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The Challenges of Sustainable Investing

Evaluating Portfolio Construction Strategies

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Abstract

Over the past decades, investment preferences towards portfolio construction have changed from focusing solely on profit maximization, into a combination of good financial performance as well as a responsible sustainability outcome. The purpose of this paper is threefold: first, to investigate whether a sustainable portfolio based on a high environmental, social and governance (ESG) score contributes to positive returns or affects financial performance negatively. Secondly, the study analyzes whether sin stocks can lead to better financial performance or whether they can be included without compromising positive returns. Thirdly, the two factors are combined, by looking at whether sin stocks with high ESG scores perform better. Performance is primarily measured through the construction of a High-Minus-Low (HML) factor based on data from the Russell 3000 from 2009-01-01 through 2022-12-31. The factor is evaluated with Fama-French three-factor and five-factor models, as well as the Carhart four-factor model. The regressions demonstrate mixed results: portfolio construction conditioned on sustainable information may increase or decrease financial performance. The most significant positive results are obtained from the portfolios constructed based on ESG score of sin stocks. On the other hand, excluding all sin stocks from a portfolio significantly decreases portfolio performance. The evidence suggests that improved performance of sin stocks or any stocks with high ESG scores depend on how the portfolios are constructed and weighted. These results contribute to previous literature, as they confirm that sin stocks with a high ESG score outperform those with a low ESG score. Consequently, the latter could be excluded, without impacting financial returns.

Keywords: Sustainable investing, ESG, sin stocks, Russell 3000, Fama-French factor model, Carhart four-factor model, Portfolio construction.

Contents

List of Tables

1

Introduction

An increasing number of public and private investors nowadays prefer to invest in a socially responsible manner, with sustainability as the prime factor (Kempf and Osthoff, 2007). This raises the question of the performance of sustainable investments: does sustainability contribute to abnormal returns on the stock market? The purpose of this study is to create relevant factors to explain returns in the stock market, in order to optimize socially responsible investment strategies when building efficient portfolio of equities.

The challenges faced by company management and entrepreneurs in the field of business have changed. Historically, their primary objective was first and foremost to meet revenue targets, providing maximum value for investors. However, over the past decades, the requirements imposed on companies are influenced by a global trend: a rise of eco-consciousness as well as a more altruistic concern for others. A successful company is now not only defined in terms of revenue targets and growth, but it is also expected to contribute to a more sustainable society.

Companies have a significant impact on society from different perspectives. In terms of the environment, the hundred least sustainable companies have released 71% of the world's total gas emissions since 1988 (Meredith, 2017). Additionally, in terms of the social spectrum, an increasing number of employees are diagnosed with burnout and depression due to increased workload and stress(APA, 2021). In view of these facts, the historical objective of profit maximization has been expanded to include maximizing social value, by engaging in the wellbeing of employees and the environment and by managing the company responsibly, from a financial perspective. A company's sustainability contribution is commonly measured by its Environmental, Social, and Governance performance (ESG). Public and private investors now use such ESG scores for screening investment opportunities.

Although the ESG score is a good tool for portfolio selection, another widely used approach is to consider the industry in which the company operates. Company stocks from more harmful or unethical industries such as alcohol, tobacco, weapons, gambling or fossil fuel production are considered sin stocks, as they negatively affect a sustainable society and are therefore often excluded from an investor's portfolio. Sin stocks are often associated with strong financial performance over time, which can make it challenging to exclude them from a portfolio entirely. Blitz and Fabozzi (2017) argue that investors can selectively exclude certain segments of sin industries without significantly impacting the financial performance of the portfolio.

This study aims to contribute to existing literature on sustainable investing strategies by analyzing three different ways of constructing a sustainable stock portfolio. First, it focuses on the financial performance when constructing an investment portfolio based on an ESG score, while including all industries. Secondly, this study investigates the performance of the ESG score and financial performance while excluding sin stocks from the portfolio. Lastly, the methods of ESG score and sin stocks are combined, by evaluating whether sin stocks with high ESG scores outperform sin stocks with low ESG scores.

The next chapter will review previous literature on the financial performance (in terms of positive, negative or insignificant results) of these three different sustainable investment methods. In chapter 3 we discuss data selection; how the three portfolios are constructed, using the same equity sample. To evaluate and determine the best-performing method, different factor models are considered; including different weighting methods, numbers of stocks, and time periods. These factors are explained under Methods. Chapter 4 presents the outcome from the regressions and analyzes the results. It examines the variables, assesses the impact of each factor on portfolio performance and identifies the most effective approach. The findings show that sustainability (ESG) may under certain circumstances contribute to positive returns. Excluding sin stocks from the portfolio does not give significant results, and the portfolio perform worse compared to the inclusion of sin stocks. When looking at the ESG score of sin stocks, high ESG scores indicate abnormal returns. Chapter 5 recapitulates the main findings in a conclusion.

2

Literature Review

This chapter discusses the background, terminology and findings from previous research on the topic. The review is divided into three main parts: firstly, literature about the relationship between ESG score and stock performance (positive, negative or insignificant results); secondly, literature about the inclusion or exclusion of sin industries and its impact on stock returns; and thirdly, literature analyzing investment strategies based on ESG scores within sin industries.

2.1 ESG Score and Stock Performance

Framework

The definition of sustainability from an investor's standpoint is socially responsible investing (SRI), which aims to capture both positive long-term financial returns with a positive social and environmental impact (Alsayegh et al., 2020). To determine whether a company is socially responsible, the ESG score is commonly used (Auer and Schuhmacher, 2016). Rating agencies base their ESG score on various measurements and key indicators, but all the ratings are founded on the three ethical non-financial pillars: environmental, social, and governance impact (Billio et al., 2021). The environmental pillar ranges from the use of natural resources, carbon emissions, energy efficiency to pollution. The social pillar refers to the wellbeing of the workforce and other issues like human rights and data privacy. The governance pillar covers how the company is managed, including board diversity, shareholder rights and corporate ethics (Boffo and Patalano, 2020). Because of the wide range of areas involved when calculating ESG, the scores of the rating agencies may differ. Determining a single ESG score for an individual company may be challenging, nevertheless, the metrics provide a good understanding of whether a company is unethical or takes sustainable responsibility (Boffo and Patalano, 2020).

To find significant evidence regarding the relationship between returns in the financial market and sustainability practices of companies, numerous studies with different methods have been conducted. The review of previous literature on the impact of ESG scores on stock return is divided into three sections: studies showing a positive, negative or insignificant outcome.

Positive Performance

According to Aydoğmuş et al. (2022), improving a company's ESG score has a correlation with enhanced company performance in terms of revenue and profitability. Weber, (2008) concluded that the increase in revenue stems from increased employee satisfaction, better company reputation, and avoidance of negative publicity (Weber, 2008). Friede et al. (2015) investigated the relationship between ESG score and corporate financial performance (CFP) based on an aggregated analysis of 2000 studies worldwide. The aggregated result display that 90% of the historical studies found a non-negative relationship between ESG and CFP. The result is confirmed by a positive ESG-CFP relationship when accounting for regions, time frames and asset classes. The only negative results occur when only considering portfolio-based ESG investment, due to portfolio implementation costs (Friede et al., 2015).

Similar research was conducted by Hvidkjær (2017), who investigated the relationship between ESG ratings and the risk-return characteristics of an investor's portfolio. According to Hvidkjaer, the argument for ESG outperformance is in essence a market failure to understand the value of ESG, and strategic investments in the ESG events should yield abnormal returns. Hvidkjaer studied previous research on ESG performance, with a focus on the impact of negative or positive screening during 1991 to 2017. Hvidkjaer found a positive relationship between ESG rating and performance, especially between 1992-2004. However, the author concluded that screening based solely on ESG score is not sufficient to conclude a direct relationship between ESG score and financial performance. Instead, Hvidkjaer argues that the screening is nevertheless useful for identifying companies that are or are not operating efficiently for their shareholders, stakeholders and employees (Hvidkjær, 2017).

Dorfleitner et al. (2014) investigate the long-term relationship between ESG scores and corporate social performance (CSP). The sample consists of American and Canadian stocks between 2002-2013. The relationship is measured by constructing a High-Minus-Low (HML) factor with a long (short) position in the 20% of the highest (lowest) ratings, which are then evaluated with the Carhart four-factor model. The results show that while incorporating factors for market risk, book-to-market value and momentum, the High-Minus-Low factor experiences significant positive alpha. In essence, investors can earn abnormal return in the long run by investing in companies with high ESG scores

(Dorfleitner et al., 2014). A study that supports Dorfleitner et al. (2014) was conducted by Ademi et al.(2022). The authors investigated the relationship between ESG score and both market value and financial performance on the S&P500 index from 2017 to 2022. MSCI ESG score was used with grades ranging from CCC to AAA, together with three different panel data regressions. The results from the panel data regressions indicate a positive correlation between ESG scores and financial performance. An increase in ESG score with one letter grade results in an increased return per capita by 1.51% (Ademi et al., 2022).

