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Master's Thesis

On the relationship between sustainability and financial return in the U.S. stock market

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Abstract

This thesis studies the relationship between environmental, social and corporate governance (ESG) indicators and return for American stocks in the period 1995-2013. The study is carried out through three empirical analyses: the portfolio formation method of Fama and French, the two-stage regression method of Fama and MacBeth and an altered version of the Fama-MacBeth regression analysis. The results of the analyses are ambiguous and lack statistical significance. Thus, the study gives no indication that a focus on ESG factors create abnormal returns in the studied sample.

In the existing literature there has not yet been established consensus about the effect of sustainability factors on stock return: Some studies find evidence of a curvilinear connection between responsibility factors and financial return. Other studies identify a negative relationship. However, most studies have ambiguous results or lack statistical power. Therefore, there are still opportunities for further research on the subject.

The author raises some critical points when including sustainability factors in an econometric analysis concerning the identification of sustainability indicators, the quantification of these factors and how they are included in the analysis. It is recommended that these challenges are considered in future research.

Contents

1 Introduction

The concept of responsible investing means investing within some responsibility framework, which typically covers environment, social, and corporate governance issues. For the past two decades the responsible investing industry has experienced a steady growth. The trend continues and has reached even higher magnitudes the past couple of years. Between 2012 to 2014 the assets under professional management in the U.S. invested according to some responsible investing strategy increased by 76% (US SIF Foundation, 2014). As the demand for responsible investment options grow so does concerns regarding the financial performance from a stakeholder perspective, in the short and long run. Most certainly stands the question: do responsible investments give abnormal return?

This thesis seeks to enlighten the above stated question by reviewing the existing literature on the subject and by conducting an empirical analysis on a sample of American stock between 1995-2013. While there has still not been established consensus about the effect of sustainability factors on return some studies find a connection. Barnett and Salomon find evidence of a curvilinear relationship between social responsibility and financial performance in two studies of 2006 and 2012. The study of Kempf and Osthoff (2007) also find a curvilinear relationship, i.e. that very 'good' and very 'bad' stocks outperform those in between.

The analysis performed by the author of this thesis study the return of firms with a positive sustainability rating in contrast to the return of firms with no positive rating, along with three other factors: market beta, size, and book-to-market ratio. The analysis is conducted from three different approaches; the portfolio formation method of Fama and French (1992), the two-sided regression method of Fama and MacBeth (1973), and the adjusted Fama-MacBeth regression method of Fama and French (1992). The results give no indication of an effect of sustainability factors on future returns. The estimated coefficients are small, with varying sign and not statistically significant. However, the results support the findings of Fama and French (1992) of a size effect in the U.S. stock market. Conclusively some concerns are raised regarding the definition and measurement of sustainability, and the problems that arise when sustainability measures are included in a statistical analysis.

1.1 Problem statement

The aim of this thesis is to determine if sustainability, in terms of environment, social, and corporate governance factors, is a common risk factor in the U.S. stock market, and thus has an effect on returns of American stocks. The assessment of this problem results in the following research questions:

(Q1) What defines sustainability, in relation to environment, social, and corporate governance (ESG) issues?

(Q2) How can sustainability be measured or proxied?

(Q3) What is the expected relationship between sustainability and stock returns?

To investigate the main problem, whether or not there is a link between U.S. stock returns and sustainability/ESG factors, an empirical study will be performed based on a sample of American stocks listed on NYSE, AMEX and NASDAQ in the period July 1995 to June 2013. Prior to the empirical implementation, the above stated sub questions will be sought answered in the literature review.

1.2 Delimitations

Different analytical methods are applied in order to investigate the main problem: The portfolio formation method and the regression method both by Fama and French (1992) and the two-stage regression method of Fama and MacBeth (1973). This thesis does not test different investment strategies, nor different screeening strategies, within sustainability investing.[1].

The empirical analysis of this thesis is limited to tests of a linear asset pricing model, based on the three-factor model of Fama and French (1992).

This thesis examines only equities listed on American stock exchanges. The results of this thesis do not necessarily apply to other asset classes or countries.

The empirical analysis will only include stocks with available information on the variables of interest in the research period.

[1] Different types of screening strategies are presented in section 2.3

Finally, throughout this thesis the terms sustainable investing, responsible investing, socially responsible investing, and ESG investing are used interchangeably to describe these investment practices.

1.3 Structure

This thesis consists of two parts, a theoretical part and an empirical analysis. The former part sets the theoretical and analytical framework for the latter. The structure of the theoretical part is as follows: Section 1 introduces the problem statement and formulates the research questions which this thesis seeks to answer. Section 2 introduces the concept responsible investing and how it has developed over time. Section 3 presents the modern portfolio theory which sets the boundaries for the analysis. Section 4 reviews the existing literature within the field of responsible investing and the studies of Fama and MacBeth (1973) and Fama and French (1992). The empirical analysis part is structured as follows: Section 5 presents the methodologies that are implemented in the three different data analyses. Section 6 describes the data that is used in the analyses. Section 7 presents the results from the empirical analyses. Lastly, section 8 discusses the obtained results, some concerns regarding the measurement of sustainability, and concludes the thesis.

2 Responsible investing

In the following section the concept of responsible investing will be introduced, starting with its history and development and leading to a common understanding/definition of the concept. So this section lays the ground for answering the sub questions in section 1.1.

2.1 History of responsible investing

Although the concept of responsible investing (henceforth referred to as RI) is relatively young, investing within a certain ethical doctrine has been practiced for centuries. The promotion of ethical capital spending has traces in both Jewish, Christian, and Islamic traditions. For centuries the Catholic Church has purposely invested its funds in companies within a certain ethical and religious framework (Matloff and Chaillou, 2013, chapter 11). In the medieval Europe loans and investments were constrained by Christian ethical guidelines based on the old testament.[2]

The earliest traces of responsible investing in America are generally considered to be the Quakers movement in the 17th century. The sermon *'The Use of Money'* of John Wesley, the founder of Methodism, stated that people should not engage in sinful trade nor profit from exploiting others. Although slave labor was common at that time, Quakers refused to be involved in slaves trade due to these ethical concerns. In the 1920s the Methodist Church in the UK refused to invest in companies that were related to what was considered 'sinful' behavior, i.e. alcohol, tobacco, weapons and gambling (Renneboog, Horst, and Zhang, 2008a).

From the 1970s to 2000s the modern concept of responsible investing developed. Growing opposition against the Vietnam war, Apartheid in South Africa, and nuclear power among the American middle class created a desire for socially responsible investment funds.

In 1971, the Pax World fund was founded, it was the first modern RI mutual fund. The fund was created for pacifist investors opposing the Vietnam War. The fund refrained from investing in weapon contractors or any other companies that profited from that war (Renneboog et al., 2008a).

[2] *"If you lend money to My people, to the poor among you, you are not to act as a creditor to him; you shall not charge him interest."* (Old Testament, Exodus 22:25)

In the 1980s concerned investors in US and Europe pushed companies with operations in South Africa to divest or move their operations to other countries, to show their concern with the Apartheid. In California, the state pension funds divested $6 billion from companies related to South Africa after a law amendment was passed (Sparkes, 2002). In the late 1980s two environmental disasters occured: the Chernobyl nuclear accident in Ukraine in 1986, and the Exxon Valdez oil spill in Alaska in 1989. These two disasters made investors (as well as the general public) aware of the negative environmental consequences of industrial development. From then responsible investing was not only about being socially responsible, but also about environmental sustainability.

During the 1990s and 2000s a series of corporate scandals[3] has added corporate governance to the watch list of responsible investors (Renneboog et al., 2008a). Thus responsible investing today considers responsibility within three issue areas: environment, social, and corporate governance.

2.2 Responsible investing - the numbers

Responsible investing has grown substantially since the 1990s. In America the Forum for Sustainable and Responsible Investment (US SIF) keeps track of the growth in RI. US SIF estimates that in 2014 more than one out of every six dollars (18%) under professional management in the United States is invested using RI strategies, which is an increase of 76% since 2012. The RI market, in terms of invested dollars, has increased ten times since US SIF first measured the size of the American RI market in 1995. This counts both shareholder advocacy and strategies incorporating environmental, social, or corporate governance (ESG) factors. The extreme growth is especially due to the growth in ESG incorporating strategies. The number of investment funds incorporating ESG factors has grown 17 fold since 1995 (US SIF Foundation, 2014).

US SIF has made a breakdown of ESG factors incorporated in the investment strategy of professionally managed assets as of 2014. The breakdown shows that social responsibility is the most important of the ESG factors to professional asset managers. 770 investment vehicles included a social factor in the investment strategy of $4.27 trillion in assets. Environmental responsibility comes second, included by 672 vehicles in the management of $2.94 trillion. Third is corporate governance issues, which is included

[3]Some of the biggest corporate scandals were Bre-X goldmining fraud in 1997, LTCM hedge fund collaps in 1998, WorldCom accounting fraud in 2001, and Enron fraud in 2001.

in the investment strategy of 501 investment vehicles that manages \$3.53 trillion. Finally, 445 investment vehicles include product-specific restrictions such as restrictions on investment in tobacco, in the management of \$1.76 trillion (US SIF Foundation, 2014).

Thus, the market for responsible investing has already grown substantially. With the evolution of the concept a common understanding - almost a definition - is forming as will be presented in the next section.

2.3 Definition of responsible investing

Responsible investing is one of many terms[4], used to describe an investment strategy that aims to maximise financial return while meeting certain ethical conditions. What exactly these conditions are and how strictly the restraints are depends on the individual investor.

Although there is no standard method within responsible investing, Blowfield and Murray (2008) identify three general strategies for responsible investing: shareholder advocacy, community investment, and screening. In the following these strategies will be explained, the two former only briefly as the focus of this thesis remains on the relationship between sustainability factors and stock return.

Shareholder advocacy

Investors that practice a shareholder advocacy strategy actively seeks to affect a company's behavior, e.g. by voting on issues at annual meetings. Institutional investors can act as proxy voters on behalf of their clients, and therefore have a heavy vote due to their large size, as they typically represent many investors in one company. Another form of shareholder advocacy is divestment, which can be very stressful for a company if a relatively large group of investors divest, as was seen in 1980s for companies with operations in South Africa (see section 2.1). Thus, this strategy relies on the investor to be actively advocating for positive change (Schueth, 2003).

Community investment

Another form of sustainability investing is investing directly in a community institution

[4]In the literature of responsible investing, other terms with the same meaning are frequently used, such as *socially responsible investing* (SRI), *ethical investing* (EI), *green investing* and *ESG investing* (Bauer et al., 2005).

to support economic development locally, typically in low-income or disadvantaged communities (Schueth, 2003).

Screening
Screening strategies are practiced widely in modern RI. There exists different approaches to the screening strategy, the common denominator of all is that companies are evaluated based on the given ethical criteria prior to any potential investment. Below are explained different approaches.

Norms-based screening
The norms-based approach screens companies to identify and exclude companies that violate certain norms, principles or standards. These norms or principles are typically based on conventions by OECD, United Nations, or other intergovernmental or governmental organizations. All investors are obligated to apply norms-based screening to some degree to comply with international law, for example to avoid investing in companies that use illegal child labor in the production. An example of a common criteria used in the norms-based screening by institutional investors is cluster bombs. While it is not illegal to invest in companies that produce cluster bombs it is often avoided by institutional investors.

Negative screening
Investors that practice negative screening exclude companies from their investment universe based on certain individual criteria. Negative screening is widely used to exclude companies that operate in industries that are regarded as controversial. Controversial business areas traditionally include tobacco, alcohol, pornography, military and gambling. Barnett and Salomon (2006) point out that negative screening may result in excluding not only individual companies, but entire industries, and thus narrow the investment universe. According to Markowitz (1959) this limits diversification of specific risk and thus should result in decreased risk-adjusted return (diversification is explained in section 3.1).

Positive screening
This approach includes companies based on given criteria, rather than excluding companies based on criteria. Companies are typically screened based on environmental, social, and corporate governance (ESG) factors. Today, there exists several agencies

that analyse and rate companies, according to different measures of ESG factors.[5] Barnett and Salomon (2006) argue that screening - positive or negative - will result in a decreased investment universe, and is thus expected to deliver decreased risk-adjusted return, compared to no screening.

Best-in-class screening

The best-in-class approach does not exclude any sector or industry, and thus allows the investor to build a sector-balanced portfolio of stocks. The best-in-class screening identifies the 'best', or 'least bad' companies in every industry and includes these to the investment universe. Screening is often based on ESG parameters, as in the positive screening approach. As for the other approaches there are pros and cons for best-in-class screening. The growth of best-in-class screening within RI may force industries to raise the bar as they compete for the best-in-class positions. However, this method is more vague than the others, as smaller companies that cannot afford to report in such details as large companies may score lower on ESG parameters although it does not reflect reality, which can push the portfolio towards large companies (Blowfield and Murray, 2008).

There are advantages and disadvantages to all of the above mentioned screening approaches. However, as this thesis aims to explore a relation between sustainability factors and stock return, rather than analysing different screening methods, this will not be addressed further.

Answer to research question (Q1)

Sustainability investing remains vaguely defined, as there are many approaches to implementing a sustainability investment strategy. However, if the concept is limited to ESG investing then a common understanding is more obvious. The areas that are often included in an ESG assessment are; climate change, waste management (e.g. disposal of hazardous waste), nuclear energy, sustainability (e.g. depending on diminishing raw materials), employee diversity, human rights (e.g. using child labor), consumer protection (e.g. predatory lending), animal welfare (e.g. animal experiments), management structure, employee relations, and executive compensation. Sometimes exposure to controversial business areas, such as tobacco, alcohol, gambling, pornography, and fire arms, are also included in an ESG assessment.

[5] MSCI ESG STATS, Eiris, and Thomson-Reuters are a few.

Answer to research question (Q2)
As will be discussed in section 8 one of the drawbacks of doing quantitative analysis on sustainability investing is that it is difficult to measure, or quantify, something that is poorly defined. As the RI industry grows so does the number of external agencies that analyse and rate companies in accordance to some ESG indicators. Although the industry seems to be settled on the overall environment, social, and corporate governance factors, the underlying indicators still vary from agency to agency. MSCI STATS is one of several agencies that offers yearly updated ESG ratings that cover a large number of American stocks. The methodology of STATS is doing a thorough company analysis in order to check on or off the underlying E, S, and G indicators (MSCI Inc., 2013). How the data is used in the investment decisions varies with the individual investor and according to the screening strategy practiced. As will be explained in section 6 the author of this thesis collapses these indicators into three overall E, S, and G dummy variables. This approach is convenient when analysing stocks on an overall ESG-rated or not ESG-rated level. While this obviously decreases the level of details it is more practical in the analytical methods implemented in this thesis, than working with 60 different indicators. The challenges in measuring sustainability and using these measures in a quantitative analysis will be discussed further in section 8.

