689294)	0.0674965 (0.0672651)	0.0473317 (0.067294)	-0.0375192 (0.1315487)
(4)	0.50811413 (0.1162521)**	0.0002105 (0.0003594)	0.0001908 (0.0002175)	0.0007129 (0.0005217)	0.243233 (0.0600734)	0.341072 (0.0119477)**	0.0020955 (0.0055602)	-0.1134935 (0.1127888)									
(3)	0.5315667 (0.123656)**	0.0002701 (0.0003762)	0.0004474 (0.0002276)	0.0005897 (0.0005899)	0.0111403 (0.0641891)	0.0375139 (0.0137309)**	0.0106193 (0.0061719)										
(2)	0.1634367 (0.0775141)*	0.0002586 (0.0002919)	0.0002563 (0.0002306)	0.0003449 (0.0006708)	0.032974 (0.073427)												
(1)	0.1952281 (0.0977228)*	0.002412 (0.0004199)	0.0002435 (0.0003421)	0.0003666 (0.0007158)													

Alpha is the return which is not explained by the other variables  
 ESG is the score of each company given by Asset4  
 Beta is the exposure to the market factor  
 MarketCap is the natural logarithm of the market capitalization  
 PTBV is the natural logarithm of the Price-to-Book value of the firm  
 Momentum is the exposure to the momentum factor  
 Durbl is a dummy variable, which gives a company "1" if the company is in the "Consumer Durables" industry and "0" if not  
 HTec is a dummy variable, which gives a company "1" if the company is in the "Business Equipment" industry and "0" if not  
 Hlth is a dummy variable, which gives a company "1" if the company is in the "Health Care" industry and "0" if not  
 Manuf is a dummy variable, which gives a company "1" if the company is in the "Manufacturing" industry and "0" if not  
 NoDur is a dummy variable, which gives a company "1" if the company is in the "Consumer NonDurables" industry and "0" if not  
 Other is a dummy variable, which gives a company "1" if the company is in the "Other" industry and "0" if not  
 Shops is a dummy variable, which gives a company "1" if the company is in the "Shops" industry and "0" if not  
 Telcom is a dummy variable, which gives a company "1" if the company is in the "Telecommunications" industry and "0" if not  
 Utils is a dummy variable, which gives a company "1" if the company is in the "Utilities" industry and "0" if not  
 The number in parentheses is the standard error of the coefficient  
 \*\*\* indicates significance on a 1% confidence level  
 \*\* indicates significance on a 5% confidence level  
 \* indicates significance on a 10% confidence level

To further investigate the effects of ESG, we examined the individual factors: Environmental, Social, and Governance. We applied the same approach as in the previous section except replacing the overall ESG score with E, S, and G. The results of the regressions with the individual factors gives us the same interpretation as from the previous section. There are no significant results of the E, S and G factors on the single stock return in any of the regressions. The only significant variable is the Market cap, with a negative sign in the regression (3), (4) and (5).

#### *4.2.3 Summary “Stock analysis on return”*

The results from the Fama-MacBeth regressions on stock level show that ESG has no significant effect on stock return. Based on our study sample, an investor will not be able to obtain abnormal returns by systematically tilting towards high ESG scores. However, we cannot conclude the opposite, namely that ESG hampers risk-adjusted return. From what we observe, the returns are seemingly explained by exposure to well-known risk factors from Arbitrage Pricing Theory. In regression (1) in table 3, we got negative coefficients for the ESG variable. Although, when extending the model with other factors, the statistical significance of ESG was no longer existent. Contemporaneously, regression (3) in table 3, shows that increased firm size and Price-to-Book ratio decreases return, on a 1% and 5% level respectively. Separating the "Environmental", "Social" and "Governance" factors do not strengthen the model.

Analyzing our results, we suspect that the ESG score itself is inherently multifactor, thus affecting inference in the analysis. Accordingly, ESG scores are not able to explain enhanced financial performance. The possible factor structure of ESG motivates us to further investigate the relationship between ESG and the other variables more thoroughly.