Negative Performance

Traditionally, investing in ESG is considered a trade-off, where investors forego financial rewards when contributing to a sustainable society (Baker et al., 2022). Boffo and Patalano (2020), investigated the relationship by creating fictive portfolios based on a sample of US stocks from 2009-2019 with ESG scores. A High- Minus-Low (HmL) factor was created, where the high (low) portfolio consisted of the top (bottom) 20th percentile ESG score with equal weight. Five portfolios were constructed using ESG scores from five different providers. The portfolio factors were evaluated with the Fama-French five-factor regression. The results display a higher alpha for low ESG portfolios in four out of five cases. Additional empirical research by Boffo on Morningstar's ESG fund performance in the U.S. found a negative correlation between ESG score and fund performance of 0.5 short-term (1-5 years) and 0.7 long-term (5-10 years) (Boffo and Patalano, 2020).

A study by Jang (2019) supports Boffo and Patalano result of a negative correlation between ESG score and financial performance. Jang created a High-Minus-Low factor based on ESG score of the European STOXX 600 index. The factor was evaluated with a Fama-French three-factor and Carhart four-factor model. The result presents a significant and negative impact of ESG score on stock performance. The regression displays a significant and negative alpha for the created factor, which confirms the negative impact of ESG scores (Jang, 2019).

Insignificant Performance

Like Dorfleitner et al. (2014), also Halbritter and Dorfleitner (2015) constructed portfolios based on high (low) ESG scores to measure if high ESG scores influence financial returns. The sample data from ASSET4 is based on the U.S. stock market from 2002 to 2020. In order to measure differences in ESG scores between different rating agencies, additional ESG data were extracted from Bloomberg, ASSET4 and KLD. Halbritter and Dorfleitner (2015) showed that the high ESG portfolio based on ESG data from ASSET4 performed similarly to the market, and the low portfolio underperformed compared to the market. The portfolios based on ESG data from Bloomberg and KLD did not indicate a relation-

ship between higher or lower ESG scores and performance. The authors argue that the choice of ESG rating agency strongly affect the outcome. However, there is no significant relationship between ESG scores and portfolio performance (Halbritter and Dorfleitner, 2015).

Auer and Schuhmacher (2016) computed a different study where they constructed portfolios based on 5th percentile high (low) ESG scores with equal constituent weight. The portfolios were evaluated with a Sharpe ratio and compared to a benchmark. The study presented a mixed result, where 15 out of 60 high-ESG portfolios had a higher Sharpe ratio compared to the market, and 18 out of 60 high-ESG portfolios outperformed the low-ESG portfolios. Additionally, 34 of 60 low portfolios outperformed the market. According to the authors, investors cannot expect a significantly higher return from stocks with high ESG scores, because investors pay a higher price for being socially responsible (Auer and Schuhmacher, 2016). Pedersen et al. (2021) argued that the demand of investors to integrate ESG in their investment portfolios is increasing. Yet, few are willing to sacrifice any financial returns. The study investigating ESG scores and their relationship to financial performance included various screening tools and portfolio selection strategies. When excluding the stocks with the lowest ESG scores from the sample, the analysis showed a decreased Sharpe ratio. Pedersen constructed a High-Minus-Low factor based on ESG scores. The factor was evaluated with a Fama-French three-factor and five-factor model. The three-factor model shows scant but significant evidence of abnormal returns (Pedersen et al., 2021). The results from the five-factor model show a consistently lower alpha, compared to the three-factor model, which means that profitability and investment factors explain the returns (Pedersen et al., 2021).

2.2 Sin Stocks Framework and Performance

Framework

Social norms affect the willingness of investors to invest in companies producing and distributing tobacco, alcohol, fossil fuels, gambling, and weapon. These industries are classified as sin industries, as they affect society negatively, both in terms of the environment, addiction and other social consequences (Hong and Kacperczyk, 2009). Whether or not to invest in sin stocks has become a popular research topic, seeing sin stocks are frequently excluded from investment funds. Excluding them entails advantages as well as disadvantages. The sin industries are constantly affected by new regulations and negative image, which consequently makes it harder for sin businesses to make a profit (Blitz and Swinkels, 2021). On the other hand, Fabozzi et al. (2008) argue that competition is lower because of the substantial barriers for entry in the industry, and the companies operating in the sin industries generally have a good position in their markets Fabozzi et al. (2008).

The next section will discuss previous literature on sin stock performance and how sin stock exclusion affected portfolio return historically.

Sin stock and positive Performance

One of the most cited studies concerning sin stock performance is a study by Hong and Kacperczyk (2009). The sample consists of price data from the CRSP on the U.S. stock market between 1926 and 2006. The authors focus on the performance of the triumvirate of sin: alcohol, tobacco and gambling. Hong and Kacperczyk measure sin stock performance through a long position in the sin stock and a short position in an equally-weighted portfolio of comparable stocks. The result from the time-series CAPM regression based on data from 1962 to 2006 shows that the portfolio has a positive alpha of 25 BPS a month with a significance level of 5%. Results from 1926 to 2006 show a similar result with an alpha of 30 BPS a month. Furthermore, a cross-sectional regression is used and confirms that sin stocks outperform similar stocks in the market with 30 BPS or 3.5% per year.

Fabozzi et al.(2008) studied how sin stocks perform compared to the market, and how social values affect stock returns. The study was based on price data for 267 sin stocks in 21 developed markets for the period between 1970 and 2007. Assets were classified as sin stocks from sin industries like alcohol, tobacco, defense, biotech, gaming and adult services. The result showed that the sin portfolio outperformed the relevant market index on an annual basis for 35 out of 37 years, with an average annualized excess return between 11.15 and 13.70% (Fabozzi et al., 2008).

Instead of analyzing a portfolio of sin stocks, Blitz and Swinkels (2021) analyzed the performance of the market portfolio when excluding the sin stocks. The portfolio was based on American stocks operating in 49 different industries, of which eleven are sin industries accounting for 11% of the market portfolio. The result shows that excluding eleven industries would decrease the expected annual return by 0.27%.

Excluding sin stocks receive the same results

Although previous literature suggests that including sin stocks in a market portfolio generates high financial performance, not all studies confirm this. Blitz and Fabozzi (2017) conducted a study based on data from the U.S. market from 1963 to 2016. The portfolio includes sin stocks from the weapon, alcohol, gambling and tobacco industries, which represent 2.1% of the total American equity market. The initial Carhart four-factor regression, when controlling for size, value and momentum, shows a significant and positive alpha, which indicates that the exclusion of sin stocks on a market portfolio results in under-performance. The results also show that the exposure to the market beta is sig-

nificantly negative, favoring low-beta stocks. In addition, the Fama-French five-factor model was applied, incorporating two additional factors, profitability and investment. These results show a small and insignificant alpha in the sin portfolio, which indicates that the two additional factors can explain the abnormal returns from sin stocks. Blitz and Fabozzi (2017) contradicts previous studies and argues that sin stock return comes from two factors: profitability and investments. An increase in the weights of stocks with similar exposure to profitability and investment would allow sin stocks to be excluded from the portfolio without loss in financial performance (Blitz and Fabozzi, 2017). Blitz and Swinkels (2021) confirm these results by debating that a portion of sin stocks can be excluded from a portfolio without resulting in poorer financial performance. However, a total exclusion of sin stocks implies less diversification and therefore poorer financial performance. The authors claim that from an asset pricing model standpoint, an investor could replace sin stocks with other assets with similar factor exposures. However, exclusion of an entire industry could not efficiently be replaced by other assets without suffering financially(Blitz and Swinkels, 2021) .

2.3 Relationship between ESG score and Sin Stocks

Framework

Like most other stock, sin stocks have an ESG score based on environmental, social, and governance performance. The ESG score of sin stocks tends to be lower compared to stocks from non-sin industries.

According to Saint-Martin and Pozza (2022), the ESG score and financial performance of a company are important factors when considering an investment. As the previous section indicates, excluding sin stocks from an efficient market portfolio contributes to poorer financial performance. Investors either tend to include all sin stocks to avoid negative performance, regardless of their poor sustainability profile, or they exclude all sin stocks from a portfolio, because they value social responsibility highly, which usually results in under-performance.