The next section will explain modern portfolio theory, which is a prerequisite for understanding how applying sustainability factors to the investment decision may affect the portfolio performance.

3 Modern portfolio theory

The following section will explain the concepts and ideas of modern portfolio theory, which laid the ground for the asset pricing models that will be applied in the data analysis of this thesis.

Markowitz (1959) concept of the efficient frontier laid the foundation for modern portfolio theory. His risk-return theory lead Sharpe (1964), Lintner (1965) and Black (1972) to develop the capital asset pricing model (CAPM). CAPM, which is a model for pricing of risky assets, has played an important role in modern portfolio theory. Though, the model has been under constant scrutiny for its lacks and shortfalls, many economists have further developed the model in an attempt of improving its predictive power. Two of the rather important contributors in this development are Fama and French (1992), who introduced an expansion of CAPM, the three factor model (TFM). CAPM and TFM will be presented in section 3.3 and 4.4 respectively.

3.1 Mean-variance analysis

The main idea of modern portfolio theory is that investors must make a risk-return trade-off when assessing potential investments. This idea was first brought up by Markowitz (1959) in his mean-variance analysis, which relies on two essential assumptions:

(1) all rational investors are risk averse, and

(2) financial markets are frictionless

The first assumption is straight forward; rational investors want to maximize the expected return given a certain variance, or to minimize the variance on their portfolio given an expected return. Thus investors are assumed to be risk averse, i.e. making an optimal trade-off between mean (expected return) and variance (risk). The second assumption is harder to accept; frictionless markets imply that all stocks are tradable at any given price, at any given time, and in any given amount. Thus, there are no short selling restrictions, and you can buy or sell 0.25 equity if you please. Frictionless markets also imply that there are no taxes or transaction costs in price taking (Markowitz, 1959, s. 6).

Minimum-variance portfolios

The existence of minimum-variance portfolios is derived directly from the first assumption; risk averse investors will at any time invest their funds in portfolio A rather than portfolio B, if portfolio A has a higher expected return than portfolio B given the same variance. Likewise portfolio A is more attractive than portfolio B, if portfolio A has a lower variance than portfolio B, given the same expected return. Thus, portfolio B is inefficient since there exists a better trade-off between mean and variance in portfolio A, portfolio B is dominated by portfolio A. If there are no portfolios dominating portfolio A, i.e. there are no portfolios that deliver a better trade-off between mean and variance, then portfolio A is a minimum-variance portfolio (portfolio A is efficient). There are several minimum-variance portfolios in the market, each of them proposing the highest expected return (mean) at a given level of risk (variance). The efficient portfolio with the lowest risk (variance), and therefore lowest expected return (mean) between the efficient portfolios, is called the global minimum-variance portfolio. The collection of all minimum-variance portfolios create a frontier, which is called the efficient frontier (see figure 1). If the first assumption holds, that rational investors are risk averse, then it is irrational to invest in any portfolios outside of the efficient frontier.

Diversifiable and systematic risk
As explained in the previous section investors must make a risk-return trade-off when evaluating a potential investment. However, when it comes to individual securities there are two types of risk: One that can be avoided, and one that can not be avoided. Diversifiable risk is risk that can be eliminated from a portfolio through diversification[6], and thus should not exist in the rational investor's portfolio. It is the risk associated with the individual security and does not represent a general risk factor in the market. Systematic risk on the other hand is the risk that cannot be eliminated through diversification and therefore cannot be averted. It is the common risk in the market explained by e.g. changes in commodity prices, interest rate, inflation or war. The systematic risk gives evidence that all stocks, more or less, are correlated. To which degree a stock is correlated with the market varies. This correlation with the market is measured by the variable β, which will be explained in section 3.3. If there existed no correlation in the market all risk could (hypothetically) be eliminated by diversification (Markowitz, 1959, p. 5).

[6]Diversification means holding enough securities in ones portfolio, so that the specific risk of each security cancels out.

3.2 Capital market line

The following section will explain what happens when a risk free asset is introduced in the market. This adds a third assumption to the list:

(3) all investors can at any time go long and/or short in the risk free asset

As the risk free asset has zero variance, the portfolio with weight 100 pct. in the risk free asset is the global minimum-variance portfolio.

Given the theory of mean-variance analysis, introducing a risk free asset to the market gives two results: (R1) Introducing a risk free asset in the market implies that all minimum-variance portfolios are plotted on a straight line, intersecting the secondary axis in r_f, the return of the risk free asset. (R2) All portfolios on the efficient frontier can be found as the weighted average of two arbitrary portfolios on the efficient frontier (Markowitz, 1959, s. 149).

Realising that the portfolio with weight 100 pct. in the risk free asset is an efficient portfolio is straight forward as it is the global minimum-variance portfolio. Hence, the risk free asset must be located on the efficient frontier. Applying (R1), that all minimum-variance portfolios are plotted on a straight line, implies that the line that intersects the secondary axis in r_f (the risk free asset's return) and is tangent to the efficient frontier is a part of the efficient frontier itself. This straight line, that only exists if a risk free asset is present in the market, is called the capital market line (CML). CML is located above the efficient frontier except in the point where it is tangent. Thus the 'old' efficient frontier is no longer efficient as there exists dominating portfolios on the CML (same variance, higher mean). All portfolios on CML are now minimum-variance portfolios. The portfolio located on CML in the point where it is tangent to the efficient frontier is called the tangency portfolio (see figure 1).

Tangency portfolio
The tangency portfolio is a minimum-variance portfolio in the market both when there is, and where there is not, a risk free asset present. Applying (R2), all portfolios on the efficient frontier can be found as the weighted average of two arbitrary portfolios on the efficient frontier, implies that all portfolios on CML can be produced as a combination of the portfolio with 100 pct. weight in the risk free asset and the tangency portfolio.

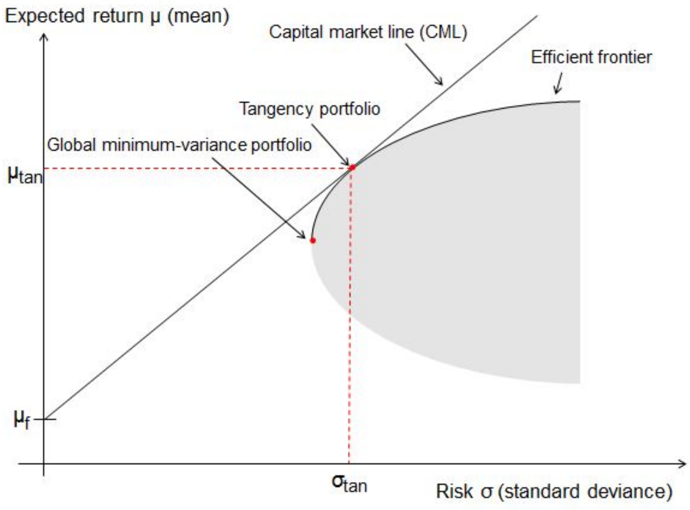

Figure 1: The efficient frontier and CML.

The CML equation is:

$$r_p = \frac{r_{tan} - r_f}{\sigma_{tan}} \sigma_p + r_f \tag{1}$$

as the capital market line intercepts the secondary axis in r_f and the slope is calculated from the return of the risk free asset r_f, its standard deviation which is zero, the expected return of the tangency portfolio r_{tan}, and its standard deviation σ_{tan}. It follows from $r_p - r_f > 0$ that the slope in (1) is always positive: An investment in risky assets should always give a premium return to r_f, otherwise these portfolios would be dominated by the portfolio with 100 pct. weight in the risk free asset, and only this portfolio would be efficient. Hence all portfolios on CML have higher expected return, and higher standard deviation than the global minimum-variance portfolio.

3.3 Capital asset pricing model

The previous section explained Markowitz (1959) mean-variance theory. The following section will go through the theory of capital asset pricing model (CAPM) which is based on mean-variance theory.

The first three assumptions of CAPM are those applicable for mean-variance theory as well (the third was applicable only when a risk free asset was present in the market):

(1) all rational investors are risk averse

(2) financial markets are frictionless

(3) all investors can at any time go long and/or short in the risk free asset

Market portfolio

CAPM introduces a new portfolio, the market portfolio, which is defined as the efficient portfolio invested in all and in exclusively risky assets. Thus, according to mean-variance theory the market portfolio is equal to the tangency portfolio. In the market portfolio the weight of each asset is equal to its market value relative to the total market value of all assets. Thus, the weights sum to 1 and each asset's weight represents its market value relative to the total market.

CAPM states that all risky assets should be rewarded with an excess return $\mathrm{r}_i - \mathrm{r_f} > 0$ relative to the risk they take. This is in compliance with the ideas of mean-variance theory. In this context 'risk' refers to systematic risk only, not diversifiable risk (see diversification in section 3.1). The systematic risk is measured by $\beta_{\mathrm{M}i}$, which is asset i's relative volatility to the market. It measures to which degree the variance on the return of asset i is due to variance in the return on the market portfolio, i.e. to which degree price movements of the asset is related to general movements in the market. Intuitively a consequence of this definition is that the higher $\beta_{\mathrm{M}i}$ the higher must be the expected excess return.

CAPM measures asset i's specific risk, $\beta_{\mathrm{M}i}$, as:

$$\beta_{\mathrm{M}i} = \frac{\mathrm{Cov}(\mathrm{r}_i, \mathrm{r_m})}{\mathrm{Var}(\mathrm{r_m})} \tag{2}$$

where $\mathrm{Cov}(\mathrm{r}_i, \mathrm{r_m})$ is the covariance between the return on asset i (r_i) and the return on the market portfolio ($\mathrm{r_m}$). $\mathrm{Var}(\mathrm{r_m})$ is the variance of the return of the market portfolio. In practice $\beta_{\mathrm{M}i}$ is often estimated by linear regression of (3) using historical returns in the equation.

An asset pricing model

As previously mentioned the CAPM states that the expected return on asset i is positively related to its $\beta_{\mathrm{M}i}$. Hence, assets that take on excess risk to the market portfolio is expected to be rewarded by an excess return to the market portfolio. Given that the expected excess return on the market portfolio is $\mathrm{E}(\mathrm{r_m}) - \mathrm{r_f}$ then the CAPM says the following linear relationship exists between asset i's expected excess return and its $\beta_{\mathrm{M}i}$:

$$\mathrm{E}(\mathrm{r}_i) - \mathrm{r_f} = \beta_{\mathrm{M}i}(\mathrm{E}(\mathrm{r_m}) - \mathrm{r_f}) \tag{3}$$

(3) shows that the higher the systematic risk ($\beta_{\mathrm{M}i}$) the higher the expected excess return ($\mathrm{E}(\mathrm{r}_i) - \mathrm{r}_\mathrm{f}$).

Black, Jensen, and Scholes (1972) find support for a positive linear relationship between asset i's expected excess return and its $\beta_{\mathrm{M}i}$ in their regressions study on the realised excess return on NYSE stocks and the realised excess return on the market portfolio in the period 1926-1966.They find that $\beta_{\mathrm{M}i}$ potentially cannot catch all systematic risk and suggest that the model is expanded by at least one other factor to capture the systematic risk that $\beta_{\mathrm{M}i}$ cannot explain. They also point out that assumption (3) is very restrictive (all investors can at any time go long or short in the risk free asset) and not an acceptable approximation to reality. Namely this assumption has often been the criticised point of CAPM. Black (1972) tests the CAPM in two cases while slagging on this assumption: (i) when there is no risk free asset in the market, but all investors can go long and short in the risky assets, and (ii) when there is a risk free asset in the market but no investors can go short in the risk free asset.

Based on the results of this test Black (1972) concludes that the expected excess return on asset i has a positive linear relationship with its $\beta_{\mathrm{M}i}$. Thus slagging on restriction (3) does not change the results. Black makes the following revised CAPM:

$$\mathrm{E}(\mathrm{r}_i) - \mathrm{E}(\mathrm{r}_\mathrm{z}) = \beta_{\mathrm{M}i}(\mathrm{E}(\mathrm{r}_\mathrm{m}) - \mathrm{E}(\mathrm{r}_\mathrm{z})) \tag{4}$$

where $\mathrm{E}(\mathrm{r}_\mathrm{z})$ is the expected return on portfolio z which is the efficient portfolio with $\beta_\mathrm{M} = 0$, also known as the minimum-variance-zero-beta portfolio. The minimum-variance-zero-beta portfolio has zero systematic risk and is thus the closest approximation to a risk free asset, when there is no risk free asset in the market. Equation (4) is similar to (3) though the expected excess return on asset i is now the excess return to the minimum-variance-zero-beta portfolio instead of the risk free asset. The same goes for the expected excess return on the market portfolio. The positive linear relationship between expected excess return on asset i and its $\beta_{\mathrm{M}i}$ is still intact.

Thus, Black's results support the main point of CAPM: that $\beta_{\mathrm{M}i}$ can capture some of the variation in the realised excess return on risky assets. However, Black, Jensen, and Scholes (1972) suggest that $\beta_{\mathrm{M}i}$ evidently does not capture all systematic risk and that the model should be expanded by another (or more) common risk factors. In the next section Fama and French (1992) three factor model, which is an expansion of CAPM by two more risk factors, will be presented. The section is introduced by a review of the existing literature on the subject of sustainability investing.

4 Literature review

This section begins by reviewing some empirical findings of previous studies in the field of responsible investing. Both in terms of what drives investors to sustainability investing and in terms of performance of responsible investing. Finally there will be a review of two study approaches that will be used in this thesis for the empirical studies: the Fama and French portfolio formation analysis, and the Fama-MacBeth regression analysis.

4.1 Drivers of responsible investing

Lately, different studies have tried to explain why some investors put their capital into sustainability investing. Most recently, Sievänen, Rita, and Scholtens (2013) investigate this issue. Based on a survey from 2010 of more than 250 pension funds in 15 European countries they find that in particular, legal origin, ownership of the pension fund, and fund size are associated with responsible investing. Specifically, they find evidence of a curvilinear relationship between fund size and RI practice, i.e. the smallest and largest pension funds tend to engage with responsible investing more frequently than medium-sized funds.