### 4.3 Stock analysis on ESG Score

#### 4.3.1 Analysis

Table 5 – Fama-Macbeth ESG score

ESG as Y	Alpha	Beta	Market Cap	PTBV	Momentum	Durbl	HiTec	Hlth	Manuf	NoDur	Other	Shops	Telcom	Utils
(4)	-21.78809 (5.458528)***	0.6648074 (0.5648336)	8.4721 (0.4861983)***	-0.5636287 (0.1361211)***	-5.792575 (2.072198)**	-4.514556 (0.475634)***	2.129567 (0.5088954)***	1.491487 (0.6634963)**	7.58632 (0.5368175)***	6.851775 (1.020045)***	-1.23058 (0.6317277)*	0.8828617 (0.7337829)	-5.885358 (0.6225344)***	5.624611 (0.6019195)***
(3)	-14.39234 (5.065972)**	-0.9550045 (0.6811262)	8.027975 (0.4601336)***	-0.12229138 (0.1663238)	-5.723528 (2.110867)**									
(2)	-14.14287 (4.881067)**	-0.279003 (0.6814586)	7.972476 (0.4350931)***	-0.4694025 (0.1815373)**										
(1)	64.89671 (0.9943681)***	-2.578274 (0.7394104)***												

Alpha is the return which is not explained by the other variables

ESG is the score of each company given by Asset4

Beta is the exposure to the market factor

MarketCap is the natural logarithm of the market capitalization

PTBV is the natural logarithm of the Price-to-Book value of the firm

Momentum is the exposure to the momentum factor

Durbl is a dummy variable, which gives a company "1" if the company is in the "Consumer Durables" industry and "0" if not

HiTec is a dummy variable, which gives a company "1" if the company is in the "Business Equipment" industry and "0" if not

Hlth is a dummy variable, which gives a company "1" if the company is in the "Health care" industry and "0" if not

Manuf is a dummy variable, which gives a company "1" if the company is in the "Manufacturing" industry and "0" if not

NoDur is a dummy variable, which gives a company "1" if the company is in the "Consumer NonDurables" industry and "0" if not

Other is a dummy variable, which gives a company "1" if the company is in the "Other" industry and "0" if not

Shops is a dummy variable, which gives a company "1" if the company is in the "Shops" industry and "0" if not

Telcom is a dummy variable, which gives a company "1" if the company is in the "Telecommunications" industry and "0" if not

Utils is a dummy variable, which gives a company "1" if the company is in the "Utilities" industry and "0" if not

The number in parentheses is the standard error of the coefficient

\*\*\* indicates significance on a 1% confidence level

\*\* indicates significance on a 5% confidence level

\* indicates significance on a 10% confidence level

In light of the ambiguous results we got from the ESG-portfolios and direct integration of ESG factors, we need further analysis to understand the results. Therefore, we want to examine the relationship between ESG and the other factors used in the model.

From regression (1), we see that a company's market beta is negatively correlated with its ESG score. This finding shows that riskier stocks have slightly lower ESG score on average. The beta coefficient is statistically significant on all conventional levels.

When we include the Fama French factors, the beta loses its significance.

Regression (2) shows that market cap is positively correlated with ESG scores on a 1%-level. Apparently, a one percent increase in a firm's market capitalization results in an average increase of 0.0797 in ESG score, which means that bigger companies tend to have better ESG scores. On the other hand, price-to-book is negatively correlated with ESG scores on a 5%-level. The result shows that an increase in P/B affects the ESG negatively, however, the effect is negligible as a 1% increase result in a 0.0047 decrease of ESG Score. In total, one could say that a tilt on high ESG scores results in a portfolio with an extra exposure to big value stocks.

In regression (3) we introduce the momentum factor. The market capitalization's effect on ESG is unchanged, but the P/B-variable is no longer significant. The momentum coefficient is negative and statistically significant on a 5% level. One percentage point increase in the last 12 month's return results in a decrease of an ESG score by 5.724.

In our final model, regression (4), market cap and price-to-book are statistically significant on a 1% level and keeps their respective signs from earlier. The momentum is unchanged. When including dummies for industries in our model, we omit "Enrgy" to avoid the dummy variable trap, as explained in section 4.2.1. "Hlth" is statistically significant on a 5% level, "Other" on a 10% level, while "Shops" is not significant on any level. The rest of the industries are significant at a 1% level.