Blitz and Fabozzi (2017) and Blitz and Swinkels (2021)suggest that it is possible to exclude only a portion of sin stocks from a market portfolio, without affecting performance. The following section will look at research that considers the ESG scores of sin stocks, in an attempt to build a more sustainable portfolio, and studies that investigate if it is advisable to limit exclusion of sin stocks to those with a low ESG score, so as not to suffer financially.

ESG scores relationship with sin stocks

Sin stocks are negatively affected by social norms, resulting in fewer investments from financial institutions and less coverage by analysts. Previous research suggests that companies working in sin industries are expected to receive higher returns, since they face greater social risk (Hong and Kacperczyk, 2009). Dyrseth (2022) looked at the performance of sin stocks from the American and European market operating in alcohol, tobacco, defense, and gambling industries from 2011 to 2021. The study computed three portfolios based on whether their ESG score was high, medium or low. The first results from the Fama-French Five-model on sin stock performance indicate that the portfolio outperforms the market by 4% per year with a significance level of 10%. The result from the combined sin and ESG portfolios indicates that the low-ESG-sin portfolio has a positive alpha with an average annual return of 21.41%, whereas the high-ESG-sin portfolio has a negative alpha of -0,0011 on a monthly basis.

Additionally, Dyrseth(2022) constructed a High-Minus-Low factor, which invested a long position in the low-ESG-sin portfolio (bottom 33th percentile) and a short position in the high-sin-ESG portfolio (top 33th percentile). The results from the Fama-French five-factor model display a positive alpha; the results are not sufficiently significant. An earlier study by Paradis and Schiehll(2021) compared ESG ratings of sin stocks with comparable stocks from a non-sin industry. Sin stocks have an average ESG score lower than the control group, indicating a higher risk exposure. The authors argue that a lower ESG rating and higher risk are compensated with better financial performance (Paradis and Schiehll, 2021).

The previous literature sections reveal that ESG scores have a generally positive impact on financial performance. First, the relationship between ESG scores and performance across all industries presents a mixed picture, with scholars discovering evidence for both positive and negative performance. Secondly, sin stocks tend to yield high financial return, making it challenging to exclude them from a portfolio without experiencing financial drawbacks. Lastly, impact of ESG score on sin stocks lacks sufficient evidence. Further to the existing literature, we wish to integrate all three strategies on the same equity sample, in order to conclude which contribute to a financially responsible and sustainable portfolio. The current study will test the hypothesis that a successful company has a high ESG score, which in turn has a positive impact on stock returns. Also based on strong historical performance of sin stocks in the literature, one expects sin exclusion to affect portfolio performance negatively. So, it is worthwhile investigating whether sin stocks with high ESG scores will outperform sin stocks with low ESG scores.

3

Data And Methodology

This chapter introduces the methodology employed to investigate our research questions, along with the selection and collection of data. Firstly, the data sample selection and collection process are presented, along with the rationale behind the chosen approach. Secondly, the portfolio constructions and factor evaluation is described.

3.1 Data

In order to analyze different strategies for constructing a portfolio that will generate high financial returns as well as socially responsible outcomes, three fictive portfolios are constructed: the first based on high (low) ESG scores, the second on exclusion of sin industries, and the third on high (low) ESG scores within the sin industries. The data collection process for these portfolios consists mainly of two parts: identifying a sufficiently large equity sample and collecting all necessary stock data required for the different testing. For this study, the data sample is based on the Russell 3000, a market capitalization weighted-value index encompassing the 3000 largest companies in the U.S. Adopting a complete, large and diversified sample helps eliminate personal bias by the authors and safeguards the study against potential survival bias. The Russell 3000 index is updated annually based on changes in market capitalization, resulting in a slightly different data sample each year. The stocks of the Russell 3000 index for each year between January 1, 2009 and December 31, 2022 were collected from the Bloomberg database. The 14-year sample period allows us to capture the long-term relationship between ESG scores and the sin industries' performance. Thomson Reuters Eikon and DataStream databases were utilized to collect equity data for each stock in the Russel 3000. Total monthly returns were chosen over closing prices, as they incorporate both stock returns and dividends, and the latter are important when evaluating sin stock performance, particularly as sin industries often prioritize high dividend payments to

maximize shareholder wealth. In addition, yearly market capitalizations were collected to facilitate the calculation of market cap-weighted equity portfolios. Also, information on ESG scores is used to classify equities into high and low ESG-score portfolios and to determine ESG score weightings. Industry classifications for each equity were also gathered to properly categorize them into their respective industries. In addition to the equity data, the monthly market factors required for constructing the Fama-French three-factor and five-factor models as well as the Carhart four-factor model were obtained from the Kenneth R. French data library.

ESG data

When examining the performance of equities in the U.S. stock market based on their ESG scores, we take into consideration how ESG scores affect returns for all the stocks with an ESG score in the Russell 3000, how the exclusion of sin stocks from the portfolios affects the returns, and how the ESG scores affect the performance of sin stocks. With this in mind, data on the ESG scores of equities and their respective industries are crucial aspects of this study.

Table 3.1: Average ESG Score

Year	ESG Portfolio	Sin-Exclusion	Sin-ESG
2009	37,81	28,29	34,32
2010	38,15	38,46	35,74
2011	39,42	40,01	34,42
2012	40,46	40,96	35,48
2013	41,20	41,40	38,72
2014	41,62	41,84	39,77
2015	42,35	42,65	39,58
2016	41,36	41,59	39,10
2017	37,23	37,29	36,43
2018	36,00	36,04	35,02
2019	36,25	36,40	34,57
2020	37,53	37,60	36,56
2021	39,89	39,36	41,05
2022	43,49	43,28	45,99

Table 3.1 display the average yearly ESG score for the ESG portfolio, sin exclusion and sin-ESG samples from 2009-2022.

ESG rating agencies employ diverse metrics and key indicators to evaluate and assign ratings. These agencies adopt varying rating systems, for example, ranging from AAA to CCC or a 0-100 scale. The same company may be assigned different ratings by different agencies. This study utilizes the Refinitiv ESG score, obtained from the Thomson Reuters Eikon database. Refinitiv's ESG score is an objective measure based on ten content areas, over 630 data points and more than 70 analytics per company (Refinitiv, 2023). These

data points originate from data reported by the company; and the agencies adjust them to account for any discrepancies. The 630 data points correspond to the Environmental, Social and Governance pillars, with a relative weighting across the three. The resulting score ranges from 0 to 100, representing the spectrum of sustainability, with 100 indicating the highest score and 0 the lowest. Every company is assigned an ESG score for a specific trading year, reflecting their actions in the previous year. Companies without an ESG score or market cap data are excluded from the sample(Refinitiv, 2023). Table 3.1 presents the average ESG scores for the different portfolio constructions from 2009 to 2022.

Industry data

In order to accurately classify equities into their respective industries, we utilized three industry classifications from Thomson Reuters: TRBC Activity, GICS sub-industry and ICB subsector names. Among these, TRBC Activity provided the most specific industry classification for this study. With a total of 503 industries, including 41 sub-industries attributed to the sin sample, the TRBC Activity classification served as the primary framework for our analysis.

Table 3.2: Number of Sin Stock in Sample

Year	Alcohol	Fossil Fuel	Gambling	Defense	Tobacco	Total
2009	7	60	3	10	3	83
2010	8	65	5	10	4	92
2011	7	75	6	12	4	104
2012	7	72	6	13	4	102
2013	7	72	6	14	4	103
2014	6	73	5	14	4	102
2015	5	73	5	14	4	101
2016	9	80	7	16	3	115
2017	12	95	12	27	5	151
2018	18	128	14	29	4	193
2019	22	147	16	27	6	218
2020	22	145	16	25	6	214
2021	20	111	17	24	6	178
2022	20	111	20	25	7	183

Table 3.2 presents the sin industries selected as the header of the table. It provides information regarding the number of stocks in each sin industry and the total count of sin stocks in the SIN-ESG sample from 2009 to 2022. The calculation of sin industries is performed using an IF formula in Excel. Stocks that match the industry specification receive a value of one, while others receive zero. After applying this specification to all stocks in a given year, industries with a zero value are excluded, resulting in a dataset that exclusively represents the sin industries.

The classification of sin industries in Hong and Kacperczyk (2009) included alcohol, tobacco and gambling. For our purposes a wider classification is adopted, like the one in Fabozzi et al. (2008, defining sin industries as producers and distributors of fossil fuel, alcohol, tobacco, defense and gambling, as these are all associated with negative exter-

nalities on society. To ensure accurate industry classification, the sample is manually screened: stocks lacking sufficient industry, ESG, or market cap data are excluded from the analysis.