Bollen (2007) studies how the dynamics of cash flows in RI funds differ from those of conventional funds. He finds that responsible investors show more loyalty, as the monthly volatility of cash flows in RI funds is lower than that of conventional funds. This suggests that responsible investing eases allocation decisions. He finds evidence that indicates that responsible investors have a multi-attribute utility function characterised by both the conventional mean-variance attribute but also a socially responsible attribute.

Firm-wise, Renneboog, Horst, and Zhang (2008a) find that engaging in social responsibility may decrease short-term profit for the firm but it pays in the long run as shareholder value could be destroyed, e.g. by reputation losses or litigation costs, if social responsibility issues are ignored.

Thus, the reasons for having an RI practice vary. As concepts like corporate social responsibility spreads so does the demand for sustainability initiatives in an investment environment. One should not neglect the fact that many asset managers will shift toward responsible investing practices to meet competition and the expectations from the institutional investors rather than for ethical reasons.

4.2 Effects of responsible investing on return

There are an increasing number of studies trying to find a relationship between some measure of sustainability and financial performance. At this point, there is still no consensus within the field. The following section gives a review of some of the studies and their results.

Barnett and Salomon (2006) study the link between social responsibility and financial performance for mutual funds that have a responsible investing practice. They hypothesize that financial loss borne by an RI fund due to poor diversification is offset as social screening intensifies because better-managed and more stable firms are selected in the portfolio. They find support for this hypothesis through empirical tests on a panel of 61 RI funds from 1972-2000. The results show that as number of social screens increases the financial return first declines but then rebounds as number of screens reaches a maximum. In other words, they find evidence of a curvilinear relationship between number of social screens used in the investment process and financial return. Moreover, they find that the financial performance of the fund varies with the types of social screens used: using screens related to community relations increased financial performance, while using environmental and labor relations screens decreased financial performance. Barnett and Salomon eventually suggest that literature move toward in-depth study of the benefits of different social screening strategies and away from the continuing debate on the financial merits of either being socially responsible or not.

Barnett and Salomon (2012) revisit the relationship between corporate social performance (CSP) and corporate financial performance (CFP). Again they find evidence of a curvilinear relationship between responsibility and financial performance. Firms with low CSP have higher CFP than firms with moderate CSP. Firms with high CSP have the highest CFP.

Galema, Plantinga, and Scholtens (2008) study how portfolio returns for US stocks, book-to-market ratios, and excess returns are related to different measures of responsibility. They find that responsible investing impact stock returns by lowering book-to-market ratio and not by generating positive alpha. Thus, explaining why so few studies are able to establish a link between alpha and RI. Their results are consistent with their hypothesis, that RI is reflected in demand differences between RI and non-RI stocks.

Humphrey, Lee, and Shen (2012) investigate the individual effect of environment, social and corporate governance factors on the financial performance of UK firms. They find no difference in the performance of firms with high or low environmental, social or corporate governance rankings. Unlike Galema et al. (2008) they find that firms do not differ in their systematic risks, book-to-market ratios or momentum exposures. However, they find that high-rated firms are consistently larger than firms with a lower rating. Their findings demonstrate that UK investors can incorporate ESG criteria into their investment strategies without incurring any significant cost (or benefit) in terms of risk or return.

Bauer, Koedijk, and Otten (2005) study how the ethical mutual funds differ from conventional funds in terms of risk, return, and investment style in the period 1990-2001. They study a sample of 103 ethical funds from the UK, US, and Germany, against a sample of conventional funds. Their results are mostly not statistically significant. Yet, they do hint that the ethical funds outperformed the conventional funds in the last couple of years of the period.

Renneboog, Horst, and Zhang (2008b) investigate the under- and over-performance hypothesis for all responsible investment funds world-wide. They study RI funds in the US, UK, European, and Asia-Pacific countries and find that RI funds under-perform conventional funds everywhere, although their results are not statistically significant in all cases. Their results suggest that there is a trade-off between sustainability and financial return, so that investors are giving up some return in order to invest ethically.

Kempf and Osthoff (2007) criticise previous studies that have used funds rather than firms in their performance analysis as it is impossible to distinguish alpha related to portfolio manager skills from alpha related to a responsibility investment style, thus blurring the results. The authors perform a study on a large sample of US stocks in the period 1992-2004. They find evidence that investors can increase risk-adjusted return by implementing a long-short strategy, that goes long in stocks with high sustainability ratings, and short in stocks with low sustainability ratings. They also find that which screening method is used matters: implementing a positive or best-in-class screening approach leads to the highest alphas. Stocks with extreme ranking perform better than stocks with in-between ranking, supporting the curvilinear relationship found by Barnett and Salomon.

Answer to research question (Q3)
Based on recent studies in responsible investing it is not clear what effect responsibility factors have on return. Some studies suggests that responsibility measures can capture risk factors in the market, and therefore yields higher return. Others indicate that firms engaging in responsibility issues are 'safer' than those ignoring these issues and thus, pays in the long run. Others again find that the 'extreme' cases (those either very 'sin' or very 'good') yield abnormally high returns. Common for most studies is that they lack statistical significance. As an increasing number of agencies specialise in analysing and rating firms based on sustainability factors (in particular ESG related factors) there will be a firmer ground for performing empirical studies within the field of responsible investing as the data amount increases. However, the quality and objectivity of agency ratings could be a concern, as discussed in section 8.

4.3 Fama-MacBeth regression

This section explains the methodology of the regression approach of Fama and MacBeth (1973) and gives a brief summary of their results. The Fama-MacBeth regression analysis is relevant for this thesis as it gives a widely used approach to analysing relationships between stock return and risk. The Fama-MacBeth methodology will be applied in the empirical analysis of this thesis.

Fama and MacBeth (1973) test three implications of the CAPM model (see section 3.3). The tests are based on stocks listed on NYSE in the period 1935-1968. They derive the three testable implications from equation (3):

(C1) In an efficient portfolio the relationship between the expected return on a security and its risk is linear.

(C2) β_{Mi} in (3) captures all risk of security i in the efficient portfolio.

(C3) Investors are risk-averse, i.e. higher risk should be associated with higher expected return $E(r_i) - r_f > 0$.

Methodology
The Fama-MacBeth (FM) regression approach is a two-stage procedure. First they

run N time series regressions on individual securities (one for each security) against the market portfolio to estimate each stock's market beta, $\beta_{\mathrm{M}i}$. Then they group the securities into twenty portfolios according to their ranked $\beta_{\mathrm{M}i}$. Now they run T cross-sectional regressions of the twenty portfolios' return and $\beta_{\mathrm{M}p}$ against the market portfolio (one for each month t) to estimate the coefficient of β_{M}, i.e. the risk premium on beta. Finally, they calculate the time series average of the coefficient.

Results
The results of Fama and MacBeth (1973) cannot reject that there is a linear relationship between expected return and risk of securities. Although they find stochastic non-linearities in some periods, these effects may cancel out. Their results also cannot rule out that β_i captures all the risk associated with security i in the efficient portfolio. Lastly, they find support for the hypothesis of an efficient capital market, i.e. security prices reflect all available information in the market.

The FM regression approach is a good way to estimate the market betas, because these cannot be measured precisely for each security (as opposed to e.g. size, and book-to-market which can be measured). This is a reason why the FM regression approach is a very popular method, even today.

4.4 Fama and French: Three-factor model

Fama and French (1992) introduce an expansion of CAPM called the three-factor model. The three-factor model adds two common risk factors to the CAPM, size and book-to-market:

$$\mathrm{r}_i - \mathrm{r_f} = \mathrm{a}_i + (\mathrm{r_m} - \mathrm{r_f})\beta_{\mathrm{M}i} + \mathrm{SMB}\beta_{\mathrm{S}i} + \mathrm{HML}\beta_{\mathrm{V}i} \tag{5}$$

where $\beta_{\mathrm{M}i}$ is the market beta for stock i, $\beta_{\mathrm{S}i}$ is the size beta for stock i (which can be interpreted as the security's sensitivity to size-related price movements), $\beta_{\mathrm{V}i}$ is the book-to-market beta for stock i (which can be interpreted as the security's sensitivity to book-to-market-related price movements), SMB (small size minus big) is the historic excess return on small cap stocks over large caps (the small-cap premium), and HML (high book-to-market minus low) is the historic excess return on value stocks over growth stocks (the value premium).

Fama and French (1992) study the cross-section of expected stock returns in the U.S. They apply two methods in their research; portfolio formation and Fama-MacBeth regressions. Both methods are used to estimate the parameters in the three-factor model. Fama and French's study uses NYSE, AMEX and NASDAQ stocks in the period 1963-1990 (Fama and French, 1992, p.446). In the following, the portfolio formation method is explained along with the results of the study.

Methodology

Fama and French form 100 portfolios based on size and book-to-market in year t-1 using the following method: first they find the 10 deciles break points for the size factor, and divide the stocks into 10 portfolios based on size in year t-1. Then they sort the the stocks in the 10 size portfolios on book-to-market and divide each portfolio into 10 portfolios based on book-to-market. The result is 100 portfolios with different characteristics in terms of size and book-to-market. Next step is to calculate the average monthly return for each portfolio based on returns from July year t to June year t+1. This procedure (forming portfolios and calculating average return) is repeated every year.

Results

Fama and French examine the relationship between average return, size, and book-to-market on US stocks. The results show a positive linear relationship between book-to-market and average return and a negative linear relationship between size and average return. The two factors do not seem to proxy the other, since the relationship is also significant when controlled for the other variable. They use a similar approach to look for a relationship between average return, β, E/P (earnings to price) and leverage. They find that both E/P and leverage act as proxies for book-to-market, as their positive effect on average return disappears when controlled for book-to-market. Fama and French find a positive relationship between β and average return in only one test and this effect disappears when controlled for size, thus indicating that β is in fact a proxy for size. Therefore, only size and book-to-market seem to consequently have an effect on average return, also when controlling for the other. The result of the study does not support CAPM theory of a risk factor β that captures all systematic risk. Fama and French (1992) find that β captures some size effect, which explains why one test showed a positive relationship between β and average return. However, this does not mean that β as a common risk factor does not explain variation in return on common stock. It is just not evident that it captures other risk factors than size in the NYSE, AMEX og NASDAQ stock in the period 1963-1990.

Fama and French (1992) suggest that more studies are done which seek to uncover some of the common risk factors that β_i might capture. They also discuss that size and book-to-market may in fact be proxies for other core risk factors, which again should be studied further.

5 Empirical methodology

This section will present the methodologies used for the empirical analysis of the main problem: Whether sustainability, in terms of ESG issues, is a common risk factor in the U.S. stock market.

5.1 Analytical methods

There are different ways to evaluate the problem above. This thesis will be doing two types of analyses in the aim to answer the problem statement. The first is a regression approach which develops a multi-factor asset pricing model that includes ESG as a risk factor and then estimates the coefficients of the model. If the coefficient of the ESG-variable is with statistical significance different from zero then ESG may actually be a true risk factor. The sign of the estimated coefficient should then indicate whether ESG as a risk factor is associated with a risk premium (positive sign) or a risk discount (negative sign). Other risk factors will be assessed as well, to test if the statistical significance and the estimated coefficient change as these variables are added/dropped in the model. Another way of assessing the problem, is by looking at the historical performance of portfolios with different characteristics in terms of ESG (and other parameters) and simply comparing the performance of non-ESG portfolios to that of ESG portfolios. If the ESG portfolios consistently over-/under-perform the non-ESG portfolios then it could be an indication of ESG being a true risk factor thus, paying a risk premium/discount. Again the other potential risk factors are included in the construction of portfolios to control for the effects of these.

The econometric methodologies applied in the analysis of this thesis are based on the aforementioned analytical methods. The methodologies are the Fama and MacBeth (1973) regression approach, the Fama and French (1992) portfolio construction approach, and the adjusted Fama-MacBeth regression approach by Fama and French (1992). They will be presented in the following sections. First the multi-factor model that is used in the regression approach will be presented below.

Multi-factor model

The model that is analysed in the regression analyses is a multi-factor model based on the three-factor model of Fama and French (1992) where there is added a fourth ESG factor:

$$\mathrm{r}_{it} - \mathrm{r}_{\mathrm{f}t} = \mathrm{a}_i + \mathrm{b}_{1t}\beta_{\mathrm{M}i} + \mathrm{b}_{2t}\beta_{\mathrm{S}i} + \mathrm{b}_{3t}\beta_{\mathrm{V}i} + \mathrm{b}_{4t}\beta_{\mathrm{ESG}i} + \mathrm{e}_{it} \quad (6)$$

where b_{1i}, b_{2i}, b_{3i}, and b_{4i} are coefficients (risk premia) of the variables β_{Mi}, β_{Si}, β_{Vi}, and β_{ESGi}, which are the market-variable, size-variable, book-to-market-variable, and ESG-variable respectively. These are the risk factors under analysis.

5.2 Fama-MacBeth regression analysis

The Fama and MacBeth (1973) two-stage regression analysis is widely used in econometrics as it deals with a problem that arises when testing factor models that contains the market-variable, β_{Mi}: As β_{Mi} cannot be observed directly in the market one must approximate the variable by estimation, thus creating an errors-in-variables problem as the estimated $\hat{\beta}_{Mi}$ is different from the true β_{Mi}. The Fama-MacBeth regression approach is one solution to this problem.

The multi-factor model in equation (6) contains risk factors that can be observed directly in the market, namely size, book-to-market, and ESG[7]. The FM approach blurs the information in the size, book-to-market, and ESG variables as it estimates these on a portfolio level and then estimate their coefficients, rather than using the actual observed data on a security level to estimate the coefficients right away. For this reason the author of this thesis apply two different regression analyses, one based on the traditional FM regression method as described in the following, and one based on the adjusted FM regression approach by Fama and French (1992) which is described in section 5.4

Equal-weighted and value-weighted portfolios

The FM regression analysis will be done both on equal-weighted and value-weighted portfolios. In the former case, all averages are calculated as equal-weighted average and the equal-weighted portfolio of NYSE, AMEX, and NASDAQ stocks are used as a proxy for the market portfolio. In the latter case, all averages are calculated as value-weighted average and the value-weighted portfolio of NYSE, AMEX, and NASDAQ stocks are used as a proxy for the market portfolio. This applies throughout the FM analysis in all aspects.

