Sustainable Investments: An analysis on the inclination towards green investments and their long-term performance.

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ABSTRACT,
Recent concerns on a global scale towards sustainability, pollution, human rights, and an overall view of righteousness have been a focused subject in most areas of expertise. In consequence, businesses and financial markets have also been subject to change when it comes to different metrics in this sense. The apparition of Environmental Societal and Governance metrics and scores have changed the landscape of financial markets as they were decades ago. The focus of some investors has shifted towards greener alternatives. This research took an interest in offering a clearer view of what is happening in terms of investing in a sustainable manner. Specifically, the research conducted has its focus on understanding if, on long-term, it pays off to invest sustainably. In addition to this, the findings are challenged by different factors of interest in the context of ESG rated investments. The study showed that in simpler terms of only risk and return, sustainable investment portfolios might have a poorer performance, be safer from classic market risk, but have other risks to be addressed. Hence, the green investment strategy might be beneficial only from a social implication perspective.

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1. INTRODUCTION

It is a universally known fact that, for decades, we have been polluting and slowly degrading our planet, thus, in recent years, multiple actions have been taken to tackle this challenge: switching materials used to renewable or reusable ones, introduction of alternative transportation, encouragement of sustainable practices, and more (Hossain, 2023). With the apparition of the sustainable and environmentally-friendly mindset, whether it was pushed forward socially (World Economic Forum, 2023) or regulatorily (e.g., European Union Legislation regarding the Environment and Climate Change (EUR-Lex, n.d)), multiple business opportunities in this context arose or adapted from something else to being sustainable. Some businesses have reached a point where they are now able to list themselves on the stock market, as green companies are a popular subject to discuss along with the increasing pressures and policies (Ijaz, 2023).

A first glance at current research implies that ESG ranked investments are profitable choices among investors, and the traditional view of shareholder capitalism is being replaced by a focus on stakeholders, however, the performance differs according to the region, and the study samples data from a 12-month interval (Gubareva et al., 2023). A supporting study suggests that sustainable finance is still in its „infancy" but explores the different returns of ESG investment indexes based on the ESG ranking guidelines used. Results are rather similar in terms of returns, with the standard deviations being highly variable between indexes (Bolognesi, 2023). De Jong and diBartolomeo (2022) explore the performance of sustainable-rated stocks when included in indexes and after their deletion from the index. The paper finds that performance does not decline when deleted, moreover, the performance constantly increases while included within the investment index (the example index being the S&P 500).

However, the focus of the problem is placed on the long-term performance of investment portfolios. The selected literature explores the performance of stocks or the indexes they are included in; the analysis is done at intervals of up to a year. Due to long-term investing referring to periods longer than a year (Chen, 2023), these can only serve as a starting indicator of the risk-adjusted return of a sustainable investment portfolio or the stocks included within a portfolio. There are limitations when it comes to finding peer-reviewed scientific papers and books regarding long-term ESG investments. Due to the concept of ESG ranking being rather recent (Pompella & Costantino, 2023), no immediate conclusion can be drawn from existing studies.

Consequently, an exploration of multiple findings, theories, and data would be the next step in establishing some clearer foresights, taking into consideration multiple factors affecting the possible long-term performance of ESG investment portfolios.

1.1 Problem statement

The main point of interest would be if ESG (Environment, Social, Governance) investments perform any better than regular investment choices and whether private investors' portfolios are better off with choices of green stocks rather than the classic choices of stocks. Inherently, this interest in performance explores the „why" of these choices, what drives investors towards alternating their choices with a sustainable attitude. ESG-rated stocks can be defined as investments measured in terms of sustainability, moreover, on the environment (e.g. carbon emissions, air and water pollution), society (e.g. Diversity, Human Rights), and governance (e.g. Internal Stability of the company) (Benson, 2023).

1.2 Research question

The research question formulated as a base for the analysis, along with the sub-questions identified, are:

- **Do sustainable attitudes towards investment strategies improve long-term performance of private investment portfolios?**
    - What drives the adoption of sustainable investments, considering the regulatory and market trend impacts?
    - What are green investments and how are they measured in terms of performance?
    - How susceptible are green investments to market risk?

1.3 Contribution

The proposed research aims to establish if the inclusion of sustainable investments brings higher financial benefits to private investment portfolios compared to regular, low average ESG score, portfolios, from a long-term perspective. A combination of previous research on different aspects related to sustainable investing, an analysis and comparison of previous market data, and the application of financial foresight methods would help investors have a deeper understanding of the implications and possible future of ESG-ranked investments.