Table 3.2 illustrates a rapid increase in the number of sin stocks with an ESG score from 2009 to 2020, followed by a decline in the final two years of the sample period. With a sufficiently large number of stocks, the sample allows for the construction of well-diversified portfolios, although the fossil fuel industry stands out as notably larger than other industries.

3.2 Method

In order to investigate if ESG scores affect stock returns. High-Minus-Low (HML) portfolios are constructed using ESG scores of equities as a factor. The evaluation of financial performance will be done using the Fama-French three-factor and five-factor models, along with the Carhart four-factor model. The following sections will explain the portfolio constructions and methodology used for this research.

3.2.1 Portfolio Construction

Weighting criteria and percentiles

The factor for the factor mimicking portfolios is the ESG score, where two weighting criteria and two weighting percentiles are used. Based on the three portfolio samples, 12 portfolios are constructed, corresponding to 4 portfolios for every sample. The first weighting criteria is the ESG score, where stocks in both the high and the low ESG-score portfolio are weighted based on their ESG score. Stocks with higher ESG score are given a higher weight in their corresponding portfolio. The second weighting criteria is market capitalization. Also, in this case a higher weight is given to the stocks with a higher market capitalization in their corresponding portfolio. The two percentiles for stock inclusion in the portfolios are the 30th and the 10th percentile. The 30th and 10th percentile portfolios include the stocks with 10%/30% highest (lowest) ESG score. Table 3.3 demonstrates how many stocks are included in each portfolio.

ESG Portfolio

The ESG portfolios are constructed based on the total sample of stocks with an existing ESG score from the Russell 3000 index. In order to evaluate different portfolio constructions, the requirements from the "Weighting criteria and percentiles" section are implemented. The portfolios are restructured in the start of every year.

Sin-Exclusion Portfolio

The sin-exclusion portfolios are based on the ESG portfolio, the sin stocks are excluded from the ESG portfolios. In order to evaluate different portfolio constructions, the requirements from the "Weighting criteria and percentiles" section are implemented. The portfolios are restructured in the start of every year.

Sin-ESG Portfolio

The sin-ESG portfolios are based on all sin stocks with an ESG score in the Russell 3000 index. In order to evaluate different portfolio constructions, the requirements from the "Weighting criteria and percentiles" section are implemented. The portfolios are restructured in the start of every year.

Table 3.3: Number of Stocks In each Percentile and HML portfolio

			High	Low	High	Low		
Year	ESG Port 10th	ESG Port 30th	Sin-Ex 30th	Sin-Ex 30th	Sin-Ex 10th	Sin-Ex 10th	Sin-ESG 30th	Sin-ESG 10th
2009	71	213	196	181	64	58	24	9
2010	85	256	232	223	91	71	27	10
2011	95	287	261	240	87	76	31	11
2012	99	298	272	255	91	77	30	11
2013	99	297	265	260	87	78	30	11
2014	98	294	263	257	87	78	30	11
2015	97	292	266	256	88	80	30	11
2016	107	322	287	277	99	92	34	12
2017	178	536	492	484	165	159	45	16
2018	243	731	676	659	223	215	58	19
2019	277	832	769	744	254	240	65	21
2020	283	850	789	754	263	259	64	21
2021	288	865	802	786	266	238	53	17
2022	285	855	791	783	266	264	55	18

Table 3.3 display the number of stocks in each of the HML protfolios, ESG portfolio, Sin-Exclusion, and Sin-ESG. The headings refer the following HML portfolio construction criteria: ESG Portfolio (ESG Port), Sin-Exclusion (Sin-EX), and sin-ESG (sin-ESG). The 30th, and 10th are used to explain the weighting percentile used for the portfolio. The reason for the inclusion of all four high and low Sin-Exclusion portfolios are that the weights between the high and the low portfolios are uneven since the sin stocks were excluded directly from the high and low ESG portfolios.

Mimicking Portfolio

Different methods exist to create a factor-mimicking portfolio factor, such as Cross-sectional regression, Time-series regression and portfolio approach. This study uses a portfolio approach. The ESG scores of the stocks in the sample will be used as a factor. The stocks are then sorted according to their ESG scores. The stocks with low and high ESG scores are grouped in two different portfolios. Lastly, a factor-mimicking portfolio is constructed, a long position is taken in the portfolio with high ESG scores and a short position in the portfolio with low ESG scores (HML) (Asgharian, 2004).

The portfolio performance is measured every month by multiplying the individual weights of all constituents with their respective monthly total return. The individual returns are added together to represent the portfolio return for a specific month. A monthly factor for every portfolio is established, with a total of 168 observations from the sample period. The data sample duration is from 2009-01-01 to 2022-12-31, and the stocks of the Russell 3000, the ESG scores and market caps are updated at the beginning of every year, based on the previous year's performance. The stocks of the individual portfolios will be given two different weights every year: market cap and ESG score.

$$\frac{Marketcap}{TotalMarketcap} \qquad \frac{ESGScore}{TotalESGscore}$$

The market-cap weighting allows the size of the company to influence the outcome of the portfolio, because it increases the differences in weights between the stocks. ESG-weighting provides a more equal weight between the stocks, as the difference between the stocks ESG score is small. Nevertheless, the increase of stock with high ESG score will have a larger influence of the portfolio return.

In short, the portfolio strategy employed in this study offers a complete picture of the performance of the portfolios and enables modifications, based on market and stock-by-stock performance variations.

Time Period Split

To analyze the portfolio performance over time and during specific time periods, the sample data are split into two periods, from 2009-01-01 to 2017-12-31 and from 2018-01-01 to 2022-12-31. The factors are evaluated over the total sample periods and during the two split periods. Time period split will demonstrate whether the factor is experiencing more significant results during the last five years, or whether the factors worked more efficiently further back in time. As the market conditions constantly change, it can be expected that the observations of the last five years are more relevant to conclude how to structure an efficient sustainable portfolio today. If large variations exist between the two periods, this will affect the full sample regression.

3.2.2 Portfolio Evaluation

In order to evaluate how the portfolio is performing over time, the factors are evaluated on a monthly basis over the full sample period and in two different time periods. The performance of the factors created from the ESG, sin-exclusion and sin-ESG portfolios is investigated using a Fama-French three-factor and five-factor model, along with the Carhart four-factor model. The models are used to evaluate if the Fama-French models

can explain the return of the factors, or if the created factors are left unexplained by the models. A positive alpha would confirm that portfolio has higher returns compared to the market. A negative alpha would confirm that the portfolio display negative returns compared to the market; an insignificant alpha would suggest that the created factor cannot explain the historical returns.

To measure the relationship between ESG and stock returns, we define the different ESG portfolio factors as the dependent variable. The factor is measured with the total monthly return of the portfolio, where R is the total return from portfolio I at time T. The independent variables vary depending on which model is used. The Fama-French three-factor and five-factor models, along with the Carhart four-factor model are used for evaluating performance.

Fama-French three-factor Model

The Fama-French three-factor model (Fama and French, 1993) is a well-known financial model used to empirically evaluate the return of stocks and portfolios. Three factors are included in the model. Size or Small-Minus-Big (SMB) is measured by market capitalization and value. Value or High-Minus-Low (HML) is measured by book-to- market ratio (B/M). Market beta is measured with the excess return of the market portfolio. The factor SMB is constructed with a diversified portfolio of stocks with low market capitalization minus the return on a diversified portfolio of stocks with high market capitalization. The HML factor is created with a diversified portfolio of stocks with high B/M minus the return of a diversified portfolio of stock with low B/M (Fama and French, 2015). The test of the three-factor model by Fama-French (1993) is centered around the time-series regression:

$$R_{i,t} - \ Rf = \ \alpha_{i,t} + \ \beta_i(R_{M,t} - \ R_F) + s_i SMB \ + h_i HML \ \ + \ \varepsilon_{i,t}$$

$R_{i,t}$ = The return on a security or portfolio i, at time t.
R_F = The risk free rate.
$R_{M,t}$ = The return on the value-weighted market portfolio
$\varepsilon_{i,t}$ = Zero-mean residual
SMB = Size premium (Small-Minus-Big)
HML= Value premium (high-Minus-Low)

If the security or portfolios factor exposure β_i, s_i, and h_i can explain all variations of expected return for the security or portfolio, then the α_i will be equal to zero (Fama and French, 2015).