The month-by-month portfolio return is calculated as follows, where x_{it} denotes the weight of security i at time t, and r_{it} denotes the return on security i at time t:

[7] The accuracy and objectivity of the ESG factor is up for discussion as there exists a number of agencies rating firms on ESG issues based on a number of different qualitative criteria, as discussed in the conclusion of this thesis.

$$\mathrm{r}_{p,t} = \sum_{i=1}^{\mathrm{N}} \mathrm{x}_{it}\mathrm{r}_{it} \tag{7}$$

The equal-weighted portfolio uses the weights $\mathrm{x}_{it}^{\mathrm{ew}}$ and the value-weighted portfolio uses the weights $\mathrm{x}_{it}^{\mathrm{vw}}$ calculated as follows, where N denotes the number of securities in the portfolio at time t and ME_{it} is the market equity of security i at time t:

$$\mathrm{x}_{it}^{\mathrm{ew}} = \frac{1}{\mathrm{N}} \tag{8}$$

$$\mathrm{x}_{it}^{\mathrm{vw}} = \frac{\mathrm{ME}_{it}}{\sum_{i=1}^{\mathrm{N}} \mathrm{ME}_{it}} \tag{9}$$

The portfolio variables are calculated following the same procedure as the portfolio return, where $\hat{\beta}_{\mathrm{M}i}$ is the estimated market-variable for security i. The calculation of the remaining portfolio variables follow the same procedure:

$$\hat{\beta}_{\mathrm{M}p} = \sum_{i=1}^{\mathrm{N}} \mathrm{x}_{it}\hat{\beta}_{\mathrm{M}i} \tag{10}$$

Regression analysis

The Fama-MacBeth method is a two-stage regression analysis where the variables in the model are estimated first and then used in the estimation of their coefficients which are really the estimates of interest. These regressions are done on a portfolio level instead of for individual securities. The analysis is performed on a number of testing periods, of different length T (see table 1). In the following, the FM methodology as applied by the author is explained.

Estimating market betas

Every testing period is initiated by a market-variable estimation period of seven years (84 months) where the market beta for each security is estimated. This is done by regressing the security's monthly excess returns over the 84-month period against the monthly excess market returns. The returns are in excess to the risk free interest rate, proxied by the 1-month US treasury bill. The model that is used in the regressions is the classic one-factor market model, CAPM:

$$\mathrm{r}_{it} - \mathrm{r}_{\mathrm{f}t} = \mathrm{a}_i + \beta_{\mathrm{M}i}(\mathrm{r}_{\mathrm{m}t} - \mathrm{r}_{\mathrm{f}t}) + \mathrm{e}_{it} \tag{11}$$

	1	2	3
Portfolio formation period	1988-1994	1988-1994	1995-2001
Initial estimation period	1995-1999	1995-1999	2002-2006
Testing period	2000-2013	2000-2007	2007-2013
No. of available securities	6731	6731	7879
No. of securities meeting requirements	1328	1356	1444

Table 1: Fama-MacBeth regressions: An overview of portfolio formation, estimation, and testing periods. Number of available securities are the number of securities listed on NYSE, AMEX and NASDAQ in the first year of the portfolio formation period. To meet requirements securities must have return, market equity, book-to-market, and ESG data for every month in the testing period.

where $t = 1, ..., 84$, $i = 1, ...,$N, and N is number of securities in month t.

Portfolio formation

Next step is forming the portfolios. The number of portfolios formed depends on which variables are used for the portfolio formation. In the following, P refers to the number of portfolios. Table 2 shows total number of portfolios for every situation. The portfolios in situation two are formed as follows: First five portfolios are formed based on the ranked values of β_{M}. Within each of the five portfolios the stocks are ranked based on ln(ME), which is size. Then each portfolio is divided into five portfolios based on the ranked values of ln(ME) within the portfolio. In total, that gives 25 portfolios with different β_{M}-size characteristics. In every situation, portfolios are formed following this procedure.

Variables used in portfolio formation	Number of portfolios P
β_{M}	20
β_{M}, ln(ME)	25 (5x5)
β_{M}, ln(ME), ln(BE/ME)	12 (2x2x3)
β_{M}, ln(ME), ln(BE/ME), ESG	16 (2x2x2x2)

Table 2: Number of portfolios formed by different variables.

Estimating variables

Every portfolio formation period is followed by a five-year (60-month) estimation period where the included variables from the multi-factor model in equation (6) are estimated. $\hat{\beta}_{\mathrm{M}i}$, $\hat{\beta}_{\mathrm{S}i}$, $\hat{\beta}_{\mathrm{V}i}$, and $\hat{\beta}_{\mathrm{ESG}i}$ are the estimated variables for the underlying securities in each portfolio from P time series regressions on the 60-month period of the model:

$$\mathrm{r}_{it} - \mathrm{r}_{\mathrm{f}t} = \mathrm{a}_i + \beta_{\mathrm{M}i}(\mathrm{r}_{\mathrm{M}t} - \mathrm{r}_{\mathrm{f}t}) + \beta_{\mathrm{S}i}\mathrm{SMB}_t + \beta_{\mathrm{V}i}\mathrm{HML}_t + \beta_{\mathrm{ESG}i}\mathrm{GMN}_t + \mathrm{e}_{it} \tag{12}$$

where SMB_t is the excess return on small stocks over large stocks in month t, HML_t is the excess return on high book-to-market stocks over low in month t, and GMN_t is the difference in return between ESG-rated firms and not-rated firms in month t. All of these are calculated for both value-weighted and equal-weighted portfolios. For each portfolio p the estimated variables $\hat{\beta}_{\mathrm{M}p}$, $\hat{\beta}_{\mathrm{S}p}$, $\hat{\beta}_{\mathrm{V}p}$, and $\hat{\beta}_{\mathrm{ESG}p}$ are calculated as shown in equation (10).

Estimating coefficients

The monthly return, r_{pt}, in each test period is calculated for each portfolio p as shown in (7). Then the test period's estimated portfolio variables are inserted as lagged variables in equation (6) together with the excess portfolio return. Using lagged variables makes the model predictive in nature, which is intended. The coefficients in (13) are estimated by T cross sectional regressions, one for each of the T months in the test period. The estimated coefficients are $\hat{\mathrm{b}}_{1t}$, $\hat{\mathrm{b}}_{2t}$, $\hat{\mathrm{b}}_{3t}$, $\hat{\mathrm{b}}_{4t}$, and the intersect $\hat{\mathrm{a}}_p$.

$$\mathrm{r}_{pt} - \mathrm{r}_{\mathrm{f}t} = \mathrm{a}_p + \mathrm{b}_{1t}\hat{\beta}_{\mathrm{M}pt-1} + \mathrm{b}_{2t}\hat{\beta}_{\mathrm{S}pt-1} + \mathrm{b}_{3t}\hat{\beta}_{\mathrm{V}pt-1} + \mathrm{b}_{4t}\hat{\beta}_{\mathrm{ESG}pt-1} + \mathrm{e}_{pt} \tag{13}$$

Calculating statistics

The above outlined regressions result in a time series of T observations for each coefficient k (including the intersect). Note that the number of coefficients vary depending on which variables are included/suppressed in the model. The final step is to calculate the following statistics for all K coefficients. This is done in every testing period for the coefficients of the variables that are included in the model. The results for each period and model are presented in table 6, and table 7 in section 7.1.

Mean of the monthly coefficient estimates:

$$\overline{\hat{\mathrm{b}}_{\mathrm{k}}} = \frac{1}{\mathrm{T}}\sum_{t=1}^{\mathrm{T}}\hat{\mathrm{b}}_{\mathrm{k}t} \tag{14}$$

Standard deviation of the monthly coefficient estimates:

$$\mathrm{s}(\hat{\mathrm{b}}_{\mathrm{k}}) = \sqrt{\frac{1}{\mathrm{T}}\sum_{t=1}^{\mathrm{T}}(\hat{\mathrm{b}}_{\mathrm{k}t} - \overline{\hat{\mathrm{b}}_{\mathrm{k}}})^2} \tag{15}$$

First-order autocorrelation of the monthly coefficient estimates (computed about the sample mean):

$$\rho_{\mathrm{M}}(\hat{\mathrm{b}}_{\mathrm{k}}) = \frac{1}{(\mathrm{T}-1)\sigma_{\mathrm{k}}^2} \sum_{t=1}^{\mathrm{T}-1} (\hat{\mathrm{b}}_{\mathrm{k}t} - \overline{\hat{\mathrm{b}}_{\mathrm{k}}})(\hat{\mathrm{b}}_{\mathrm{k}t-1} - \overline{\hat{\mathrm{b}}_{\mathrm{k}}}) \tag{16}$$

where $\sigma_{\mathrm{k}^2} = (s(\hat{\mathrm{b}}_{\mathrm{k}}))^2$ is the variance of the monthly estimates of coefficient k.

First-order autocorrelation of the difference between the monthly intersect estimates and the monthly risk free rate (computed about an assumed mean of zero):

$$\rho_0(\hat{\mathrm{a}}) = \frac{1}{(\mathrm{T}-1)\sigma^2} \sum_{t=1}^{\mathrm{T}-1} (\hat{\mathrm{a}}_t - \mathrm{r_f})(\hat{\mathrm{a}}_{t-1} - \mathrm{r_f}) \tag{17}$$

where $\sigma^2 = (s(\hat{\mathrm{a}} - \mathrm{r_f}))^2$ is the variance of the difference between the monthly intersect estimates and the monthly risk free rate.

The t-statistics for the null-hypothesis ($\mathrm{H}_0 : \overline{\hat{\mathrm{b}}_{\mathrm{k}}} = 0$):

$$\mathrm{t}(\overline{\hat{\mathrm{b}}_{\mathrm{k}}}) = \frac{\overline{\hat{\mathrm{b}}_{\mathrm{k}}}}{\mathrm{s}(\hat{\mathrm{b}}_{\mathrm{k}})/\sqrt{\mathrm{T}}} \tag{18}$$

Mean of the monthly coefficients of determination, r_t^2, adjusted for degrees of freedom:

$$\overline{\mathrm{r}^2} = \frac{1}{\mathrm{T}} \sum_{t=1}^{\mathrm{T}} \mathrm{r}_t^2 \tag{19}$$

Standard deviation of the monthly coefficients of determination:

$$\mathrm{s}(\mathrm{r}^2) = \sqrt{\frac{1}{\mathrm{T}} \sum_{t=1}^{\mathrm{T}} (\mathrm{r}_t^2 - \overline{\mathrm{r}^2})^2} \tag{20}$$

5.3 Fama-French portfolio analysis

The methodology of Fama and French (1992) is more practical, and perhaps less scientific, than the regression approach of Fama and MacBeth. The analysis consists of dividing the sample of securities into a number of portfolios based on the variables of interest. The monthly return of each portfolio is calculated for the following year and then the securities are reallocated yearly. By the end of the testing period the result is a time series of average monthly returns for each portfolio.

The variables of interest are β_{M}, size, book-to-market, and ESG factor. The three latter are observable for individual securities, while the former must be estimated. The following paragraph explains how the β_{M}-variables are estimated for all securities.

Estimating pre-ranking market beta

For every security i in the period 1995-2012 the yearly pre-ranking-$\beta_{\mathrm{M}it}$ is estimated from the past 2-5 years (as available) of monthly return data by time series regression of equation (11). The value-weighted portfolio of NYSE, AMEX and NASDAQ stocks proxy the market portfolio. Next step is forming portfolios. Following the method of Fama and French (1992) it is important to allow for variation in beta that is unrelated to the size effect[8]. Therefore, ten portfolios are formed based on the securities' size (market equity, ME). Then each portfolio is split into ten portfolios based on the estimated pre-ranking-$\hat{\beta}_{\mathrm{M}it}$. This results in 100 portfolios with different size-beta-characteristics for each year in 1995-2012.

Estimating post-ranking market beta

The portfolios' post-ranking market betas are estimated by regression of the CAPM expanded by a lagged excess market return variable:

$$\mathrm{r}_{pt} - \mathrm{r}_{\mathrm{f}t} = \mathrm{a}_p + \hat{\beta}_{\mathrm{M1}p}(\mathrm{r}_{\mathrm{m}t} - \mathrm{r}_{\mathrm{f}t}) + \hat{\beta}_{\mathrm{M2}p}(\mathrm{r}_{\mathrm{m}t-1} - \mathrm{r}_{\mathrm{f}t-1}) + \mathrm{e}_{pt} \tag{21}$$

this results in two estimated beta-variables, $\hat{\beta}_{\mathrm{M1}p}$ and $\hat{\beta}_{\mathrm{M2}p}$, for each portfolio for each year t. The yearly post-ranking portfolio beta estimates, $\hat{\beta}_{\mathrm{M}pt}$, are calculated as the average of the two estimated betas.

All the securities in a given portfolio are now assigned the estimated post-ranking-$\hat{\beta}_{\mathrm{M}pt}$ of its portfolio p in year t. Since securities may switch portfolio over the years (as their size and estimated pre-ranking-$\hat{\beta}_{\mathrm{M}it}$ vary) the post-ranking-$\hat{\beta}_{\mathrm{M}it}$ is not necessarily constant for the individual security over time.

Forming portfolios

In June of each year t the sample of securities are divided into a number of portfolios by the following procedure: The securities are sorted by the (first) variable of interest. The securities are allocated to P_1 portfolios according to their ranked variable. The number of portfolios P_1 and the quantiles that make the breakpoints for the grouping are shown in table 3. In the cases of a single-sort portfolio formation next step is

[8] Chan and Chen (1991) find that beta may be a proxy for firm size.

calculating average monthly portfolio return. In the cases of a dual-sort (or more) portfolio formation the next step is as follows: The securities within each portfolio is sorted by their value of the second variable of interest. The securities are grouped into P_2 sub-portfolios according to their ranked variable. The number of portfolios P_2 and the quantiles that make the breakpoints for the grouping are shown in table 3. This step is repeated K times, one for each variable k included in the given test. The result is $P = P_1 \cdot P_2 \cdot ... \cdot P_k$ portfolios with different characteristics of the included parameters.