In terms of academic advancements, the paper aims to build upon existing literature on the subject. On its own, the paper should serve as further basis for other research, given that sustainable finance is undergoing rapid changes constantly (Natalucci, 2022).

2. LITERATURE REVIEW

In answering the research question and its sub-questions, multiple theories are needed. Firstly, previous analyses in the performance of ESG stocks from a short-term perspective is needed in order to compare the long-term performance of green assets/portfolios.

It is important to understand why investors choose investments, whether they are incentivized by returns or moral satisfaction. In this sense, multiple researchers have analysed the main incentives for choosing ESG investments, as well as normal investments.

To know if and how sustainable investments are pushed to adoption, it is important to know if there are any risks associated with these types of investments, from the systematic risks to theoretical risks such as greenwashing, the transparency of rating agencies, and other identified factors.

2.1 Long-term performance and Risk

Measuring the performance of investment portfolios can be done in multiple ways; however, in answering the question, a long-term perspective is needed, so multiple theories from investment analysis could be of help, such as analysing the long-term returns of theoretical investment portfolios, adjusting them to risk, analysing their vulnerability to systematic and unsystematic risk, and forecasting.

Financial methods identified to be commonly used in explaining the impact different factors have on an asset would help highlight fundamental differences between regular and green stocks. It is important to notice whether ESG-ranked stocks are as vulnerable to different market risks as regular stocks.

The Capital Asset Pricing Model (CAPM) calculates the expected return in terms of the risk-free rate of return, the market volatility of the asset, and the market risk premium (Kenton, 2023). The difficulty of the method would be estimating the risk-free rate of the stock, should it not be readily available as an estimate. The methods would indicate how attractive an investment is, but does not consider different factors such as the environmental impact of a company.

Another option would be the Fama-French Five-Factor model, in some cases a better model than CAPM, due to the consideration of multiple factors, unlike CAPM's single factor, the market beta (Bolognesi, 2023). The Fama-French model is a more comprehensive method of calculating the expected return of stocks.

Some literature suggests that higher ranked ESG assets have yielded higher than predicted returns at lower risk, but the high returns are greatly influenced by investor demand, thus there is a continuous need for ESG-oriented investors to enter the markets. (De Jong & diBartolomeo, 2022).

2.2 Investors' preferences and behaviour

The choice of investment is highly dependable on the perception of the investor for the investment itself. Thus, some consider more factors when deciding upon which type of asset to choose, while some do not have a particular reasoning for their choice. This is the case with sustainable investments as it is important to notice if most investors pick such investments blindly or not, and the reasoning behind the choice.

Siemroth and Hornuf (2021) explore that the choice of investing in green assets is mainly born from both environmental impact and potential higher returns. Moreover, investors who allocate larger shares of their funds to sustainable investments are those who either believe that green investments are more profitable or believe the environmental impact is more important to them. From this study it is concluded that 25% of investors do not give up higher returns for impact, 13% give up a higher return for any kind of impact, and 60% give up a higher return for a sufficiently large impact. Thus, investors prefer environmental impact over social impact.

Gutsche et al. (2023) reached a similar conclusion when it comes to the preference of investors towards sustainable investments, being strongly inclined towards this type of investment compared to allocating their funds in a random manner. The study also supports Siemroth and Hornuf (2021) in terms of the motives behind the choice identifying two motives: monetary gain and non-monetary gain. The non-monetary gains refer to personal qualities such as altruism, where investors are driven by the satisfaction of contributing socially. Another interesting variable contributing to the non-monetary drivers is "warm glow", a feeling of good when an individual performs the act of giving. This driver leads to the investors' psychological benefit and not necessarily to financial gain. In terms of the monetary incentives, the study finds that financial returns and costs, along with associated risks, is still relevant in their choice. Thus, the study concludes that while the choice of asset is still considered financially, non-monetary incentives are crucial in the choice for sustainable investments.

Heeb et al. (2022) continue the idea of the "warm glow" effect, the emotional and personal satisfaction of investors. The addition to the idea is that the investors care more about the idea of making a change than the actual impact the invested-in asset can have. The trade-off regarding monetary gains to have a social impact is also apparent in this study.