Carhart four-factor model

The Carhart four factor model (1997) is an extension of the Fama-French three-factor model. The model is developed by Mark Carhart and includes all previous factors from the Fama-French three-factor model. The fourth factor adds a cross-sectional momentum factor, Winners-Minus-Losers (WML), to capture additional explanatory effects of the multifactor model from momentum (Carhart, 1997). The factor is created by subtracting the equally weighted portfolio of low-performing stocks from the equally weighted portfolio of high-performing stocks. Stocks are classified into a high-momentum portfolio if the 12-month return trend is positive (Carhart, 1997)

$$R_{i,t} - \ Rf = \ \alpha_{i,t} + \ \beta_i(R_{M,t} - \ R_F) + s_i SMB \ + h_i HML \ + m_i MOM \ + \ \varepsilon_{i,t}$$

MOM= Momentum (Winners-Minus-Losers)

Fama-French five-factor Model

The Fama French five- factor model is a further development from the Fama-French three-factor model and adds two more factors to explain asset returns: Profitability or Robust-Minus-Weak (RMW) and investment or Conservative-Minus-Aggressive (CMA). The profitability factor(RMW) captures the effect of profitable firms performing better than low profitable firms. RMW creates a factor with a diversified portfolio of stocks with robust profitability minus a diversified portfolio of stocks with weak profitability. The investment factor(CMA) captures effects from high investment firms performing better than low investment firms. The CMA factor consists of a diversified portfolio of stocks with low investment minus a diversified portfolio of stocks with high investment; Fama and French define these as conservative and aggressive firms (Fama and French, 2015). The Fama French five-factor Model:

$$Rf = \ \alpha_{i,t} + \ \beta_i(R_{M,t} - \ R_F) + s_i SMB \ + h_i HML \ + \ r_i RMW \ \ + c_i CMA \ + \ \varepsilon_{i,t}$$

RMW= Profitability (Robust-Minus-Weak)
CMA=Investment (Conservative-Minus-Aggressive)

If the security or portfolios factor exposure β_i s_i, h_i, r_i, and c_i, can explain all variations of expected return for the security or portfolio, then α_i will be equal to zero (F.F., 2015). Fama-French five-factor alpha, α_5 is controlling for the market risk premium (Rm – rf), along with size (SMB), value (HML), profitability (RMW), and investment (CMA) factors.

4

Results

The following section is divided into four subsections, where each section introduce different results. Firstly, section 4.1 introduces the descriptive statistics of the high and low portfolios for the different samples. The remaining parts introduces the result from the Fama-French three and five-factor model as well as Carhart four-factor model where each sections 4.2, 4.3 and 4.4 is attributed to one specific portfolio sample.

4.1 Descriptive Statistics

Table 4.1 presents the descriptive statistics of three portfolios: ESG, Sin-exclusion, and Sin-ESG, employing different weighting methods. The high **ESG portfolios** exhibits higher average monthly returns and lower standard deviation compared to the low portfolios. Additionally, the high portfolio demonstrates higher average Sharpe ratios which indicates that stocks with higher ESG scores yield superior returns. As indicated in Table 4.1, all ESG portfolios exhibit skewness values ranging from -0.553 to -0.116, and kurtosis values ranging from 2.611 to 0.71. These results suggest that the portfolio returns are approximately normally distributed.

The **sin-exclusion portfolio**, being a derivative of the ESG portfolio, exhibits similar characteristics. The Sharpe ratios and average returns of the sin-exclusion portfolios are influenced by the exclusion of sin stocks which demonstrate good financial performance. Across all sin-exclusion portfolios, the high portfolio exhibits higher average monthly returns, lower standard deviation and higher average Sharpe ratios compared to the low portfolios which indicates that stocks with higher ESG scores yield superior returns. As indicated in Table 4.1, all portfolios exhibit skewness values ranging from -0.553 to -0.116, and kurtosis values ranging from 2.611 to 0.71. These results suggest that the portfolio returns are approximately normally distributed. Notably, the sin-exclusion portfolio displays a minimal disparity between the 30th and 10th percentile portfolios. The 30th

Table 4.1: Descriptive Statistics: High and Low Portfolios 2009-2022

	High							Low						
Weighting	AR	ST.Dev	Skew	Kurt	Min	Max	Sharpe	AR	ST.Dev	Skew	Kurt	Min	Max	Sharpe
30th ESG														
ESG-Portfolio	1,33	5,37	-0,17	2,52	-21,49	19,13	0,25	1,09	5,97	-0,16	2,27	-23,17	20,96	0,18
Sin-Exclusion	1,32	5,35	-0,14	2,21	-20,54	19,66	0,25	1,15	5,76	-0,23	1,86	-21,20	20,06	0,20
SIN-ESG	1,35	7,31	0,16	5,28	-33,59	32,77	0,18	0,62	10,19	0,42	5,18	-44,33	50,93	0,06
30th MC														
ESG-Portfolio	1,10	4,57	-0,37	0,70	-13,14	13,40	0,24	1,05	5,49	-0,29	1,83	-19,21	18,38	0,19
Sin-Exclusion	1,15	4,59	-0,36	0,51	-12,10	12,75	0,25	1,08	5,29	-0,37	1,57	-17,86	16,35	0,20
Sin-ESG	0,99	5,93	-0,05	3,81	-25,76	22,72	0,17	1,06	9,34	0,37	6,76	42,54	51,02	0,11
10th ESG														
ESG-Portfolio	1,27	5,03	-0,27	2,18	-19,94	16,95	0,25	0,99	6,24	-0,12	2,03	-21,94	23,43	0,16
Sin-Exclusion	1,29	4,97	-0,26	1,96	-19,12	17,31	0,26	1,11	5,82	-0,32	1,65	-20,18	19,08	0,19
Sin-ESG	1,03	6,83	-0,14	2,39	-28,62	23,30	0,15	0,57	10,19	0,62	3,05	-33,65	46,50	0,06
10th MC														
ESG-Portfolio	1,03	4,48	-0,39	0,56	-11,45	13,11	0,23	1,05	5,77	-0,55	2,61	-21,64	17,99	0,18
Sin-Exlsuion	1,10	4,50	-0,37	0,45	-10,52	12,73	0,25	1,11	5,43	-0,65	2,35	-20,52	17,04	0,21
Sin-ESG	0,86	5,76	-0,08	2,26	-22,04	20,79	0,15	1,00	9,85	0,95	7,74	-38,86	59,08	0,10

Table 4.1 displays the descriptive statistics for the high and low portfolios across all constructions and weighting methods from 2009 to 2022. The high portfolios are represented on the left side, and the low portfolios are on the right side. The 10th and 30th describes the percentages on stock inclusion of each portfolio. "MC" stands for market cap weighting and "ESG" stands for ESG weighting. The column headings represent key metrics, including Average Return (AR), Standard Deviation (ST.Dev), Skewness (Skew), Kurtosis (Kurt), and Sharpe Ratio (Sharpe).

percentile consistently exhibits higher average monthly returns, although the Sharpe ratios for these portfolios are nearly identical.

The **sin-ESG portfolio** has a smaller sample size compared to the other portfolios since it exclusively consists of sin stocks, which under certain year contribute to underdiversification and a larger standard errors. Table 4.1 demonstrate that the high sin-ESG portfolio with ESG weighting outperform the low portfolio with 0.73% on a monthly basis. The 10th percentile sin-ESG portfolio with ESG weighting exhibits a similar trend, where the high portfolio significantly outperforms the low portfolio. In contrast, the 10th percentile sin-ESG portfolio with market cap weighting displays a significant spread in the returns, leading to a larger kurtosis compared to other portfolios.

The overall trend from the descriptive statistics indicate that average market capitalization of the high ESG portfolios consistently surpasses that of the low ESG portfolios. This observation supports Auer and Schuhmacher (2016) theory that companies with a market capitalization above two billion tend to place greater emphasis on achieving a good ESG score. As ESG measures have gained importance as investment factors, the average ESG scores have continuously improved from 2009 to 2015 and have rapidly increased towards the end of the sample period. The increase in average scores could indicate that all companies have become more sustainable or that they are more aware of how to manipulate the score to appear more sustainable. Furthermore, the ESG weighting portfolio strategy continuously display higher returns and lower standard deviations which are due to a

more equal portfolio weight over the stocks.

4.2 Portfolio Evaluation ESG

ESG portfolio factors are derived from the 30th and 10th percentiles of the highest and lowest ESG scores, respectively. The first portfolio is weighted based on ESG scores, while the second portfolio is weighted by market capitalization. As shown in table 4.2 the 30th percentile ESG portfolio factor, with market cap weight, exhibits an insignificant alpha at the 5% significance level across all factor models, suggesting that the ESG score factor cannot explain returns more than the factor models. However, the same portfolio weighted by ESG scores, shows a significant positive alpha of 0.225% on a monthly basis with the Carhart four-factor model, at the 5% significance level. The positive alpha indicate that the factor explain abnormal returns. In contrast, the five-factor model reveals an insignificant alpha, implying that the profitability (RMW) and investment (CMA) factors account for the portfolio returns and arguable can explain the ESG factor. One aspect influencing the results, are the number of stocks included where the 30th percentile might contribute to over-diversification.