As we can see, "Durabl", "Other" and "Telcm" have a negative exposure to ESG score. "Manuf", "Nodur", "Hitec" and "Utils" are the mentionable industries with positive exposure, the rest are barely more exposed to ESG compared to "other".

For instance, a firm in the “Manufacturing” industry will have an ESG score which is 6,85 higher and a firm in “Telecom” will have a decline in the ESG score of 5,62 compared to the “Energy” industry.

#### *4.3.2 Summary “Stock analysis on ESG Score”*

In our analysis of the ESG, we have found several indications that the ESG score is categorized by a factor structure. If an investor strictly follows an investment strategy based on the ESG score, the investor will, in consequence, end up picking stocks with high market capitalization and with a low P/B, namely large value stocks. From Fama & French's studies, we know that these factors have the opposite effect on stock return. In addition, there is also a correlation of 0,501 between market cap and ESG (Appendix 3). An interpretation of this finding may be that larger firms to a higher degree prioritize scoring well on ESG, compared to smaller firms. Possibly, this is due to the big firms' higher exposure to media attention and coverage, leading to greater expectations of what sustainability profile the companies have. As a result of being more in the spotlight, the larger firms could benefit more from focusing on ESG compared to smaller firms. Due to differences in available resources, one can argue that larger firms are more capable of reporting ESG.

We found evidence that an ESG-based investment approach results in a tilt towards particular industries. According to our research, overweighed exposure is given to the industries: "Manufacturing", "Non-Durables", "Hitech" and "Utilities". One can argue that an explanation for this is the variation in transparency within the industries. Some industries might not require the same attention to ESG, therefore the emphasize on ESG measures is not given. Furthermore, some industries may perhaps be better “tailored” for the ESG reporting model, thus more capable of achieving high scores from the reporting agencies. The results are also in line with the results from our portfolio analysis, where we identified a clear difference between the two ESG portfolios' industry allocation and average firm size. In conclusion, we have identified a factor structure within the ESG scores, which proves tilt towards both style and industry.

## 5.0 Conclusion

In this thesis, we look at the relationship between ESG scores and financial performance at a more recent time period than other publications. In contrast to most studies, we solely focus on stocks on the S&P500. We use ESG scores which is sophisticatedly estimated from an independent third party to ensure objectivity. From what we know, no other studies have been done on the new and improved Thomson Reuters ESG scores. Moreover, we challenge traditional financial selection processes and models by integrating ESG into the investment decision.

Our results indicate that ESG is inherently multi-factor, meaning that using ESG scores as investment criteria result in a tilt on style and industry. Whether ESG integration enhances financial performance or not, is not as straightforward to answer as it appears at first glance. The overweighting of certain industries and large value stocks can help explain why the performance of ESG strategies varies so much from study to study. Our research cannot conclude whether the returns are hampered or enhanced by an investment strategy solely based on ESG scores. However,

In the portfolio approach, we use ESG scores as a screening tool to form two portfolios. One portfolio with the best scoring firms, another with the lowest scoring firms, and lastly a long-short portfolio of the best minus the lowest. We compared excess return, industry composition and differences in market capitalization. The results indicated that “Bottom” consisted of smaller value stocks compared to “Top”. We also spotted substantial differences in the industry composition of the portfolios. In spite of not finding any differences in return directly, their dissimilar composition may affect ESG investor’s diversification. Secondly, we looked at our sample on a stock level. In this part, we ran the ESG scores as an explanatory variable in several well-known financial models. With the regressions, we searched for excess return, controlled for style and industries. We could not detect any statistically significant alphas, yet confirmed our previous findings from the introductory study in regards to size, value, and industry

Lastly, we examine the consequences of having an ESG tilt. We discover statistically significant relationships between the score given and both style and industry. For instance, we find a strong relationship between ESG and market capitalization, which means that large firms on average have higher ESG scores. However, we cannot causally conclude why this is. A plausible explanation could be that bigger firms have more resources, thus enable them to be in compliance with the reporting of myriads of ESG sub-criteria. Moreover, larger firms are more visible to the increasingly demanding public, which incentivizes a change of focus towards ESG. A more extensive study on causality would be needed for such conclusions to be drawn. Likewise, the correlations between ESG and certain industries clearly show differences in scoring. Therefore, one should critically evaluate how the ESG scores are conducted, as the methodology can indirectly favor certain types of businesses.