2.3 Greenwashing

Greenwashing can be defined as withholding information or altering it as to change the public image, consequently the perception of stakeholders or "misleading consumers regarding the environmental practices of a company" (Romero, 2008). There are many concerns in this sense as the performance of an asset linked to greenwashing might decrease as misleading information is revealed. Another concern linked to greenwashing would be the inconsistency in ESG ratings, due to the difference in methodologies used by rating agencies as well as a bias towards differed metrics of interest, the difference in the focused aspect (Ghitti et al., 2023).

2.4 Market Bubble

Another factor to be considered and debated would be the possibility of the sustainability trend just being a market bubble waiting to „burst" and all ESG assets currently being overvalued, such as the „.com" bubble, where investors are „overly enthusiastic" (Bolognesi, 2023). Related to the subject of a market "bubble", in the sense of the stock being overvalued, Reber (2021) discusses the information asymmetry given by the ESG disclosures occurring at the initial public offering of a company. During the IPO, given the level of ESG disclosure, the confidence of investors rises and so does their optimism regarding the perception of risk.

2.5 Hypotheses

Thus, the following factors have been identified as presenting an increased interest in the context of green stocks and their behaviour in terms of performance:

1. ESG ranking
2. Investor Behaviour
3. Risk and Return
4. Transparency and validity of ESG
5. Investor Demand
6. Greenwashing
7. A potential Market Bubble

Combined theories which are needed to answer the research question along with its sub-questions can start an analysis to test the following hypotheses:

H0: The ESG ranking of an asset does not significantly impact the long-term risk-adjusted returns of investment portfolios.

- H1: The ESG rating of assets significantly impacts the systematic risk of investment portfolios.

Hypothesis 0 aims to test whether investment portfolios with a high average ESG score perform better in the long-term than lower-rated portfolios.

Hypothesis 1 supports the first hypothesis by examining if there is a difference in the systematic risk vulnerability across different ESG rated portfolios. This would determine the sensitivity of the sustainable portfolios to the market, thus how stable and "safe" green investments actually are.

3. METHODOLOGY

In order to test the hypotheses, it is important to determine appropriate testing methods, thus, for the main research question, the interest lays on the performance change related to the adoption of ESG investments. The secondary hypothesis are focused on the risk ESG investments present and the relevant ESG factors influencing the choice of investments.

Answering the secondary question is highly relevant to answering the main research question as the performance will be measured in terms of multiple factors. Some factors such as "Market Bubble" and "Investor Behavior" can be explored only conceptually through literature or surveying, and serve as a theoretical risk to the performance of the sustainable portfolios. Other factors can be estimated or have already been estimated with data readily available (e.g. returns, systematic risk). Rating companies in terms of ESG is not done in a universal manner and multiple agencies with personal strategies and frameworks exist, thus they are not consistent (Escrig-Olmedo et al., 2019).

As with all foresight methods, the chosen model will only predict the long-term performance of the portfolio including sustainable assets and it does not promise an entirely certain future for the long-term investment. The purpose is to further build on existing data and research on a recent subject of interest in investments and to debate contradicting opinions on the matter.

3.1 ESG rating impact

A multiple regression analysis can be used to put the dependent variable (risk-adjusted return) against multiple predictors/factors influencing the outcome of the dependent variable. This would highlight which risk factors influence the risk-adjusted return of a portfolio, depending on the ESG-rating. The main independent variables are the Fama-French 5 factors in the selected period of analysis, as historically measured per month.

The criteria for the selection of stocks can be defined by already existing and publicly available ESG ranking methods (such as an ESG-ranking agency fully disclosing their criteria). Refinitiv (now known as LSEG), is one of the agencies with an open methodology using publicly available ESG data in their ranking.

Investments will be chosen based on their ESG to create a diverse collection in terms of rating. It is important to have an equal number of investments with a rating score of over 50 and below 50 as to further isolate and facilitate the analysis data in a fair manner.

3.2 Risk analysis

Hypothesis 1 (H1) can be tested through the regression analysis of the risk-adjusted returns of the portfolios against different risk variables. The model aims to explain the systematic risk of the portfolio, while also highlighting the unsystematic risk associated with the portfolio. Additionally, an analysis of relevant literature already discussing the risks associated with ESG investments could support or contradict this hypothesis. Defining a basis for what ESG investments represent based on ranking, collecting past trading data of these ESG investments, and measuring their volatility in terms of the price, along with all available data regarding risks on different trading platforms, can determine the what are the risks of investing in sustainable stocks. As mentioned in section 2., the performance would be calculated considering risk with methods of predicting expected returns while taking into consideration multiple factors.