Table 4.2: Results ESG-Portfolio 2009-2022

Model	30th ESG	30th MC	10th ESG	10th MC
FF 3				
Alpha	0,232**	0,129	0,377**	0,107
	(0,111)	(0,130)	(0,148)	(0,186)
Carhart 4				
Alpha	0,225**	0,120	0,360**	0,089
	(0,111)	(0,129)	(0,146)	(0,184)
FF 5				
Alpha	0,084	0,002	0,202	-0,062
	(0,104)	(0,124)	(0,140)	(0,181)

Table 4.2 presents the regression results from 2009-2022 of the ESG-Portfolio HML portfolios using the Fama-French three(FF 3) and five-factor(FF 5) models, as well as the Carhart four-factor(carhart 4) model. The headings have the following meanings:"30th ESG" refers to the HML portfolio constructed by dividing the high and low portfolios based on the 30th percentile and portfolio weights are based on the ESG score. The "30th MC" portfolio are divided in the same manner as the 30th ESG portfolio, but the weights are assigned based on market capitalization. For the "10th ESG" and "10th MC" portfolios, the weights are determined using the same methodology as their 30th percentile counterparts, but the portfolios are divided based on the 10th percentile.The star symbols are referring to the degree of significance the P-value received, This paper use the following significance levels and the corresponding amount of stars :P $\leq 0.1, P \leq 0.05, P \leq 0.01, *, **, ***$.

The 10th percentile portfolios contain less stocks resulting in a larger difference between the high and low portfolios which increase the influence of ESG score. The market cap weighted portfolio shows an insignificant alpha across all three models, due to a larger standard error. In contrast, the 10th percentile portfolio with ESG weighting demonstrates a significant positive alpha at the 5% level with the Carhart four-factor model. The positive alpha translate to a monthly return 0.360%, indicating outperformance of both the market and the 30th percentile portfolio. The five-factor model show an insignif-

icant alpha, where the additional factors of profitability (RMW) and investments (CMA) receiving large and significant alpha instead suggesting that companies with high ESG scores achieve high returns due to their strong profitability and investment performance. Instead of proposing ESG contribute to higher financial returns, one could say that companies with high ESG scores have high profitability and investments which contribute to positive returns. Furthermore, the effect from the profitability and investment factors in the Fama-French five-factor models, is additionally supported by Pedersen et al. 2021. The ESG factor performance reveals mixed outcomes between the different weighting methods, with both positive and insignificant results, consistent with the study by Auer and Schuhmacher 2016.

The overall findings indicate that the factor generate abnormal returns in the Fama-French three and Carhart four-factor models with ESG weighting. However, the returns are primarily explained by the profitability and investment factor in the Fama-french five-factor model. The results from the ESG portfolios highlight that the market cap portfolios are heavily influenced by large stocks, resulting in insignificant performance. On the other hand, the ESG portfolios display a more balanced distribution and perform well in the regressions. The best performing portfolio construction is the 10th percentile portfolio with ESG weighting.

4.2.1 ESG Time Period Split

The two different time period splits exhibit significantly different results compared to the full sample regressions. The 10th percentile ESG portfolio with both ESG and market cap weighting display significant alpha on the 5% level in the first period, 2009-2017. However, the ESG weighting portfolio is consistently demonstrating positive alpha, whereas the market cap weighted portfolio is consistently demonstrating negative alpha. The differnce between the portfolios are influenced by large market capitalization companies with high ESG score, demonstrating low financial performance which significantly affect the outcome of the market cap weighting portfolio.

From 2018-2022, the 10th percentile market cap weighted portfolio demonstrates positive and significant alpha on the 5% level with the four-factor model, although an insignificant alpha with the Fama-French five-factor model. The time period split expose highly interesting result, where the factor is overall less significant the last five years, which might indicate that ESG is better explained by other Fama French factors today compared to the first time period. The 30th percentile portfolios do neither receive significant results on the first nor second time period. This significantly different performance is due to the number of stocks included in the portfolios, where the 30th percentile are over-diversified which makes it difficult for performing significant and abnormal returns. As the result

Table 4.3: Results ESG-Portfolio 2009-2017/2018-2022

	2009-2017				2018-2022			
Model	30th ESG	30th MC	10th ESG	10th MC	30th ESG	30th MC	10th ESG	10th MC
FF 3								
Alpha	0,158	-0,058	0,353**	-0,407**	0,302	0,372	0,391	0,854*
	(0,118)	(0,134)	(0,160)	(0,186)	(0,196)	(0,264)	(0,254)	(0,359)
Carhart 4								
Alpha	0,160	-0,054	0,359**	-0,400**	0,312	0,402	0,400	0,880**
	(0,118)	(0,132)	(0,156)	(0,181)	(0,201)	(0,269)	(0,261)	(0,368)
FF 5								
Alpha	0,096	-0,083	0,268*	-0,408**	0,066	0,056	0,165	0,446
	(0,118)	(0,137)	(0,157)	(0,189)	(0,187)	(0,231)	(0,255)	(0,337)

Table 4.3 presents the regression results for the time period split of the ESG HML portfolios using the Fama-French three (FF 3) and five-factor(FF 5) models, as well as the Carhart four-factor (carhart 4) model. The results from 2009-2018 are shown on the left-hand side, while the results from 2018-2022 are displayed on the right-hand side of the table. The headings in the table have the following meanings:"30th ESG" refers to the HML portfolio constructed by dividing the high and low portfolios based on the 30th percentile, with portfolio weights assigned based on the ESG score. Similarly, the "30th MC" portfolios are divided in the same manner as the 30th ESG portfolio, but the weights are assigned based on market capitalization. For the "10th ESG" and "10th MC" portfolios, the weights are determined using the same methodology as their 30th percentile counterparts, but the portfolios are divided based on the 10th percentile. The star symbols are referring to the degree of significance the P-value received, This paper use the following significance levels and the corresponding amount of stars :P $\leq 0.1, P \leq 0.05, P \leq 0.01, *, **, ***$.

change significantly between the full sample and the two period splits, it is not possible to conclude a significant relationship during all market conditions, although the portfolio outperforms during specific period and portfolios.

4.3 Portfolio Evaluation Sin-Exclusion

The sin-exclusion portfolio factors share the same conditions as the ESG portfolio, except that all sin stocks are excluded from the ESG portfolios. Overall the sin-exclusion portfolio demonstrates worse financial performance compared to the ESG-portfolio, which is due to the exclusion of sin stocks. Neither the 10th or 30th percentile portfolios with ESG weight nor market cap weight indicate any significant alpha on the 5% level which indicates that the portfolio factors cannot be distinguished from zero in the regression models. The insignificant results are likely influenced by a large standard error. In comparison to the ESG portfolios that include sin stocks, the sin-exclusion portfolios demonstrate significantly worse performance for both the 10th and 30th percentile portfolios. This relationship implies that sin stocks tend to have high stock return, and excluding them all without a strategy leads to under-performance of the portfolio.

This result is supported by Blitz and Swinkels (2021) study on the exclusion of sin industries from the market portfolio which concluded worse performance of portfolios without sin stocks. Furthermore, Hong and Kacperczyk (2009) found that a portfolio consisting solely of sin stocks outperforms the market due to a sin stock premium which explains why the exclusion of sin stocks cause the portfolio to perform worse. Overall, the results

Table 4.4: Results Sin-Exclusion 2009-2022

Model	30th ESG	30th MC	10th ESG	10th MC
FF 3				
Alpha	0,133	0,102	0,210	0,022
	(0,111)	(0,130)	(0,144)	(0,185)
Carhart 4				
Alpha	0,135	0,104	0,213	0,023
	(0,111)	(0,130)	(0,144)	(0,186)
FF 5				
Alpha	-0,022	-0,022	-0,028	-0,133
	(0,101)	(0,124)	(0,132)	(0,182)

Table 4.4 presents the regression results form 2009-2022 of the Sin-Exclusion HML portfolios using the Fama-French three(FF 3) and five-factor (FF 5) models, as well as the Carhart four-factor (Carhart 4) model. The headings in the table 4.4 has the same meaning as table 4.2. The star symbols are referring to the degree of significance the P-value received, This paper use the following significance levels and the corresponding amount of stars :P $\leq 0.1, P \leq 0.05, P \leq 0.01, *, **, ***$.

indicate that it is not possible to exclude all sin stocks from a portfolio and exhibit similar portfolio returns.