Calculating average monthly portfolio returns

The average monthly portfolio return is calculated for each portfolio from July year t to June year $t+1$. The average return is calculated as the equal-weighted average of the underlying securities' returns. The average $\hat{\beta}_{\mathrm{M}p}$, ln(ME), and ln(BE/ME) are also calculated for each portfolio and the number of securities in each portfolio is recorded.

The above stated procedure of forming portfolios and calculating average monthly returns are continued in every year of the testing period. By the end of the testing period the result is a time series of average monthly portfolio returns and portfolio characteristics in terms of beta, size, book-to-market, ESG, and number of underlying securities.

Calculating time series averages

Finally the time series average of the average monthly returns, beta, size, book-to-market, and number of firms are calculated for each portfolio. These are presented in table 8, table 9, table 10, and table 11 in section 7.2.

5.4 An adjusted Fama-MacBeth approach

Fama and French (1992) use an altered version of the Fama-MacBeth approach by running regressions on individual securities rather than on portfolios of securities. Their reasoning for this is that forming portfolios blurs the information of the size and book-to-market parameters, which can be observed directly in the market for individual securities. Thus the positive effects of an estimate $\hat{\beta}_{\mathrm{M}}$ closer to the true β_{M} is in best case reduced by the less accurate size and book-to-market values (Fama and French, 1992, p.432). The adjusted Fama-MacBeth methodology uses the estimated post-ranking-$\hat{\beta}_{\mathrm{M}it}$ from the Fama-French portfolio formation methodology.

Estimating coefficients

Table 3: An overview of how securities are grouped by different variables in the Fama-French portfolio formation analysis.

Variables used in grouping	Number of portfolios (grouping method)	Quantiles used for breakpoints
β	12 (stocks are divided into ten groups, group 1 and 10 are split in half).	10 pct. quantiles (median of group used to split group 1 and 10 in half).
ln(ME)	12 (stocks are divided into ten groups, group 1 and 10 are split in half).	10 pct. quantiles (median of group used to split group 1 and 10 in half).
ln(BE/ME)	12 (stocks are divided into ten groups, group 1 and 10 are split in half).	10 pct. quantiles (median of group used to split group 1 and 10 in half).
ESG	5 (stocks are grouped by 'not rated', 'E-strength', 'S-strength', 'G-strength', and 'ESG-strength' which covers stocks with an E, S or G strength).	
ln(ME), ln(BE/ME)	100 (ten groups are formed by ln(ME), then each group is divided into ten groups by ln(BE/ME)).	10 pct. quantiles.
ln(ME), ESG	10 (five groups are formed by ln(ME), then each group is divided into two groups, 'not-rated' and 'ESG-rated').	20 pct. quantiles.
ln(ME), ln(BE/ME), ESG	8 (two groups are formed by ln(ME), then each group is divided into two groups by ln(BE/ME), finally each groups is divided into two groups, 'not-rated' and 'ESG-rated').	Median used for first grouping, group-medians used for second grouping.

The coefficients, b_{1t}, b_{2t}, b_{3t}, and b_{4t}, in (22) are estimated by T cross-sectional regressions of the securities' monthly excess returns against the previously estimated post-ranking-$\hat{\beta}_{Mit}$, ln(ME), ln(BE/ME), and the ESG-variable:

$$r_{it} - r_{ft} = a_i + b_{1t}\hat{\beta}_{Mit} + b_{2t}\ln(ME_{it}) + b_{3t}\ln(BE/ME_{it}) + b_{4t}ESG_{it} + e_{it} \qquad (22)$$

Calculating statistics

The cross-sectional regressions above results in a time series of T estimates for each coefficient. The final step is to calculate the average slopes (means of the coefficients) and their t-statistics. The means of the monthly coefficient estimates are calculated as in equation (14) and the t-statistics are calculated as the means of the coefficients divided by their respective time series standard error as in equation (18). The regression results are presented in table 13 in section 7.3.

Year	Number of firms	
	Excl. ESG data	Incl. ESG data
1995	3239	278
1996	3471	283
1997	3436	291
1998	3431	359
1999	3351	315
2000	3209	334
2001	3028	513
2002	3074	545
2003	3018	1477
2004	2929	1498
2005	2748	1414
2006	2672	1425
2007	2611	1409
2008	2551	1535
2009	2577	1649
2010	2509	1673
2011	2409	1633
2012	2363	1626

Table 4: Adjusted Fama-MacBeth analysis: Number of firms included in each year of the regressions when ESG data is exluded, and when ESG data is included. Including ESG data decreases the number of firms included in the analysis.

6 Data description

In the this section the data used in the empirical analysis is described. The analysis is based on three data sets: market data, book data, and ESG data. These are described separately in the following. The timing of the market data and the book data is based on the timing used by Fama and French (1992).

Sample of securities
The sample of securities used in the analyses of this thesis is detected each year of the analysis. It is the intersection of securities with book-to-market data of December year *t-1*, market equity data of June year *t*, and return data for every month from July year *t* to June year *t+1*. In the analyses that include an ESG variable the sample is further reduced as the securities must then also have an ESG-rating in December year *t-1*. The time gap between the independent variables' data points and the dependent variable's (return) data point ensures that the model will be predictive in nature.

In the market beta estimation part of all analyses it is a requirement that a security has at least two years of monthly return data available prior to the estimation of market beta for the current year. Thus the sample is restricted to these securities.

In the Fama-MacBeth analysis it is further a requirement to be included in the analysis that a security has return data for every month of the full testing period.

6.1 Market data

The market data used in all three empirical analyses are monthly stock returns, and market equity. While the return data is calculated monthly the market equity (ME) data is calculated biannually, in June and in December. ME in June is used as size-variable and ME in December is used in the calculation of book-to-market. The market data is retrieved from the Center for Research in Security Prices (CRSP). The extracted fields are; PRC, which is closing price in USD (in cases where PRC is not available CRSP gives the average of the bid/ask spread instead) and SHROUT, which is number of shares outstanding.

The monthly return data are calculated as below, where PRC_{it} is the closing price (or average bid/ask spread) of security i at time t:

$$\mathrm{r}_{it} = \frac{\mathrm{PRC}_{it}}{\mathrm{PRC}_{it-1}} - 1 \tag{23}$$

The yearly market equity data are calculated as below, where SHROUT_{it} is the number of shares outstanding of security i at time t:

$$\mathrm{ME}_{it} = \mathrm{PRC}_{it} \cdot \mathrm{SHROUT}_{it} \tag{24}$$

6.2 Book data

The Book data used in the analyses is retrieved from COMPUSTAT. The book data is used to calculate the yearly book-to-market ratios. The fields extracted from COMPUSTAT are; SEQ, which is total stockholder's equity and PSTK, which is total preferred stock.

The book equity (BE) data is calculated as below, where SEQ_{it} is stockholder's equity for security i at time t and PSTK_{it} is preferred stock for security i at time t:

$$\mathrm{BE}_{it} = \mathrm{SEQ}_{it} - \mathrm{PSTK}_{it} \tag{25}$$

The book equity data at the fiscal year end of year *t-1* is matched with market equity of December year *t-1* to calculate book-to-market ration as below:

$$\mathrm{BE/ME}_{it} = \frac{\mathrm{BE}_{it}}{\mathrm{ME}_{it}} \tag{26}$$

6.3 ESG data

The ESG data used in the analyses is retrieved from MSCI ESG STATS (STATS), which is *"an annual data set of environmental, social, and governance (ESG) ratings of publicly traded companies"* (MSCI Inc., 2013). The STATS data set includes over 60 ESG indicators in seven ESG categories:

- Environment
- Social:
  - Community

  - Human rights
  - Employee relations
  - Diversity
  - Customers
- Governance

The binary ratings in these categories are divided into two sets of indicators: strengths, which measures management best practices, and concerns, which measures the most serious challenges. The data set covers 650-3000 companies in the period 1995-2012 (see table 5).

Coverage universe	1991-2000	2001-2002	2003-present
500 largest US companies	X	X	X
MSCI KLD 400 Social Index	X	X	X
1000 largest US companies		X	X
1000 largest US companies			X
Approximate total number of companies covered	650	1100	3000

Table 5: Coverage universe of the STATS data set. Source: MSCI Inc. (2013).

Transforming STATS data into ESG variables

There are undoubtedly several approaches to how the STATS data set can be included in an empirical analysis. As previously stated the data set is very comprehensive especially in the latest years. It is extremely time consuming to make a regression analysis on a data set with over 60 indicators and the results are unlikely to be robust. It is also unrealistic to make an analysis based on forming portfolios by many indicators as the number of underlying stocks is diminishing with the number of portfolios formed. Thus the STATS data set must be concentrated. The author of this thesis has created an ESG dummy variable, which is included in the three analyses:

$$\text{ESG} = \begin{cases} 0 & \text{if sum of E, S, and G strengths} = 0 \\ 1 & \text{if sum of E, S, and G strengths} > 0 \end{cases} \tag{27}$$

Besides this ESG dummy variable, the author includes the following variables in the adjusted FM analysis: E+, S+, G+, E-, S-, and G-, where the former is defined as:

$$\text{E+} = \begin{cases} 0 & \text{if sum of E strengths} = 0 \\ 1 & \text{if sum E strengths} > 0 \end{cases} \tag{28}$$

the latter are defined in a similar manner, where plus refers to strengths and minus refers to concerns.

It is a choice by the author to focus on ESG strengths rather than concerns. The STATS data set invites further analysis to be done, which could also focus on concerns rather than strengths or a combination of the two. Focusing on strengths emphasises the focus of this thesis as to explore whether investing in firms with a sustainability focus creates abnormal returns.

7 Empirical results

The following section presents the results from the three empirical analyses. Overall, there is no indication that an increased focus on ESG issues has any effect on return. The results of the adjusted Fama-MacBeth analysis do hint that focusing on environment and social issues could cause a discount in return, while negative governance issues may also cause a discount. However, there is no general indication of an abnormal return for firms with an ESG focus.

7.1 Fama-MacBeth regression analysis

The results of the Fama-MacBeth regression analysis is shown in table 6 for the value-weighted portfolios and table 7 for the equal-weighted portfolios. Fama and MacBeth (1973) note an important point when interpreting the t-statistics of regressions of common stock returns: Fama (1965) and Blume (1970) suggest that common stock returns are heavy-tailed and likely follow a nonnormal symmetric distribution rather than the normal distribution. Fama and Babiak (1968) find that this should result in overestimated p-values when assuming normally distributed variables. Yet, Fama and MacBeth (1973) argue that this does not effect the rejection of the null-hypotheses negatively as a hypothesis that is rejected under the assumption of normality, is rejected on even firmer ground when tails are fat. Hence, the true characteristic exponent of the distribution of the common stock returns, may indeed be lower than two.

All tests have very low means of the coefficients of determination. The highest mean of adjusted R squared is 55%. However, the aim of the study is not to obtain high values of adjusted R squared but identifying whether the individual variables have predictive power on the stock return.

Market beta

The mean of the regressed coefficients of the market beta-variable, $\overline{\hat{b}_1}$, is not statistically significant in any of the fitted models in the overall period 2000-2013 except for the equal-weighted one-factor model, where the t-statistic is 2.64 (see panel A). In the sub period 2000-2007 the signs of the t-statistics for this variable are randomly positive and negative and there are absolutely no statistically significant estimates. In the latest sub period 2007-2013 the t-statistic of the estimated coefficients is 2.87 in the one-factor equal-weighted model. In the value-weighted equivalent, the two-factor and three-factor value-/equal-weighted models the t-statistic is between 1 and 2. In the four-factor model (which includes an ESG variable) all t-statistics are numerically very small.

Size

The mean of the regressed size coefficients, $\overline{\hat{b}_2}$, have high positive t-statistics above 2 in eight out of 18 models. In further three models, the t-statistic is numerically greater than 1.5. In the two-factor and three-factor value-weighted models the mean estimates are significant with t-statistics numerically above 2.6, in both the overall period 2000-2013 and the in sub period 2000-2007. In both the value-weighted and equal-weighted four-factor models the t-statistics are close to zero in almost all periods.

Book-to-market

The mean of the regressed book-to-market coefficients, $\overline{\hat{b}_3}$, have randomly positive and negative signs and are not statistically significant in any models.

ESG

The mean of the regressed ESG coefficients, $\overline{\hat{b}_4}$, have low t-statistics with varying signs in all periods both in the value-weighted and equal-weighted models. The highest t-statistic is 0.93. The standard deviations of the means are very high, between 0.505-0.775 in all periods.

Subconclusion

The results of the Fama-MacBeth regressions possibly indicate a positive size-effect on future stock returns, at least in the overall period 2000-2013 and the sub period 2000-2007. Positive effects of market beta are also indicated in some periods but not consistently. Many periods show negative t-statistics for the market beta coefficient, though these are all close to zero. The results give no indication of book-to-market or ESG effects on stock returns. Therefore, the null-hypothesis - that the coefficient of the ESG-variable is significantly different from zero - cannot be rejected based on this analysis.