3.3 Other factors influencing the investment choice

Other factors with a potential influence on the performance of sustainable investments would be investor behaviour, closely linked to market trends, regulatory influence and the potential of a market bubble, or the overestimation of the actual value of these investments. Such factors cannot properly be tested using the current model and will only be explored systematically through previous research as to be further considered when concluding the analysis results. Analysing these factors require the application of different models.

3.4 Applying the model

As mentioned, the model will be represented by a multiple regression analysis with consideration for multiple factors with potential to influence the dependent variable in question. The proposed model will be applied in a software called R Studio using the R programming language.

All relevant data will be imported to the software to be processed according to the model in a structured manner. Thus, financial data for a period of three years (January 2020 to January 2023) was imported from Yahoo Finance according to the market indexes selected based on ESG scores. The data will be separated in monthly average returns over the selected period. Separation of the assets will be done in groups of 10 as to create balanced portfolios and easily distribute the weights of the assets. Monthly returns of the portfolios in a combination with the Fama-French 5, enable the historical analysis of the data, as well as forecasting it using a rolling forecast method.

The software allows for testing the model for its fit, what independent variables actually have an impact on the dependent variable and their degree of impact, how accurate the model is, and other relevant statistics to the proposed research. The model will not only test data from highly-ranked ESG assets, but also „regular" stocks in order to notice the difference between the two types of investments. The model will be completed with visual representations of the results as to facilitate the observation of the potential differences. In the analysis, the returns are extracted on a daily basis, converted to monthly returns for each index, separated on the basis of ESG score, adjusted according to equal portfolio weights (a 10% weight for each asset), then adjusted according to the RF of that period (month), thus the excess return.

The regression model, however, does not include the ESG score itself. As the ESG scores for historical periods of time cannot be obtained and one constant value of the score would not yield any meaningful results in the analysis, it will only be used as an indicator of what assets would be included in the theoretical investment portfolios. Therefore, the regression model would be as follows:

$$excess\ return = \beta 0 + \beta 1 * Mkt.RF + \beta 2 * SMB + \beta 3 * HML + \beta 4 * RMW + \beta 5 * CMA + \varepsilon$$

The model's interest lays on the excess return (Rj – Rf) as influenced by several risk factors: market beta (Mkt.RF), size (SMB), value (HML), profitability (RMW), and investment (CMA). It will be applied for all three cases of portfolios with a low, medium, and high average ESG score.

In addition to this regression model, which in essence test Hypothesis 1, historical data analysis of the portfolio returns and their forecast for a future period will be concluded.

4. DATA AND RESULTS

4.1 Data description

4.1.1 ESG ratings

Regarding the factor of ESG rating and how companies are being rated, it was necessary to define the framework used in their rating. This is due to all factors influencing the final ESG score and how they might cascade down to the potential return of the stocks. The first option to create a common and comprehensive framework for rating companies was to find and combine all publicly available frameworks from different rating agencies. In the search for such rating agencies, there has been a common issue in most cases, the service is paid and/or only available for institutions/companies, with inquiry required. This is a recent issue born along the introduction of ESG rating companies, the lack of transparency and data availability. The issue is often resolved by contracting multiple agencies in order to have a more complete view of the ESG rating of different companies (Adcock et al., 2023). However, for the sake of this research, contracting multiple paid services is not possible, especially in the context of an independent researcher. In the search for transparent agencies offering a publicly available methodology LSEG Data & Analytics is currently the only seemingly reliable source. As the data provider shows detailed methodology, from the process of data collection to criteria and calculation. In addition to the regular Environmental Societal and Governance criteria used for the score, the agency includes an "ESG controversy score" (Refinitiv, n.d.-b).

Thus, in the case of the LSEG framework for ESG rating, the data collection starts with sources such as Annual reports, Company Websites, NGO websites, Stock exchange filings, CSR reports, News sources, and they are processed and entered into a global ESG database. The ESG score is calculated based on 10 criteria from the three different pillars (Environmental, Social, Governance). Criteria included in the calculation are:

- Resource use
- Emissions
- Innovation
- Workforce
- Human Rights
- Community
- Product responsibility
- Management
- Shareholders
- CSR strategy

Detailed "themes" for each category are offered in the guidelines. LSEG has a database of already calculated ESG(C) scores for multiple companies using their method of estimation. As a result, for the selected companies to be used in the analysis, the ESG scores can be directly searched from LSEG's search engine, showcasing the overall ESG score along with specific scores for each criterion. For the selected assets, each ESG score was searched and put in a separate file to be further used in R Studio along with the financial data collected in order to start applying the model.