4.3.1 Sin-Exclusion Time Period Split

During the first period from 2009 to 2017, the 10th percentile portfolio with market cap weighting shows a significant alpha of -0.470 with the Carhart four-factor model. Compared to the portfolio which include sin stocks, the sin-exclusion portfolio demonstrate worse performance indicating high stock returns from sin stocks. The 10th percentile ESG weighted portfolio displays a positive alpha, although not statistically significant at the 5% level.

Table 4.5: Results Sin-Exclusion 2009-2017/2018-2022

	2009-2017				2018-2022			
Model	30th ESG	30th MC	10th ESG	10th MC	30th ESG	30th MC	10th ESG	10th MC
FF 3								
Alpha	0,075	-1,05	0,206	-0,469***	0,181	0,349	0,227	0,723 *
	(0,111)	(0,122)	(0,154)	(0,172)	(0,203)	(0,276)	(0,254)	(0,375)
Carhart 4								
Alpha	0,073	-0,106	0,204	-0,470***	0,201	0,384	0,257	0,764**
	(0,111)	(0,123)	(0,154)	(0,173)	(0,207)	(0,281)	(0,259)	(0,380)
FF 5								
Alpha	0,09	-0,129	0,095	-0,457**	-0,077	0,09	-0,005	0,299
	(0,0109)	(0,124)	(0,146)	(0,176)	(0,187)	(0,238)	(0,251)	(0,299)

Table 4.5 presents the regression results for the time period split of the sin-exclusion HML portfolios using the Fama-French three(FF 3) and five-factor (FF 5) models, as well as the Carhart four-factor (Carhart 4) model. The results from 2009-2018 are shown on the left-hand side, while the results from 2018-2022 are displayed on the right-hand side of the table. The headings in Table 4.5 have the same meaning as in Table 4.3.The star symbols are referring to the degree of significance the P-value received, This paper use the following significance levels and the corresponding amount of stars :P $\leq 0.1, P \leq 0.05, P \leq 0.01, *, **, ***$.

During the second time period, the 10th percentile portfolio with market cap weighting

demonstrates significant but this time positive alpha. The dramatic shift from negative to positive alpha between the two time periods can be attributed to the higher return of non-sin stocks in the last five years, which effect the sin-exclusion portfolio positively.

Furthermore, in the second time period, the ESG weighted portfolio did not achieve significant alpha with any factor model. When sin stocks are excluded, the market cap weighted portfolios outperformed the ESG weighted portfolios over the last five years. This suggests that non-sin stocks with larger market capitalization perform better than those with low market capitalization when sin stocks are excluded. Consequently, when comparing the ESG and sin-exclusion portfolio it is possible to conclude that sin stocks exhibit high stock performance, as the performance decreased when excluding sin stocks. The result is supported over both time-periods, which additionally supports the argument of excluding sin stocks resulting in worse portfolio performance.

4.4 Portfolio Evaluation Sin-ESG

The sin-ESG factor is based on all sin stocks from the Russell 3000 with an ESG score. The sin stock sample is limited, which results in smaller stock portfolios compared to the ESG and sin-exclusion portfolio. The 30th percentile sin-ESG portfolio, with ESG weights, exhibits significant alpha across all three factor models, as presented in Table 4.6. The positive and significant alpha indicate that the factor can be statistically differentiated from zero and the factor generate abnormal returns.

Table 4.6: Results Sin-ESG 2009-2022

Model	30th ESG	30th MC	10th ESG	10th MC
FF 3				
Alpha	0,994**	0,344	0,833**	0,304
	(0,320)	(0,337)	(0,406)	(0,467)
Carhart 4				
Alpha	0,918**	0,273	0,741*	0,190
	(0,300)	(0,321)	(0,383)	(0,436)
FF 5				
Alpha	0,923***	0,306	0,750*	0,203
	(0,330)	(0,347)	(0,414)	(0,477)

Table 4.6 presents the regression results form 2009-2022 of the Sin-ESG HML portfolios using the Fama-French three (FF 3) and five factor(FF 5) models, as well as the Carhart four-factor(Carhart 4) model. The headings in the Table 4.6 have the same meaning as Table 4.4.The star symbols are referring to the degree of significance the P-value received. This paper use the following significance levels and the corresponding amount of stars :P $\leq 0.1, P \leq 0.05, P \leq 0.01, *, **, ***$.

The 30th percentile portfolio with market cap weight, shows insignificant alpha from all factor models, which is attributed to excessively large influence on portfolio returns to sin stocks with large market capitalization since the sample size is small. Similar to the ESG portfolio, the factor based on ESG weighting experiencing more positive and significant

results. The 10th percentile portfolios with market cap experience insignificant alpha over all factor models. However, the same portfolio with ESG weighting demonstrates a significant alpha.

The results from the Sin-ESG portfolio support the hypothesis of better performance of sin stocks with high ESG scores. Where the optimal sin-ESG portfolio consists of the 30th percentile with ESG weighting which consistently demonstrate abnormal returns. The results contradict the previous study by Dyrseth (2022),which concluded a positive alpha for the low ESG-sin portfolio which are reasonable affected by different samples and time periods. Blitz and Fabozzi (2017) and Blitz and Swinkels (2021) argued the possibility of excluding parts of sin industries and still receiving the same performance. The results from the regression supports the hypothesis that it is possible to exclude sin stocks based on ESG score if investing with a similar weight (ESG weight) among all stocks. This result is of extra importance, since it makes it possible to exclude sin stocks without suffering financially.

4.4.1 Sin-ESG Time Period Split

During the first time period, between 2009 and 2017 the 30th percentile sin-ESG portfolio with ESG weight display a significant and positive alpha across all factor models which indicate abnormal returns between 0,911% and 0,991% per month. In contrast, the 30th percentile market cap weighted portfolio displays an insignificant alpha with all factor models. The difference between the weighting methods indicate that a few large market capitalization sin stocks significantly influence the return during the first time period. As described in (Table 4.7) all 10th percentile factor are receiving an insignificant alpha.

Table 4.7: Results Sin-ESG 2009-2017/2018-2022

	2009-2017				2018-2022			
Model	30th ESG	30th MC	10th ESG	10th MC	30th ESG	30th MC	10th ESG	10th MC
FF 3								
Alpha	0,960*	0,217	0,512	-0,367	0,955**	0,334	1,382*	1,260
	(0,445)	(0,423)	(0,481)	(0,554)	(0,454)	(0,583)	(0,761)	(0,874)
Carhart 4								
Alpha	0,991**	0,247	0,541	-0,323	0,909*	0,303	1,124	1,106
	(0,400)	(0,381)	(0,446)	(0,472)	(0,464)	(0,597)	(0,753)	(0,887)
FF 5								
Alpha	0,911**	0,215	0,612	-0,368	0,921*	0,350	1,116	1,112
	(0,455)	(0,430)	(0,486)	(0,545)	(0,487)	(0,629)	(0,804)	(0,935)

Table 4.7 presents the regression results for the time period split of the Sin-ESG HML portfolios using the Fama-French three(FF 3) and five-factor(FF 5) models, as well as the Carhart four(Carhart 4) factor model. The results from 2009-2018 are shown on the left-hand side, while the results from 2018-2022 are displayed on the right-hand side of the table. The headings in the table have the same meaning as Table 4.5. The star symbols are referring to the degree of significance the P-value received, This paper use the following significance levels and the corresponding amount of stars :P $\leq 0.1, P \leq 0.05, P \leq 0.01, *, **, ***$.

The second time period split, between 2018 and 2022 indicate similar results. The 30th percentile portfolio with ESG weight receive significant and positive alpha over all factor

models (Table 4.7). This result support the result from the first time period split, which increases the robustness of the results pointing toward a relationship between high ESG score and high sin stock return. The market cap weighted portfolio is receiving insignificant alpha and cannot statistically be differentiated from 0. Interestingly to notice, the alpha has changed from negative to positive from the first to second time split, although insignificant alpha (Table 4.7). The 10th percentile ESG weighting portfolios show a significant alpha over with the Fama-French three-factor model on the 10% level. Nevertheless, we conclude that the 10th percentile portfolios are generally under-diversified as can be seen in table 3.3.

5

Conclusion

Historically, companies have focused on maximizing profits for their shareholders without considering the consequences on the environment and society. However, as the world is increasingly concerned about sustainability, so are shareholders. Investors are more likely to invest in companies with high sustainability ratings; they consider ESG scores or exclude stocks from unethical, so-called sin industries from their portfolio, although they are not ready to sacrifice financial returns. The purpose of this thesis is to investigate how an investor can construct a sustainable investment portfolio without suffering financially. First, this study calculates performance in relation to ESG scores for all stocks in the sample. Secondly, the study examines whether the exclusion of sin stocks from the portfolio affects performance negatively. Lastly, this research explores the possibility of combining these two methods by analyzing the ESG score of sin stocks. The data for analysis were collected from the Bloomberg database on the Russell 3000 index, including total monthly returns of each stock. The time frame from January 1, 2009, to December 31, 2022 is split into two periods, in order to establish whether the relationship between the performance of ESG and sin stocks changed over time.