Since the reporting and coverage of ESG data shift from being an extra service to a required part of running a company, future researchers will have access to improved data. Presumably, academic papers on the topic will multiply in number and substantially increase in precision. As long as our society continues to challenge the status-quo in finance, thereby pushing towards sustainable investments, the need for research escalates in importance. Also, because we need to ascertain if this push is something that actually improves sustainability, as opposed to merely being a disguised marketing strategy.

In spite of not quantifying the exact loss of diversification and costs associated with the achieved factor tilt, we raise awareness of the consequences of uncritical use of ESG integration. Therefore, ESG investors ought to take tilt into considerations, otherwise, incidental risks may be the true reason for one's success or failure.

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## 7.0 Appendix

### Appendix 1:

#### **ESG Provider selection:**

The increasing popularity within the field of sustainable responsible investments has caused a growth in the number of companies providing ESG data. For our research, we required data which gave us the most reliable reporting of ESG, and at the same time was easily collectible. When reaching out to the different providers, we faced a challenge that many providers required a substantial fee for providing the data we requested. We considered the following ESG data providers:

#### RobeccoSAM

RobeccoSAM is an investment specialist which focuses exclusively on sustainable investments. In addition to asset management, they offer sustainability indices and private equity and ESG benchmark reporting to companies. They cover over 3400 listed companies around the world, divided into 60 industries and 600 data points per company. The challenge with RobecoSAM was that we were only able to obtain a single overall ESG score per company, which would make it difficult to look at E, S, G separately. The score is reported with a score between 0-100.

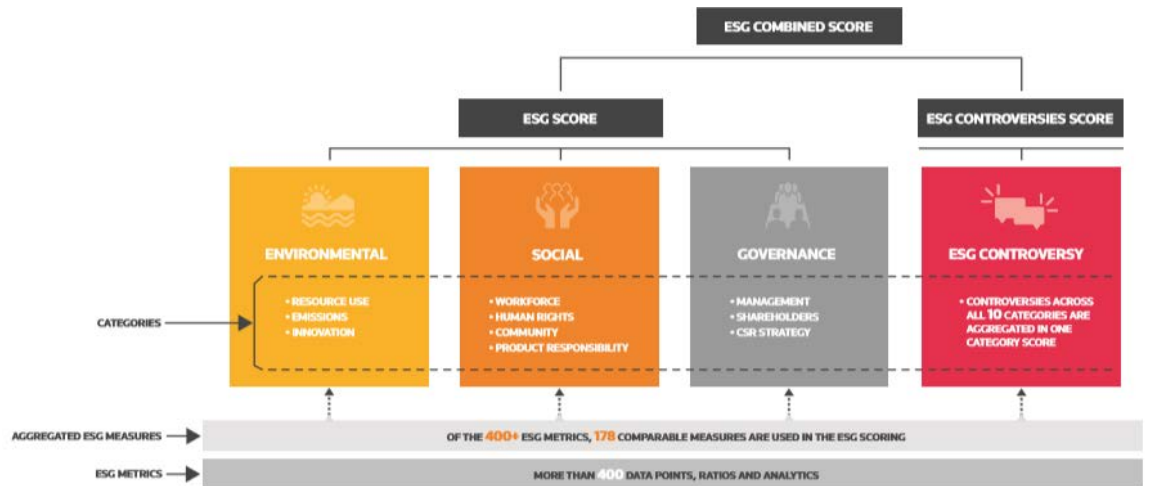
#### Sustainalytics:

Sustainalytics is also a global provider of ESG data, which covers the 11 000 largest countries in the world. They have an in-house research staff of 170+ analysts, with over 25 years of experience in the ESG research market. They are specialized in how ESG factors affect companies and how you can use the different factors to manage risk. However, as with RobeccoSam, we could only obtain a single score per company within the range of 0-100.