Table 6: Fama-MacBeth regressions results - value-weighted

Panel A 2000-2013:

$\bar{\hat{a}}$	$\overline{\hat{b}_1}$	$\overline{\hat{b}_2}$	$\overline{\hat{b}_3}$	$\overline{\hat{b}_4}$	$\overline{\hat{a}-r_f}$	$s(\bar{\hat{a}})$	$s(\overline{\hat{b}_1})$	$s(\overline{\hat{b}_2})$	$s(\overline{\hat{b}_3})$	$s(\overline{\hat{b}_4})$	$\rho_0(\overline{a-r_f})$
.0013	.0058	...	...	...	-.0003	.056	.073	...	...	...	.00
.0049	.0035	.0082	...	...	.0033	.044	.053	.034	...	...	.12
.0054	.0029	.0086	-.0028	...	.0038	.047	.066	.034	.051	...	.11
.0030	-.0004	-.0048	.0035	-.0139	.0014	.068	.020	.047	.031	.644	.01

$\rho_M(\overline{b_1})$	$\rho_M(\overline{b_2})$	$\rho_M(\overline{b_3})$	$\rho_M(\overline{b_4})$	$t(\bar{\hat{a}})$	$t(\overline{\hat{b}_1})$	$t(\overline{\hat{b}_2})$	$t(\overline{\hat{b}_3})$	$t(\overline{\hat{b}_4})$	$t(\overline{\hat{a}-r_f})$	$\overline{r^2}$	$s(r^2)$
.01	...	...	...	.29	.99	...	...	...	-.06	.15	.19
.03	.06	...	...	1.37	.83	3.01	...	...	.92	.20	.21
.07	.04	-.07	...	1.45	.54	3.11	-.68	...	1.03	.26	.25
.02	-.10	-.06	-.02	.55	-.26	-1.28	1.42	-.27	.26	.50	.30

Panel B 2000-2007:

$\bar{\hat{a}}$	$\overline{\hat{b}_1}$	$\overline{\hat{b}_2}$	$\overline{\hat{b}_3}$	$\overline{\hat{b}_4}$	$\overline{\hat{a}-r_f}$	$s(\bar{\hat{a}})$	$s(\overline{\hat{b}_1})$	$s(\overline{\hat{b}_2})$	$s(\overline{\hat{b}_3})$	$s(\overline{\hat{b}_4})$	$\rho_0(\overline{a-r_f})$
.0032	.0041	...	...	...	.0008	.063	.081	...	...	...	-.02
.0113	-.0044	.0120	...	...	.0088	.035	.049	.037	...	...	.05
.0127	-.0056	.0115	-.0013	...	.0102	.035	.058	.039	.042	...	.07
.0028	.0000	-.0082	.0044	.0304	.0003	.073	.012	.046	.035	.505	-.05

$\rho_M(\overline{b_1})$	$\rho_M(\overline{b_2})$	$\rho_M(\overline{b_3})$	$\rho_M(\overline{b_4})$	$t(\bar{\hat{a}})$	$t(\overline{\hat{b}_1})$	$t(\overline{\hat{b}_2})$	$t(\overline{\hat{b}_3})$	$t(\overline{\hat{b}_4})$	$t(\overline{\hat{a}-r_f})$	$\overline{r^2}$	$s(r^2)$
-.04	...	...	...	.47	.47	...	...	...	.11	.13	.16
-.09	.02	...	...	3.00	-.84	2.95	...	...	2.33	.25	.22
-.06	-.01	-.21	...	3.33	-.89	2.69	-.28	...	2.66	.34	.24
.09	-.09	-.15	-.05	.35	.01	-1.61	1.15	.55	.04	.45	.31

Panel C 2007-2013:

$\bar{\hat{a}}$	$\overline{\hat{b}_1}$	$\overline{\hat{b}_2}$	$\overline{\hat{b}_3}$	$\overline{\hat{b}_4}$	$\overline{\hat{a}-r_f}$	$s(\bar{\hat{a}})$	$s(\overline{\hat{b}_1})$	$s(\overline{\hat{b}_2})$	$s(\overline{\hat{b}_3})$	$s(\overline{\hat{b}_4})$	$\rho_0(\overline{a-r_f})$
-.0009	.0077	...	...	...	-.0015	.047	.064	...	...	...	.03
-.0026	.0129	.0037	...	...	-.0032	.053	.057	.029	...	...	.16
-.0030	.0127	.0051	-.0045	...	-.0036	.057	.073	.028	.061	...	.13
.0033	-.0009	-.0009	.0026	-.0657	.0027	.063	.026	.047	.026	.775	.10

$\rho_M(\overline{b_1})$	$\rho_M(\overline{b_2})$	$\rho_M(\overline{b_3})$	$\rho_M(\overline{b_4})$	$t(\bar{\hat{a}})$	$t(\overline{\hat{b}_1})$	$t(\overline{\hat{b}_2})$	$t(\overline{\hat{b}_3})$	$t(\overline{\hat{b}_4})$	$t(\overline{\hat{a}-r_f})$	$\overline{r^2}$	$s(r^2)$
.09	...	...	...	-.17	1.02	...	...	...	-.26	.18	.21
.09	.11	...	...	-.42	1.93	1.07	...	...	-.51	.14	.20
.13	.15	.00	...	-.45	1.49	1.58	-.63	...	-.53	.17	.22
.01	-.12	.12	.00	.44	-.30	-.15	.83	-.72	.37	.55	.27

Table 7: Fama-MacBeth regressions results - equal-weighted

Panel A 2000-2013:

$\bar{\hat{a}}$	$\overline{\hat{b}_1}$	$\overline{\hat{b}_2}$	$\overline{\hat{b}_3}$	$\overline{\hat{b}_4}$	$\overline{\hat{a}-r_f}$	$s(\bar{\hat{a}})$	$s(\overline{\hat{b}_1})$	$s(\overline{\hat{b}_2})$	$s(\overline{\hat{b}_3})$	$s(\overline{\hat{b}_4})$	$\rho_0(\overline{a-r_f})$
-.0041	.0180	...	...	...	-.0056	.060	.085	...	...	...	.04
.0039	.0044	.0089	...	...	.0023	.059	.073	.039	...	...	-.01
.0089	.0008	.0078	-.0082	...	.0073	.048	.066	.038	.048	...	.03
.0059	.0007	-.0004	-.0003	.0185	.0043	.059	.025	.040	.028	.707	.12

$\rho_M(\overline{b_1})$	$\rho_M(\overline{b_2})$	$\rho_M(\overline{b_3})$	$\rho_M(\overline{b_4})$	$t(\bar{\hat{a}})$	$t(\overline{\hat{b}_1})$	$t(\overline{\hat{b}_2})$	$t(\overline{\hat{b}_3})$	$t(\overline{\hat{b}_4})$	$t(\overline{\hat{a}-r_f})$	$\overline{r^2}$	$s(r^2)$
.12	...	...	...	-.85	2.64	...	...	...	-1.18	.18	.22
-.01	.00	...	...	.82	.76	2.85	...	...	.48	.22	.23
.02	-.04	-.12	...	2.33	.15	2.56	-2.15	...	1.91	.27	.25
-.06	-.12	.00	-.10	1.25	.34	-.13	-.15	.33	.91	.52	.31

Panel B 2000-2007:

$\bar{\hat{a}}$	$\overline{\hat{b}_1}$	$\overline{\hat{b}_2}$	$\overline{\hat{b}_3}$	$\overline{\hat{b}_4}$	$\overline{\hat{a}-r_f}$	$s(\bar{\hat{a}})$	$s(\overline{\hat{b}_1})$	$s(\overline{\hat{b}_2})$	$s(\overline{\hat{b}_3})$	$s(\overline{\hat{b}_4})$	$\rho_0(\overline{a-r_f})$
.0065	.0084	...	...	...	.0040	.048	.084	...	...	...	-.07
.0125	-.0043	.0104	...	...	.0101	.045	.063	.045	...	...	-.11
.0165	-.0058	.0072	-.0066	...	.0140	.037	.061	.042	.043	...	.06
.0081	.0000	-.0025	-.0013	-.0364	.0056	.054	.023	.038	.028	.666	-.01

$\rho_M(\overline{b_1})$	$\rho_M(\overline{b_2})$	$\rho_M(\overline{b_3})$	$\rho_M(\overline{b_4})$	$t(\bar{\hat{a}})$	$t(\overline{\hat{b}_1})$	$t(\overline{\hat{b}_2})$	$t(\overline{\hat{b}_3})$	$t(\overline{\hat{b}_4})$	$t(\overline{\hat{a}-r_f})$	$\overline{r^2}$	$s(r^2)$
.04	...	...	...	1.24	.92	...	...	...	.77	.22	.24
-.08	-.04	...	...	2.57	-.63	2.13	...	...	2.06	.29	.24
-.06	-.09	-.12	...	4.07	-.88	1.54	-1.42	...	3.44	.36	.26
-.10	-.24	-.14	-.23	1.36	.01	-.61	-.41	-.50	.95	.55	.30

Panel C 2007-2013:

$\bar{\hat{a}}$	$\overline{\hat{b}_1}$	$\overline{\hat{b}_2}$	$\overline{\hat{b}_3}$	$\overline{\hat{b}_4}$	$\overline{\hat{a}-r_f}$	$s(\bar{\hat{a}})$	$s(\overline{\hat{b}_1})$	$s(\overline{\hat{b}_2})$	$s(\overline{\hat{b}_3})$	$s(\overline{\hat{b}_4})$	$\rho_0(\overline{a-r_f})$
-.0163	.0293	...	...	...	-.0169	.070	.087	...	...	...	.09
-.0063	.0146	.0071	...	...	-.0068	.071	.082	.031	...	...	.04
.0000	.0086	.0086	-.0101	...	-.0006	.056	.071	.033	.053	...	.01
.0034	.0014	.0020	.0008	.0824	.0029	.065	.027	.042	.029	.753	.21

$\rho_M(\overline{b_1})$	$\rho_M(\overline{b_2})$	$\rho_M(\overline{b_3})$	$\rho_M(\overline{b_4})$	$t(\bar{\hat{a}})$	$t(\overline{\hat{b}_1})$	$t(\overline{\hat{b}_2})$	$t(\overline{\hat{b}_3})$	$t(\overline{\hat{b}_4})$	$t(\overline{\hat{a}-r_f})$	$\overline{r^2}$	$s(r^2)$
.18	...	...	...	-1.98	2.87	...	...	...	-2.05	.12	.18
.02	.09	...	...	-.75	1.52	1.95	...	...	-.81	.14	.18
.06	.08	-.12	...	.00	1.02	2.22	-1.61	...	-.09	.16	.20
-.02	.00	.18	.03	.45	.45	.41	.22	.93	.37	.47	.31

7.2 Fama-French portfolio analysis

The results of the Fama-French portfolio analysis from July 1995 to June 2012 are shown in table 8, table 9, and table 10. Figure 2 and figure 3 show the average monthly return across the portfolios in two different groupings. Figure 4 and figure 5 show the cumulative return for a sample of the same portfolios over time. In the following the results will be presented for each analysed variable.

Market beta

Table 8, panel A shows average monthly return, beta, ln(ME), ln(BE/ME), and number of firms for the 12 beta-formed portfolios. As expected, the average monthly return increases with market beta indicating that market beta captures some (market) risk which pays a risk premium. Note that ln(ME) decreases as beta (and return) increases, i.e. higher beta portfolios are on average associated with smaller firm size. This is a first indication that beta might in fact be a proxy for size. The average number of firms vary slightly between the portfolios. This happens due to the fact that many stocks have the same value of post-ranking beta. Before forming the portfolios stocks with missing return data for the following year are removed. When the portfolios are formed based on post-ranking beta the number of stocks therefore vary because the number of stocks with different post-ranking beta values differ.

Size

Table 8, panel B imply that average monthly return decreases as average size increases. Table 9, panel A shows the same effect; in all eleven book-to-market columns (including the 'All' column) the average monthly return decreases as the average size of the portfolio increases. Figure 2 illustrates the trend: Small firm bars are 'hotter' than large firm bars. Figure 4 depicts the cumulative return of 25 sample portfolios with different size and book-to-market attributes. It seems that small firms have higher cumulative return in most cases. These results could indicate that size is a risk factor and smaller firms are compensated with a premium return as Fama and French (1992) find evidence for. Table 8, panel B shows that average market beta declines as firm size grows. This relationship is also seen in table 9, panel B: In all of the book-to-market columns the average market beta is reduced as average size of the portfolio increases. This is another indication that there might be a negative relationship between size and beta and that one of them might in fact be a proxy for the other, supporting the findings of Chan and Chen (1991) that beta is indeed a proxy for size. Finally, the same panel also shows that ln(BE/ME) decreases as size increases. This is not surprising, as size (ME) is the denominator in BE/ME and hence, BE/ME gets smaller as ME gets bigger.

Table 10, panel A shows the average monthly return for the eight portfolios formed on size, book-to-market, and ESG. This is also illustrated in figure 2. The average monthly return is consistently lower for small firm portfolios than large firm portfolios. This result opposes the previously observed negative relationship between return and firm size. However, the range is narrow with only two size spectres. Table 11, panel A shows the average monthly return for ten size-ESG portfolios. Likewise this panel indicates that average monthly return increases with firm size. Nonetheless, one should be careful not to draw any conclusions from these results due to the few observations (portfolios). Table 11, panel B supports the evidence of a negative relationship between size and beta as average market beta decreases with firm size, both for not-ESG and ESG portfolios.

Book-to-market

Table 8, panel C indicates that firms with higher book-to-market ratio gives abnormal returns as average monthly return increases as book-to-market ratio increases. This could be derived from the negative relation between book-to-market and size and just be a hidden size effect. Table 9, panel A shows the average monthly return when controlled for size. In most of the eleven size rows (including the 'All' row) average monthly return increases as ln(BE/ME) increases. This supports the evidence of Fama and French (1992) that book-to-market is a common risk factor in the U.S. stock market. Figure 4 and figure 5 illustrate how the cumulative return increases dramatically as book-to-market increases. Figure 2 also depicts how average monthly return is higher for high book-to-market firms than for lower book-to-market firms.

ESG

Table 8, panel D clarify that the average monthly return for the not-ESG portfolio is higher than that of portfolios with either E, S, or G positive ratings and that of the portfolio with both E, S, and G positive ratings. However, within the ESG portfolios the group with E, S, and G positive ratings perform better than those with either E, S, or G positive ratings. The panel also shows that better performing portfolios consistently have higher average market beta and lower ln(ME). This supports some of the previous indications; that there exists a negative relationship between size and return and that beta and size may be a proxy for one another.

Panel A in table 8, table 10, and table 11 all show that for small firms, ESG-rated (E, S, and/or G positive rated) firms receive higher average monthly returns than not-ESG firms. For medium and large firms, the opposite relationship is observed. Interestingly, in all cases the small firm ESG portfolio has smaller average ln(ME) than the small firm not-ESG portfolio. The opposite is reported for the medium and large firm groups; ESG-portfolios have bigger average ln(ME) than the not-ESG portfolios. This could imply that the fluctuations seen in average monthly return may be a consequence of the changes in size. Figure 5 emphasize this tendency; in the 'small' groups the cumulative return are higher for the ESG portfolios than the not-ESG portfolios, while the ESG portfolios under-perform in the 'big' groups.

Subconclusion

The portfolio formation study supports the evidence already found by Fama and French (1992) of a negative relation between firm size (ln(ME)) and return. This connection is seen in several cases of this analysis. Fama and French (1992) further find that firms with higher book-to-market ratio outperform firms with lower book-to-market. This link is also identified in some of the results of this study but not consistently. Regarding a possible connection between ESG focus and return, one should be very careful interpreting too much from the results of this analysis. There are weak indications that for small firms ESG may create positive abnormal returns. Yet, the result is not statistically significant given the few observations (portfolios).