Three different portfolios were created, each attributed to a specific research question. The portfolios, called ESG, sin-exclusion, and sin-ESG, were analyzed using both ESG and market cap weighting. For each portfolio, a High-Minus-Low (HML) factor was constructed, taking a long position in the high portfolio and a short position in the low portfolio. The factor is evaluated by the Fama-French three-factor and five-factor models as well as the Carhart four-factor model.

From the analysis we learn that the high-ESG portfolios have higher average return and larger average market cap than the low-ESG portfolios. First, the 10th and 30th percentile ESG portfolio with ESG weighting that does include sin stocks demonstrates a significantly positive alpha which indicate abnormal returns. This factor could be used to construct a sustainable portfolio without suffering financially. Secondly, the factor regres-

sion models prove that the sin-exclusion model performs worse than the first. No portfolio factor receives a significantly positive alpha between 2009 and 2022, which confirms previous evidence of the fact that all sin stocks cannot be excluded from a portfolio. Thirdly, the 30th percentile sin-ESG portfolio displays significantly positive alpha over all factor models, so sin stocks with high ESG scores exhibit abnormal returns. The time period split regressions show significantly positive alphas during both periods. The result from the regressions prove that it is possible to earn abnormal returns on the sin-ESG portfolios. Overall, the returns are highly dependent on the number of stocks in the portfolio and on the specific weighting method. Highly diversified as well as under-diversified portfolios show insignificant results. In short, it is important to bear in mind when constructing a sustainable investment portfolio that excluding sin stocks results in underperformance. However, sin stocks with high ESG score display abnormal returns, which consequently results in higher returns while including sin stocks with high ESG score.

The main limitation of this study is the fact that although the ESG score is considered an objective measurement of a company's environmental, social, and governance practices, it tends to vary between rating agencies and may be influenced by the larger market capitalization companies themselves. Some bias toward large market capitalization companies transpires from the fact that the high-ESG portfolios continuously demonstrate a higher average market capitalization compared to the low-ESG portfolio. The high-ESG portfolios weighted on market capitalization generate less significant and spread-out returns, which indicates that the high market capitalization companies do not necessarily get higher returns. In order to measure the influence of the ESG score more efficiently, the score from various agencies can be downloaded and the effect from ESG scores can be compared between companies with similar market capitalization's.

Further, it would be interesting to find out if there exist other factors outside the scope of sustainability that affect the ESG score of companies, such as, for example, market capitalization. When examining the feasibility of excluding sin stocks from a portfolio based on ESG scores, it would be valuable to assess if the factor not only performs well on historical returns but also on future returns.

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Appendix

A Descriptive statistics

Table 5.1: Descriptive Statistics: High and Low Portfolios 2009-2017

	High							Low						
Weighting	AR	ST.Dev	Skew	Kurt	Min	Max	Sharpe	AR	ST.Dev	Skew	Kurt	Min	Max	Sharpe
30th ESG														
ESG-Portfolio	0,96	5,20	-0,43	3,72	-21,49	18,08	0,18	0,58	5,96	-0,34	2,99	-23,17	19,35	0,10
Sin-Exclusion	0,94	5,12	-0,47	3,16	-20,54	17,25	0,18	0,68	5,66	-0,47	2,58	-21,20	18,18	0,12
SIN-ESG	1,31	5,00	0,19	0,80	-11,85	15,92	0,26	0,68	8,29	0,23	0,85	-18,74	27,64	0,08
30th MC														
ESG-Portfolio	0,93	4,54	-0,37	1,05	-13,14	13,41	0,21	0,61	5,64	-0,33	2,38	-19,21	18,38	0,11
Sin-Exclusion	0,98	4,51	-0,41	0,74	-12,10	12,75	0,22	0,70	5,50	-0,41	1,99	-17,86	16,35	0,13
Sin-ESG	0,91	4,26	-0,18	0,80	-12,21	13,63	0,21	1,12	7,36	-0,02	0,80	-20,92	21,66	0,15
10th ESG														
ESG-Portfolio	0,95	4,98	-0,50	3,11	-19,94	16,10	0,19	0,43	6,09	-0,36	2,43	-21,94	20,00	0,07
Sin-Exclusion	1,51	4,28	0,27	1,57	-10,77	17,31	0,35	1,47	5,09	0,07	1,20	-12,52	19,08	0,29
Sin-ESG	0,97	5,46	0,04	-0,03	-11,34	16,20	0,18	1,00	8,29	0,38	0,97	-17,18	32,45	0,12
10th MC														
ESG-Portfolio	0,93	4,52	-0,34	0,76	-11,45	13,11	0,21	0,44	6,04	-0,73	2,87	-21,64	17,79	0,07
Sin-Exlsuion	1,16	3,87	-0,29	0,95	-10,32	11,14	0,30	1,64	4,02	0,07	0,62	-7,96	14,36	0,41
Sin-ESG	0,78	4,46	-0,16	0,07	-12,14	11,99	0,17	1,60	7,37	0,54	0,78	-16,46	28,09	0,22

Table 5.1 displays the descriptive statistics for the high and low portfolios across all factor constructions and weighting methods from 2009 to 2017. The high portfolios are represented on the left side, and the low portfolios are on the right side. The column headings represent key metrics, including Average Return (AR), Standard Deviation (ST.DEV), Skewness (Skew), Kurtosis (Kurt), and Sharpe Ratio (Sharpe). The descriptive statistics are computed using Excel formulas such as Average, STDEV.S, Skew, Kurt, Min, and Max. The Sharpe Ratio is calculated manually.

Table 5.2: Descriptive Statistics: High and Low Portfolios 2018-2022

	High							Low						
Weighting	AR	ST.Dev	Skew	Kurt	Min	Max	Sharpe	AR	ST.Dev	Skew	Kurt	Min	Max	Sharpe
30th ESG														
ESG-Portfolio	1,99	5,59	0,16	0,92	-11,73	19,13	0,36	2,01	5,94	0,16	1,03	-11,48	20,96	0,34
Sin-Exclusion	1,99	5,73	0,20	1,00	-11,73	19,66	0,35	2,01	5,87	0,12	0,70	-10,52	20,06	0,34
SIN-ESG	1,42	10,23	0,10	2,85	-33,59	32,77	0,14	0,53	12,92	0,49	5,03	-44,33	50,93	0,04
30th MC														
ESG-Portfolio	1,42	4,64	-0,39	0,28	-10,93	11,2 4	0,31	1,83	5,18	-0,12	0,51	-10,35	15,24	0,35
Sin-Exclusion	1,45	4,77	-0,31	0,27	-10,73	11,94	0,30	1,77	4,87	-0,15	0,18	-8,90	13,76	0,36
Sin-ESG	1,12	8,10	-0,04	2,11	-25,76	22,72	0,14	0,96	12,11	0,51	6,12	-42,54	51,02	0,08
10th ESG														
ESG-Portfolio	1,85	5,11	0,07	0,69	-10,68	16,95	0,36	1,99	6,43	0,21	1,45	-13,46	23,43	0,31
Sin-Exclusion	0,9	6,0	-0,5	1,4	-19,1	15,4	0,1	0,46	6,90	-0,47	1,24	-20,18	18,29	0,07
Sin-ESG	1,13	8,77	-0,23	1,92	-28,62	23,30	0,13	-0,21	12,90	0,80	2,74	-33,65	46,50	-0,02
10th MC														
ESG-Portfolio	1,22	4,44	-0,48	0,31	-10,59	10,73	0,28	2,14	5,12	0,19	0,75	-8,53	17,99	0,42
Sin-Exlsuion	1,01	5,46	-0,37	-0,29	-10,52	12,73	0,18	0,17	7,22	-0,54	0,86	-20,52	17,04	0,02
Sin-ESG	1,00	7,57	-0,07	1,43	-22,04	20,79	0,13	-0,09	13,12	1,16	6,59	-38,86	59,08	-0,01

Table 5.2 displays the descriptive statistics for the high and low portfolios across all factor constructions and weighting methods from 2018 to 2022. The high portfolios are represented on the left side, and the low portfolios are on the right side. The column headings represent key metrics, including Average Return (AR), Standard Deviation (ST.DEV), Skewness (Skew), Kurtosis (Kurt), and Sharpe Ratio (Sharpe). The descriptive statistics are computed using Excel formulas such as Average, STDEV.S, Skew, Kurt, Min, and Max. The Sharpe Ratio is calculated manually.