#### Thomson Reuters

Thomson Reuters is a provider of in-debt environmental, social and governance data on over 7000 global companies. They offer more than 400 different ESG

metrics, with a history going back to 2002. The ESG data is categorized into four categories: Environmental, social, Governance and ESG controversy. For our thesis, we are going to focus on the overall ESG score, which excludes the ESG controversies score. The ESG score is reported in a range of 0-100. The data is accessible through Eikon by Thomson Reuters, where we also can obtain the separate scores of E, S, and G (Thomson Reuters, 2018). The structure of the data available is shown below:



The ESG overall score is constructed on 10 categories within the E, S, and G, and based on a subset of 178 comparable ESG measures.

For our research, we decided on moving forward with the data provided by Thomson Reuters. This is based on the fact that the Thomson Reuters data was easily accessible through the Eikon client, and Thomson Reuters was the only provider which offered a separate score for E, S, and G.

## **Appendix 2:**

### **Data collection**

The sample period is dictated by the available reported ESG data, and when we considered older data, the reporting was poor for the majority of stocks we looked into. The lack of ESG reporting also forced us to look at developed markets and larger companies which actually reported ESG scores and was covered by the rating agencies. We decided to look into S&P500, which consist of approximately the 500 largest stocks listed on NYSE and NASDAQ. This sample selection

enabled us to collect ESG data for a fairly large sample and at the same time avoid facing the challenge with inconsistencies in the reporting of ESG.

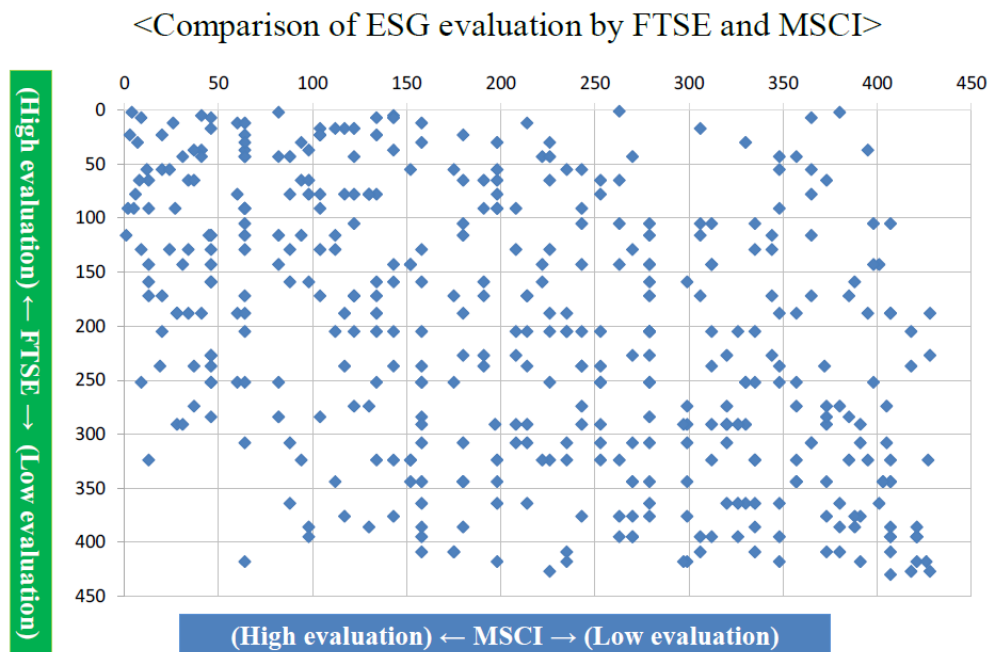
Furthermore, we downloaded the stock returns through Eikon by Thomson Reuters. The stocks selected and downloaded was based on the S&P500 constituents. The approach on stock selection is discussed further in section 3.0. The industry and Fama-French factor data were downloaded from Kenneth French's website. We also obtained the risk-free rate through the same process. Lastly, we downloaded the ESG data from Eikon by Thomson Reuters.