Company	Market INDEX	ESG Score
Church & Dwight	CHD	71
Gartner Inc	IT	75
Nvidia	NVDA	75
Marathon Petroleum	MPC	78
Alphabet	GOOGL	81
Volkswagen AG	VOW.DE	81
Motorola	MSI	82
Caterpilar	CAT	83
Microsoft	MSFT	88
Mercedes-Benz Group AG	MBG	93
KLX Energy Services Holdings Inc	KLXE	14
Carnarvon Petroleun Ltd	CVN.AX	22
Nerdy Inc	NRDY	27
Boston Beer Company Inc	SAM	30
Skechers USA Inc	SKX	33
Transocean Ltd	RIG	46
FutureFuel Corp	FF	46
Woodward	WWD	48
Oracle Corp	ORCL	48
American Vanguard Corp	AVD	49

Table 1. Selected assets and their ESG rating

4.1.2 Sustainable Assets

In terms of historical financial market data, multiple sources could have been used. Preliminary options were eToro, Trading 212, and Yahoo Finance. Due to eToro's feature of checking already existing portfolios and how they performed it could have been used as a non-formal indicator of how different portfolios have performed in the past, given some of them have included ESG investments, but finding the proper portfolios to be used in the hypothesis testing would have been very difficult and time consuming. Ultimately, Yahoo Finance was used as the primary source for data collection, directly in R Studio using different packages' functions (e.g. tidyquant). While Yahoo Finance might not be reputable enough, it is the only source integrated with the R package, needed for fast extraction of large amounts of data. The data is separated into months for each asset chosen in the analysis, showcasing all relevant information in a period over three years.

As for the selection of stocks, 10 assets were chosen to have a high or satisfactory ESG score (over 50) and 10 assets a low ESG score (below 50). From this selection, three portfolios could be

built, one having a score over 50, one below 50, and the last being a mix of assets with an average score of 50. The assets' ESG score was retrieved from LSEG. This data selection method allows the model to be applied in multiple scenarios for an investment portfolio. Thus, one scenario might include only highly-rated investments, another scenario a mix of investments, and lastly a scenario involving only low-rated investments. All three scenarios analyse theoretical investment portfolios in terms of past performance as well as the forecasted performance for the next three years, including all identified associated risks. The selection of the stocks and their ESG score was decided from the basic idea of sustainability, thus the search began with an assumption that higher polluting industries might exhibit lower ESG scores, and other industries, such as electronics and IT, might have higher scores. In the search, an interesting fact came to light as one of the higher rated companies is a petrol exploitation company. This raised some concerns related to greenwashing, the methods used for rating and what is actually considered "green" and "sustainable".

4.1.3 Systematic and unsystematic risks

In the analysis of the portfolio performance in the mentioned cases, it is important to also test how prone to the market risks each type of portfolio is. Thus, the interest lies on portfolios with a high average ESG score and how well they handle the systematic risk, as well as how much risk is unexplained by the market (unsystematic risk). Consequently, due to the interest in both systematic and unsystematic risk, the Fama and French 5-Factor model was chosen as a basis. The factors of the model serve as the independent variables in the testing of the risk exposure. All factors were collected from Kenneth R. French's Data Library from Dartmouth for the selected period of analysis (January 2020- January 2023), on monthly data.

4.2 Results

The dataset for the ESG scores of 20 assets and the returns of each asset over a period of 3 years (January 2020 to December 2022) was imported and analysed in R Studio. The financial data extracted using the "tq.get" function was reorganized into months as the original data contained over 14,000 observations and the Fama-French factors are calculated monthly. Criterion for further separation were created, thus selecting assets with corresponding ESG scores of over 50, under 50, and a combination of both. The return data is weighed equally (10% per each asset) to create a theoretical investment portfolio for each of the three cases. This weighing assumes that the assets remain at a constant allocation of resources (10%) over the period of three years as to maintain fairness and observe the growth or decline without further intervention over the period. Separated monthly data could then be combined with the 5 Fama-French factors in a separate CSV file.

Thus, the final form of the data contains the excess returns calculated using the risk factors, and the rest of the Fama-French factors. From that point, the regression and historical returns analysis, and forecast could be performed.