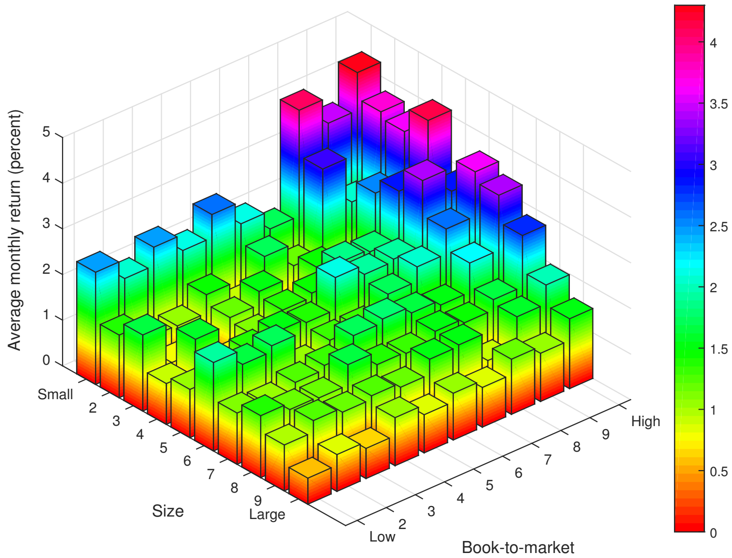

Figure 2: Fama-French analysis: Average monthly return (percent) for each of the 100 size-book-to-market portfolios. The heat map shows the return (height) of each group as color, see the color bar for interpretation.

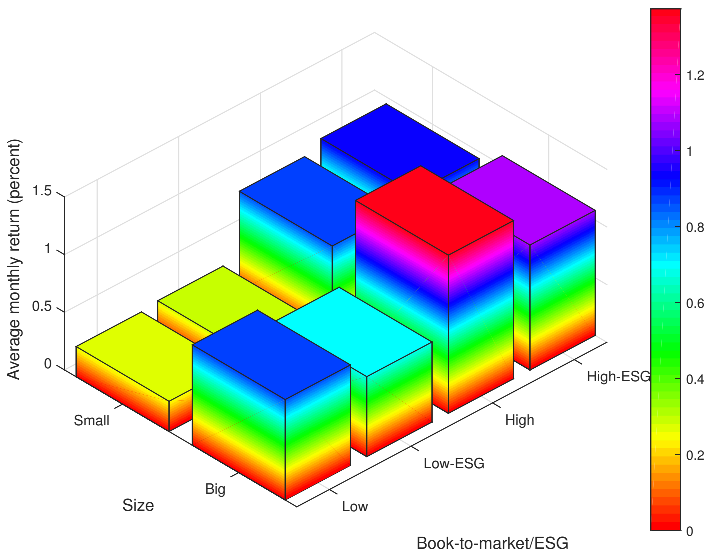

Figure 3: Fama-French analysis: Average monthly return (percent) for each of the eight size-book-to-market-esg portfolios. The heat map shows the return (height) of each group as color, see the color bar for interpretation.

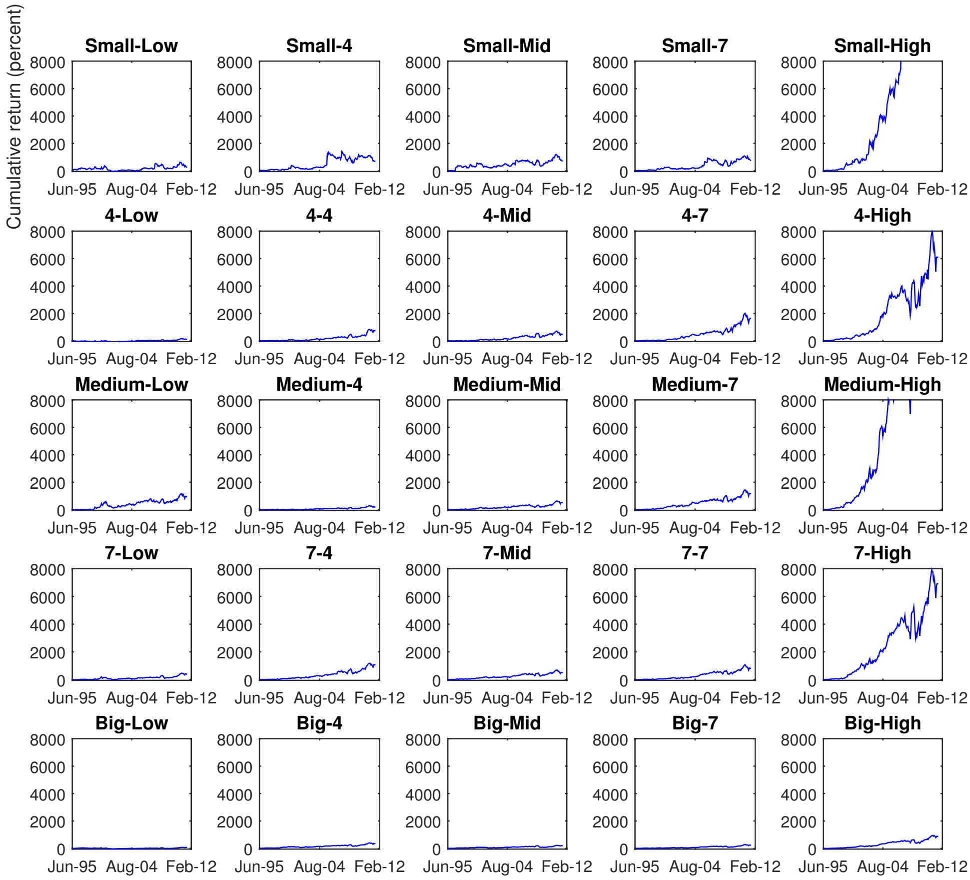

Figure 4: Fama-French analysis: Cumulative return (percent) for a sample of the size-book-to-market portfolios. The Small-High portfolio has overall the highest cumulative return of $39,134 in October 2013.

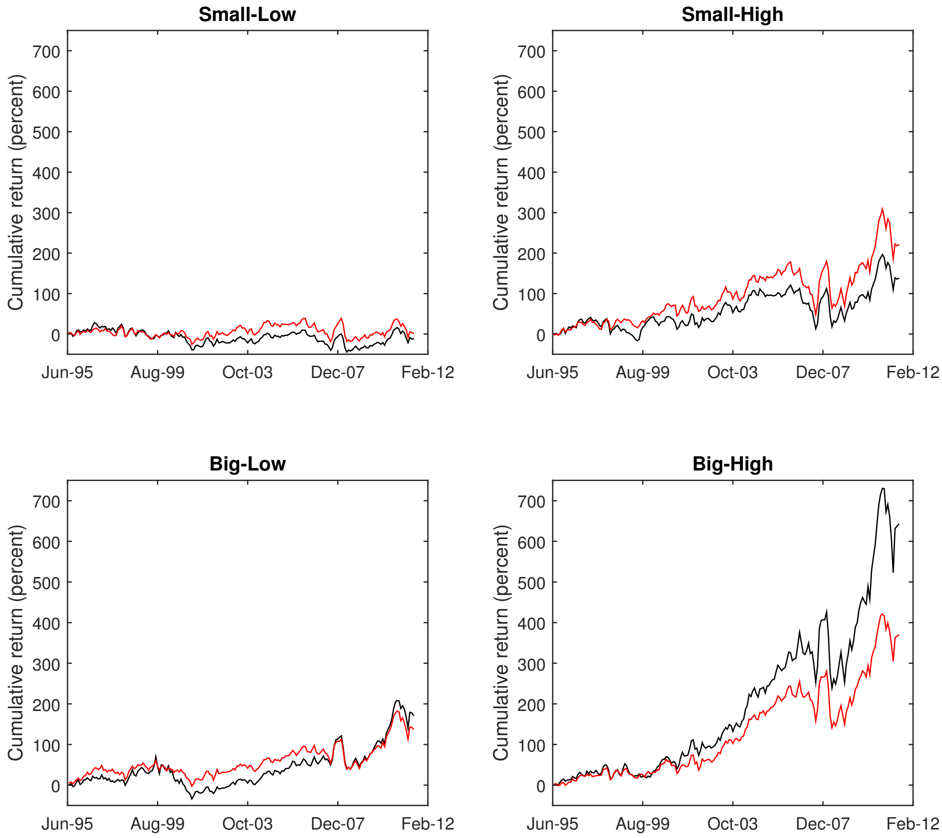

Figure 5: Fama-French analysis: Cumulative return (percent) for the eight size-book-to-market-ESG portfolios. The black lines are the non-ESG portfolios and the red lines are the ESG-portfolios.

Table 8: Average monthly return (percent), market beta, size, book-to-market, and number of firms for different one-sorted portfolios from the Fama-French analysis.

Panel A: Portfolios formed on market beta

	1A	1B	2	3	4	5	6	7	8	9	10A	10B
Return	0.48	1.44	0.89	1.35	1.58	1.49	1.45	2.12	2.11	2.5	1.99	3.51
Beta	0.66	0.86	1.06	1.18	1.27	1.36	1.45	1.57	1.69	1.82	1.96	2.26
ln(ME)	9.28	7.48	7.17	5.85	6.16	5.53	6.76	5.3	5.17	5.82	6.4	4.97
ln(BE/ME)	-1.08	-0.99	-0.86	-0.7	-0.71	-0.6	-0.86	-0.66	-0.73	-0.94	-1.08	-0.89
Firms	155	133	293	282	287	287	284	285	286	282	149	129

Panel B: Portfolios formed on size

	1A	1B	2	3	4	5	6	7	8	9	10A	10B
Return	3.3	2.15	1.74	1.5	1.79	1.88	1.89	1.69	1.54	1.32	1.13	0.79
Beta	1.5	1.52	1.52	1.53	1.54	1.53	1.48	1.4	1.33	1.24	1.12	1.01
ln(ME)	2.07	3.02	3.8	4.58	5.21	5.82	6.43	7.05	7.71	8.55	9.55	11.02
ln(BE/ME)	-0.11	-0.33	-0.49	-0.61	-0.67	-0.79	-0.87	-0.94	-1.01	-1.12	-1.26	-1.48
Firms	143	143	285	285	285	285	285	285	285	285	143	143

Panel C: Portfolios formed on book-to-market

	1A	1B	2	3	4	5	6	7	8	9	10A	10B
Return	1.31	1.36	1.09	1.18	1.29	1.39	1.42	1.59	1.89	2.38	3.04	3.92
Beta	1.47	1.44	1.42	1.4	1.38	1.37	1.38	1.4	1.42	1.45	1.47	1.47
ln(ME)	6.9	7.13	7.12	6.96	6.83	6.59	6.34	6.02	5.68	5.14	4.55	4.01
ln(BE/ME)	-3.09	-2.16	-1.7	-1.33	-1.06	-0.84	-0.63	-0.43	-0.21	0.07	0.4	0.94
Firms	143	143	285	285	285	285	285	285	285	285	143	143

Panel D: Portfolios formed on ESG

	Not ESG	E	S	G	E, S, and G
Return	0.82	0.78	0.7	0.78	0.8
Beta	1.31	1.23	1.11	1.22	1.25
ln(ME)	7.69	8.49	9.05	8.68	8.05
ln(BE/ME)	-0.98	-1.09	-0.99	-1.12	-1.04
Firms	419	562	167	465	147

Table 9: Fama-French portfolios formed on size, and book-to-market

	All	Low-BE/ME	BE/ME-2	BE/ME-3	BE/ME-4	BE/ME-5	BE/ME-6	BE/ME-7	BE/ME-8	BE/ME-9	High-BE/ME
Panel A: Average monthly return (in percent)											
All	1.7	1.34	1.27	1.21	1.36	1.41	1.5	1.54	1.91	2.33	3.18
Small-ME	2.73	2.46	2.04	2.44	2.09	2.6	2.11	1.72	4.04	3.47	4.3
ME-2	1.74	1.37	1.03	1.01	1.41	0.89	1.69	1.2	3.04	2.04	3.73
ME-3	1.5	1.67	0.78	0.46	1.2	1.49	0.72	1.46	1.12	2.52	3.59
ME-4	1.79	0.89	1.58	0.8	1.11	1.38	1.47	1.87	1.81	2.86	4.12
ME-5	1.88	1.06	1.29	1.35	1.48	1.4	2.1	1.89	1.94	3.38	2.87
ME-6	1.89	1.94	1.61	1.74	1.03	1.3	1.31	1.75	2.06	2.61	3.58
ME-7	1.69	1.12	1.06	1.23	1.32	1.69	1.78	1.63	1.52	2.16	3.36
ME-8	1.54	1.36	1.21	1.18	1.63	1.35	1.31	1.52	1.42	1.65	2.77
ME-9	1.32	1.01	1.26	1.16	1.24	1.15	1.48	1.51	0.89	1.56	1.98
Large-ME	0.96	0.57	0.81	0.66	1.05	0.84	1.02	0.87	1.21	1.06	1.53
Panel B: Average market beta											
All	1.41	1.5	1.48	1.44	1.42	1.41	1.39	1.39	1.38	1.36	1.38
Small-ME	1.51	1.58	1.55	1.51	1.51	1.5	1.49	1.49	1.49	1.48	1.47
ME-2	1.52	1.61	1.56	1.56	1.53	1.5	1.51	1.51	1.5	1.49	1.49
ME-3	1.53	1.61	1.58	1.56	1.54	1.51	1.53	1.52	1.5	1.48	1.49
ME-4	1.54	1.63	1.6	1.56	1.55	1.52	1.51	1.51	1.53	1.49	1.51

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Table 9 – *Continued from previous page*