**Appendix 3:**

	ESG Score	Beta	M.Cap	P/B	MoM	Durbl	Enrgy	Hitec	Hlth	Manuf	NoDur	Other	Other	Shops	Utils
ESG Score	1.0000														
Beta	-0.0843	1.0000													
M.Cap	0.5105	-0.1150	1.0000												
P/B	0.0305	-0.1243	0.1400	1.0000											
MoM	-0.0291	-0.0222	0.0940	0.1658	1.0000										
Durbl	-0.0719	0.0934	-0.0339	-0.0075	0.0113	1.0000									
Enrgy	0.0209	0.1389	0.0812	-0.0911	0.0256	-0.0386	1.0000								
Hitec	0.0433	0.0239	0.0522	0.0692	0.0238	-0.0640	-0.1031	1.0000							
Hlth	0.0399	-0.1693	0.1052	0.1077	0.0029	-0.0453	-0.0730	-0.1211	1.0000						
Manuf	0.1036	0.0621	-0.0396	0.0695	0.0078	-0.0563	-0.0907	-0.1506	-0.1065	1.0000					
NoDur	0.0438	-0.1790	-0.0477	0.1317	-0.0020	-0.0416	-0.0669	-0.1111	-0.0786	-0.0977	1.0000				
Other	-0.1273	0.2455	-0.0699	-0.2039	-0.0443	-0.1009	-0.1625	-0.2698	-0.1909	-0.2373	-0.1751	1.0000			
Other	-0.0293	-0.1032	0.0072	0.1368	0.0243	-0.0547	-0.0881	-0.1463	-0.1035	-0.1287	-0.0949	-0.2305	1.0000		
Shops	-0.0079	-0.0232	0.1164	-0.0164	-0.0015	-0.0240	-0.0386	-0.0640	-0.0453	-0.0563	-0.0416	-0.1009	-0.0547	1.0000	
Utils	0.0161	-0.2302	-0.0903	-0.1265	-0.0229	-0.0444	-0.0715	-0.1187	-0.0840	-0.1044	-0.0770	-0.1870	-0.1014	-0.0444	1.0000

**Appendix 4:**

(GPIF, 2017)



## **Appendix 5:**

### **Econometric testing:**

#### **Homoscedasticity**

The ordinary least squares assumption of the variance of the error terms is constant, is also known as the assumption of homoscedasticity. The problem when dealing with a dataset with heteroscedastic error terms is that the estimators will no longer be the best linear unbiased estimators (Not BLUE). The OLS will still produce unbiased and consistent estimators, but will not inherit the minimum variance of the potentially estimated coefficients (Brooks, 2014). Hence, if we apply OLS to a dataset affected by heteroscedasticity, the produced standard errors could be wrong and force the wrong conclusions.

To test for heteroscedasticity, we can apply the White's test with the following results:

#### **White's test for heteroscedasticity (P-values)**

	CAPM	FF3	Carhart
<b>Top</b>	0	0	0
<b>Bot</b>	0	0	0
<b>Long-Shor</b>	0	0	0

#### **Autocorrelation**

Based on the assumptions of OLS, it is assumed that the error terms are also uncorrelated with each other. In the case of a violation of this assumption, our error terms would be affected by autocorrelation or they are also known as serial correlated. The problem with autocorrelation is similar to the previous problem when ignoring heteroscedasticity. The estimated standard errors could be wrong, and then wrong inferences could be made (Brooks, 2014). We can test for autocorrelation by using the DW test:

#### **Breusch–Godfrey test for autocorrelation (P-values)**

	CAPM	FF	Carhart
<b>Bot</b>	0,1253	0,0163	0,0235
<b>Top</b>	0,4666	0,5968	0,101
<b>Long-shor</b>	0,2644	0,2076	0,2752



### Multicollinearity

An implicit assumption of OLS is that there is no correlation between the independent variables. When facing no correlation between the variables, the independent variables are *orthogonal* to one another, and by adding/removing a variable will not affect the other independent variables. However, the problem occurs when the independent variables are highly correlated with each other, and it is known as multicollinearity (Brooks, 2014). We have two different cases of multicollinearity: Near multicollinearity and perfect multicollinearity. Perfect multicollinearity takes place when there is a perfect relationship between two independent variables. In most cases, the problem arises when the same independent variable is used twice in a model. Near multicollinearity is a more common encounter and is present with high correlation. The problems with near multicollinearity the  $R^2$  would be synthetically high, and at the same time, the coefficients will have high standard errors. Consequently, the regression would produce good results, but the coefficients would not be significant. See Appendix 3 for correlation matrix.