The final form of the returns (the excess returns) was tested with only one of the three types of returns being normally distributed, the low-ESG returns ($p = 0.2093$), the rest yielding p-values lower than 0.05 in the Shapiro-Wilk test.

4.2.1 Descriptive statistics

The initial number of observations for the historical data was 14,905. The financial data, due to the availability of the risk factors in months, was also calculated monthly, consequently reducing the number of observations to 710, and then further as the portfolios were created and cumulative returns were calculated.

Given in Table 3. the analysed data show a mean close to -0.04, highlighting a negative excess return across all portfolios created. The standard deviation statistic shows that as the ESG score decreases (from a high average ESG score to a low ESG score) the standard deviation is higher, thus a higher instability or variation in returns over time. The returns show median values close to 0, suggesting that the returns are small on a monthly basis. The distribution of each of the three types of return seems fairly symmetrical with a near 0 skewedness. The Cronbach's Alpha, used to test the reliability of the data, is relatively low (0.432), with indication that the independent variables might not consistently contribute to each of the portfolios' returns.

	Low ESG Portfolio	**Medium ESG Portfolio**	**High ESG Portfolio**
Sharpe Ratio	-0.62534	-0.74826	-0.72266
Risk Free Rate			0.0527

Table 2 Sharpe Ratio of the Portfolios

	Mean	**SD**	**Median**
High Excess Return	-0.0356	0.1223	0
Med Excess Return	-0.04436	0.1298	-0.01
Low Excess Return	0.0084	0.15	-0.02
Mkt.Rf	0.731	6.33	1.86
SMB	0.11	3.26	-0.1
HML	0.45	5.3	-0.3
RMW	0.81	2.96	0.4
CMA	0.79	3.27	0.78
Alpha	0.432		
N	108 obs.		

Table 3. Descriptive statistics of all combined excess returns

4.2.2 Regression Results

The regression results are showcased in Table 3. giving important information regarding how prone each portfolio is to be affected by systematic risk and which of the risk metrics is most influential in the returns value. The high average ESG portfolio is reinforced in terms of returns by the Market Risk Factor (t-value = 4.363), indicative of positive effects from this type of systematic risk. In comparison, low or medium rated portfolios present similar results from the market excess return, showing a significant influence from the market excess return across all portfolios, with a lower impact on the High ESG portfolio. Thus, the high-ESG portfolio is rather sure to move with the market and be influenced by its movements but not in the same volatile manner as the rest of the portfolios. The beta estimates are inversed by the order of the average ESG score, or the higher the ESG score, the lower the volatility. Factors such as SMB, HML, RMW, CMA vary across the portfolios, indicating their impact is specific to the portfolio type or

industry. The medium rated portfolio shows a slight significance towards the value (HML) with a p = 0.035. The model applies best to the low rated portfolio with an adjusted R^2 of 0.6794, thus the model explains 64.15% of the variance in returns.

Differences in the intercept are small, however the excess returns are also low in value and the interest lies in the long-term performance, consequently, the long-term effect of these systematic risk factors on the type of portfolio.

LOW				
	Est.	**Std. Error**	t-value	Pr(>|t|)
Intercept (Adjusted -Return)	-0.05255	0.0155	-3.391	0.00197
Mkt.Rf	0.01643	0.0026	6.116	<0.001
SMB	0.01039	0.0060	1.714	0.09676
HML	0.00704	0.0042	1.649	0.10953
RMW	-0.00676	0.0061	-1.098	0.28079
CMA	0.00137	0.0062	0.220	0.82730
Adj. R^2		0.6794		
F-statistic		15.83		
P-value		<0.001		
DF		30		
Average ESG Score		36.3		
N		36 obs.		
HIGH				
	Est.	**Std. Error**	**t-value**	**Pr(>|t|)**
Intercept (Adjusted -Return)	-0.04111	0.0164	-2.505	0.01789
Mkt.Rf	0.01240	0.0028	4.363	<0.001
SMB	-0.00023	0.0064	-0.036	0.97144
HML	0.00658	0.0045	1.458	0.15518
RMW	0.00060	0.0065	0.092	0.92724
CMA	-0.00856	0.0066	-1.293	0.20597
Adj. R^2		0.4601		
F-statistic		6.965		
DF		30		
Average ESG Score		80.7		
N		36 obs.		
MED				
	Est.	**Std. Error**	**t-value**	**Pr(>|t|)**
Intercept (Adjusted -Return)	-0.04965	0.0153	-3.240	0.00292
Mkt.Rf	0.01331	0.0026	5.013	<0.001
SMB	0.00419	0.0059	0.701	0.4888
HML	0.00927	0.0042	2.198	0.03584
RMW	-0.00309	0.0060	-0.508	0.6151
CMA	-0.00798	0.0061	-1.290	0.20703
Adj. R^2		0.5818		
F-statistic		10.74		
DF		30		
Average ESG Score		55.2		
N		36 obs.		