	All	Low-BE/ME	BE/ME-2	BE/ME-3	BE/ME-4	BE/ME-5	BE/ME-6	BE/ME-7	BE/ME-8	BE/ME-9	High-BE/ME
ME-5	1.53	1.59	1.6	1.53	1.52	1.51	1.5	1.52	1.53	1.49	1.5
ME-6	1.48	1.56	1.5	1.52	1.48	1.46	1.42	1.47	1.42	1.44	1.48
ME-7	1.4	1.53	1.46	1.42	1.38	1.38	1.39	1.35	1.36	1.35	1.4
ME-8	1.33	1.42	1.43	1.38	1.35	1.31	1.29	1.28	1.27	1.28	1.29
ME-9	1.24	1.4	1.32	1.27	1.24	1.23	1.23	1.21	1.14	1.18	1.19
Large-ME	1.07	1.11	1.16	1.11	1.13	1.12	1.07	1.06	1.02	0.94	0.95
Panel C: Average size - ln(ME)											
All	6.2	6.25	6.23	6.23	6.23	6.22	6.2	6.18	6.16	6.15	6.13
Small-ME	2.54	2.72	2.62	2.58	2.58	2.57	2.56	2.5	2.49	2.46	2.34
ME-2	3.8	3.83	3.81	3.79	3.81	3.81	3.81	3.78	3.79	3.78	3.77
ME-3	4.58	4.57	4.59	4.57	4.59	4.6	4.59	4.58	4.57	4.56	4.53
ME-4	5.21	5.21	5.22	5.2	5.22	5.22	5.23	5.22	5.21	5.2	5.19
ME-5	5.82	5.84	5.82	5.83	5.84	5.84	5.82	5.82	5.82	5.81	5.8
ME-6	6.43	6.42	6.42	6.45	6.43	6.45	6.43	6.44	6.42	6.42	6.41
ME-7	7.05	7.05	7.05	7.05	7.07	7.06	7.05	7.05	7.05	7.04	7.04
ME-8	7.71	7.74	7.71	7.72	7.73	7.71	7.72	7.72	7.7	7.7	7.69
ME-9	8.55	8.59	8.58	8.57	8.6	8.55	8.56	8.53	8.51	8.51	8.51
Large-ME	10.28	10.56	10.52	10.56	10.38	10.34	10.24	10.17	10.09	9.98	9.97

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	All	Low-BE/ME	BE/ME-2	BE/ME-3	BE/ME-4	BE/ME-5	BE/ME-6	BE/ME-7	BE/ME-8	BE/ME-9	High-BE/ME
Panel D: Average book-to-market - ln(BE/ME)											
All	-0.81	-2.55	-1.63	-1.26	-1.01	-0.8	-0.61	-0.43	-0.24	-0.01	0.47
Small-ME	-0.22	-2.01	-1.12	-0.74	-0.47	-0.25	-0.04	0.17	0.39	0.67	1.22
ME-2	-0.49	-2.47	-1.43	-0.99	-0.7	-0.47	-0.26	-0.06	0.16	0.42	0.93
ME-3	-0.61	-2.57	-1.56	-1.13	-0.83	-0.57	-0.37	-0.18	0.02	0.29	0.79
ME-4	-0.67	-2.54	-1.56	-1.15	-0.88	-0.66	-0.45	-0.26	-0.06	0.16	0.67
ME-5	-0.79	-2.6	-1.64	-1.25	-0.98	-0.77	-0.58	-0.39	-0.2	0.02	0.52
ME-6	-0.87	-2.65	-1.65	-1.28	-1.04	-0.84	-0.67	-0.5	-0.32	-0.1	0.39
ME-7	-0.94	-2.54	-1.7	-1.35	-1.11	-0.92	-0.75	-0.58	-0.43	-0.21	0.23
ME-8	-1.01	-2.53	-1.69	-1.38	-1.17	-1	-0.85	-0.7	-0.54	-0.33	0.12
ME-9	-1.12	-2.71	-1.83	-1.52	-1.31	-1.12	-0.96	-0.78	-0.6	-0.4	0.03
Large-ME	-1.37	-2.88	-2.14	-1.84	-1.61	-1.4	-1.2	-1.02	-0.82	-0.58	-0.19
Panel E: Average number of firms											
All	2852	290	285	283	285	285	283	284	284	285	288
Small-ME	286	29	29	28	28	29	28	28	28	28	29
ME-2	285	29	29	28	28	29	28	28	28	28	29
ME-3	285	29	28	28	29	28	28	29	28	28	29
ME-4	285	29	29	28	28	29	28	28	28	28	29
ME-5	285	29	29	28	29	28	28	29	28	28	29

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Table 9 – *Continued from previous page*

	All	Low-BE/ME	BE/ME-2	BE/ME-3	BE/ME-4	BE/ME-5	BE/ME-6	BE/ME-7	BE/ME-8	BE/ME-9	High-BE/ME
ME-6	285	29	28	28	28	28	28	28	28	28	29
ME-7	285	29	29	28	28	29	28	28	28	28	29
ME-8	285	29	28	28	28	29	28	28	28	28	29
ME-9	285	29	29	28	29	28	28	29	28	28	29
Large-ME	286	29	29	28	28	29	28	28	28	28	29

Table 10: Fama-French portfolios formed on size, book-to-market, and ESG factors

Panel A: Average monthly return (percent)

	All	Low-BE/ME	Low-BE/ME ESG	High-BE/ME	High-BE/ME ESG
All	0.8	0.49	0.53	1.1	1.03
Small-ME	0.63	0.26	0.28	0.86	0.94
Large-ME	0.97	0.87	0.69	1.37	1.08

Panel B: Average market beta

	All	Low-BE/ME	Low-BE/ME ESG	High-BE/ME	High-BE/ME ESG
All	1.26	1.31	1.23	1.31	1.22
Small-ME	1.39	1.38	1.37	1.4	1.38
Large-ME	1.14	1.21	1.14	1.17	1.1

Panel C: Average size - ln(ME)

	All	Low-BE/ME	Low-BE/ME ESG	High-BE/ME	High-BE/ME ESG
All	8.14	7.87	8.81	7.52	8.18
Small-ME	6.8	7.08	7.03	6.65	6.56
Large-ME	9.49	9.11	10.06	8.79	9.38

Panel D: Average book-to-market - ln(BE/ME)

	All	Low-BE/ME	Low-BE/ME ESG	High-BE/ME	High-BE/ME ESG
All	-1.05	-1.55	-1.68	-0.44	-0.5
Small-ME	-0.82	-1.37	-1.42	-0.23	-0.24
Large-ME	-1.29	-1.82	-1.89	-0.73	-0.69

Panel E: Average number of firms

	All	Low-BE/ME	Low-BE/ME ESG	High-BE/ME	High-BE/ME ESG
All	981	208	283	211	279
Small-ME	491	131	115	131	114
Large-ME	490	77	168	80	165

Table 11: Fama-French portfolios formed on size, and ESG.

Panel A: Average monthly return (pct.)				**Panel B: Average market beta**			
	All	No-ESG	ESG		All	No-ESG	ESG
All	0.8	0.82	0.78	All	1.28	1.32	1.25
Small-ME	0.22	0.09	0.24	Small-ME	1.44	1.46	1.43
ME-2	0.84	0.86	0.73	ME-2	1.35	1.35	1.35
ME-3	1.07	1.05	1	ME-3	1.28	1.29	1.27
ME-4	1.06	1.19	0.97	ME-4	1.21	1.24	1.2
Large-ME	0.84	1.23	0.77	Large-ME	1.12	1.1	1.12

Panel C: Average ln(ME)				**Panel D: Average ln(BE/ME)**			
	All	No-ESG	ESG		All	No-ESG	ESG
All	8.15	7.69	8.49	All	-1.05	-0.98	-1.09
Small-ME	5.87	5.92	5.83	Small-ME	-0.62	-0.61	-0.58
ME-2	7.2	7.23	7.19	ME-2	-0.92	-0.86	-0.96
ME-3	8.07	8.05	8.08	ME-3	-1.03	-1.03	-1.02
ME-4	8.95	8.92	8.97	ME-4	-1.19	-1.21	-1.17
Large-ME	10.65	10.02	10.74	Large-ME	-1.5	-1.54	-1.5

Panel D: Average number of firms			
	All	No-ESG	ESG
All	981	419	563
Small-ME	197	104	92
ME-2	196	105	91
ME-3	196	101	95
ME-4	196	79	117
Large-ME	196	29	168

7.3 Adjusted Fama-MacBeth regression analysis

The results of the adjusted Fama-MacBeth regression study are shown in table 12 and table 13. The first table shows the results of regressions made on the data set excluding ESG data, while the second table shows the results of the regressions made on the data set including ESG data. The difference between the two data sets is the number of firms included each year as shown in table 4. It is obvious that the number of firms in the data set including ESG data is very limited between 1995-2002. However, changing the time line of the regressions to 2003-2012 does not change the conclusion.

Market beta
The means of the estimated market beta lies between 1.61 to 1.99, with t-statistics between 3.2 to 3.71 for the larger data set which excludes ESG data. For the narrower data set which includes ESG data, the statistically significant means lie between 1.18 to 1.27 and have t-statistics between 2.62 to 2.84. These results hint a positive beta effect.

Size
The sign of the means of the estimated size coefficients depends on which data set is used in the regressions: Using the large data set gives statistically significant means of -0.14 and -0.16 with t-statistics of -2.41 and -2.13 in two of the three fitted models. This implies a negative link between size and return. The means of the estimated coefficients are very close to those obtained by Fama and French (1992) in the period July 1963 to June 1990 (which are -0.14 on average). When the regressions are ran on the slim data set the adverse effect is seen; the means of the estimated size coefficients are statistically significant in all of the nine fitted models and range between 0.15 to 0.41. Their t-statistics range between 2.44 to 5.42. The latter result suggests a positive relation between size and return. The regression results of the two data sets obviously contradict each other.

Book-to-market
The adjusted Fama-MacBeth regressions show no significant predictive power of book-to-market ratio on average monthly return. Using the larger data set in the regressions gives a mean of estimated coefficients with a t-statistic numerically larger than 2 in only one case, where the mean is -0.14. Using the narrow sample does not change much as there is still only one statistically significant mean of -0.30 with t-statistic of -2.17. Although, all t-statistics have negative sign one should be careful reading too much

from the results as they are essentially statistically insignificant and might as well be coincidental.

ESG

The analysis does not give basis for rejecting the null-hypothesis; that the true coefficient of the ESG variable is different from zero. The means of the estimations are far from statistically significant. Regarding the estimated coefficients of the G+ (governance strength), E- (environment concern), and S- (social concern) variables the conclusion is the same. In two cases for the E+ (environment strength) variable, statistically significant means are reported, which could indicate a negative effect of environment focus on return (means of -0.13 and -0.14 with t-statistics of -5.10 and -5.17). Numerically large t-statistics are likewise found in all three cases for the S+ (social strength), with means of -0.15, -0.13, and -0.12 with t-statistics of -5.37, -5.23, and -4.5. This may hint a negative effect of a social factor on return. In the two cases of the G- (governance concern) variable the means are -0.28, and -0.29, with t-statistics of -2.52 and -2.63, thus proposing a negative relation between concerns related to governance issues and stock return.

Overall, the results of the adjusted Fama-MacBeth regressions vaguely hint that firms focusing on environment and social factors may be subject to a risk discount in return. Firms that are negatively involved in governance issues may also be subject to reduced return. No link is observed between a general ESG focus and return. However, as the ESG data set lacks magnitude one should be interpret too much from the results.

Table 12: Mean coefficients (t-statistics) from month-by-month regressions of stock returns on market beta, ln(ME), and ln(BE/ME): July 1995 to June 2013

β_{M}	ln(ME)	ln(BE/ME)
1.99		
(3.69)		
	-0.16	
	(-2.41)	
1.85	-0.06	
(3.44)	(-0.93)	
		-0.29
		(-1.69)
1.93		-0.3
(3.71)		(-1.84)
1.61	-0.14	-0.42
(3.2)	(-2.13)	(-2.42)

Table 13: Mean coefficients (t-statistics) from month-by-month regressions of stock returns on market beta, ln(ME), ln(BE/ME), and ESG: July 1995 to June 2013

β_{M}	ln(ME)	ln(BE/ME)	ESG	E+	S+	G+	E-	S-	G-
0.79									
(1.84)									
	0.15								
	(2.44)								
		-0.30							
		(-2.17)							
1.21	0.25								
(2.64)	(3.87)								
1.18	0.22	-0.17							
(2.62)	(3.61)	(-1.29)							
0.79			0.00						
(1.82)			(0.07)						
1.23	0.36		0.03		-0.15				
(2.70)	(5.03)		(0.34)		(-5.37)				
1.26	0.39				-0.13				
(2.80)	(5.23)				(-5.23)				
1.23	0.36			-0.11	-0.12	0.11			
(2.71)	(5.01)			(-1.40)	(-4.50)	(0.94)			
1.18	0.34						-0.13	-0.06	-0.28
(2.65)	(4.67)						(-1.65)	(-1.73)	(-2.52)
1.24	0.37	-0.14		-0.13					
(2.80)	(5.29)	(-1.08)		(-5.10)					
1.27	0.41		0.04	-0.14					-0.29
(2.84)	(5.42)		(0.38)	(-5.17)					(-2.63)

8 Conclusion

The aim of this thesis is to analyse whether there is a relation between environmental, social and corporate governance (ESG) factors and stock returns in the U.S. The results of three empirical analyses in the period 1995-2013 give no base for the presence of any connection. The results are mixed and lacks statistical power. There are consistent indications of a negative relation between size and return in one of the analyses, supporting the evidence of Fama and French (1992). Prior studies have found both positive and negative effects of sustainability focus on stock or fund return. While most existing literature on the subject have focused on the existence of a correlation there are few focusing on causality. Renneboog et al. (2008a) argue that ESG focused firms are less risky due to less exposure to reputation loss, litigation costs and other hazardous events. This suggests that an ESG focus reduces some fundamental risk in the firm. If that is indeed the case then this idiosyncratic risk could be eliminated from ones portfolio through diversification. Another argument on causality is that it is the investors' demand for ESG focus that adjusts the price.

As discussed previously in this thesis their are challenges in conducting a quantitative analysis on sustainability factors. Firstly, there are the difficulties of how to measure sustainability: Doing a due-diligence of all firms in the sample is doubtless too exhaustive for one person. If one has access to an instant historical data set from a rating agency, that obstacle is overcome. This introduces some other hurdles as to the quality, objectivity and usability of the data set. Assuming these issues do not occur, there are other problems to be solved: How should the data set be included in the analysis? Should one pick the indicators one find suited? Are all indicators equally valid? These challenges should be considered in future research.

The author decided to concentrate all 'strength' indicators to one ESG dummy variable indicating whether a firm has any ESG strengths or none. In future research it could be intriguing to look at selected indicators and focus on one of the ESG areas: environmental, social or corporate governance issues.

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