Table 4. Regression Results for the LOW, HIGH and MED average ESG portfolios

4.2.3 Correlation

The correlation matrix (Figure 1. In Appendix) highlights a strong correlation between the three types of returns (0.7-0.74), with indication that all three portfolios are susceptible to the market movement impact, continuing to support the presence and impact of the systematic risk. The strongest correlation coefficient (0.95) lies between the medium and low excess returns, implying that both portfolios share the similar risks. High and medium have a similar correlation (0.94) with the lowest correlation being between High and Low (0.86).

The correlation matrix managed to further highlight and support the influence of the systematic risk factors across all types of investments, with lower values for RMW and HML suggesting that they are less important to the historical performance of the investment portfolios.

4.2.4 Past and forecasted performance.

In the analysis for the long-term performance, the excess returns for all three portfolios were plotted across the selected time period to visualise the how the returns behaved over the three years. The plot (Figure 2. In Appendix) shows lines for the low (green), medium (blue), high (red) ESG-rated asset excess returns. As seen in the descriptive statistics, the deviation of the returns is higher for the Low ESG portfolio, thus, more volatile compared to the High ESG portfolio.

The forecast method is a rolling forecast, or time series, of the excess returns for all three cases for a period of 3 years (January 2023- December 2025). The plots (Figure 3, 4, 5 in Appendix) showing decreasing returns for all mentioned types, due to the historical return values, highlight significant differences in forecasted returns. The last excess return value for the High ESG portfolio (approx. -1.5) is significantly lower than the Low ESG portfolio (approx. -0.6). The Medium ESG portfolio is expected to perform similarly to the low-rated portfolio.

Combined visual representation of the returns, both historically and with a long-term view for the future, with the descriptive statistics, respectively the mean of each excess return, signals that the Lower ESG-rated portfolios perform better when it comes to long term returns compared to other types of investment allocation. However, this type of strategy involves a higher uncertainty towards market conditions and volatility.

4.2.5 Hypotheses

In answering Hypothesis 1, whether the ESG rating of assets impacts the systematic risk vulnerability of portfolios, cannot be rejected by the regression analysis and descriptive statistics due to the difference in impacts across all types of Fama-French risk factors on the excess returns. As mentioned, all types of

investments are impacted similarly by the market excess return, but the overall model applies best to the lower ESG-rated portfolio given the explained variance of the model (R^2), with the standard deviation statistic further supporting the idea of increased variance in returns. Thus, the risk differs from each type of investment, the higher the ESG score of the portfolio, the lower the systematic risk impact.

In answering Hypothesis 0, given the historical data returns, supported by a time series forecast, the returns vary significantly. Although the low ESG-rated portfolio had a higher variance and was prone to be impacted by market risks, the returns were overall higher, with the mean excess return being higher than the rest. The forecast results, although not being accurate due to it following the downward trend of the three-year period in the historical data, has shown high differences in the expected returns over the next three years. Although the forecasted returns are extreme, it highlighted the differences in the excess returns and has shown that the high ESG-rates portfolio yielded the lowest returns. The forecasting method and its validity is, however, questionable due to two factors. The first is the weights of the assets in the portfolios, as usually investing would require to allocate resources in a strategic proportion in order to yield good results. The weights were distributed in a non-biased manner, allowing the natural growth and equal contribution of each asset, to avoid disproportionate results. This can be contradicted by the creation of the medium portfolio, containing both low and high rated investments. The medium portfolio managed to offer results closely related to the low ESG portfolio. The second factor questioning the forecast would be its trend. The trend before the forecast point was downward across all types of excess return, thus attributed to how they moved with the rest of the market. Increased accuracy in the forecast would have required more factors to be measured and considered. Thus, only the difference in return would have to suffice. All combined data and results can point out that there is indeed an indication of a difference across different ESG-rated investments, more specifically the higher the ESG rating, the lower the systematic risks and returns.

5. DISCUSSION

In the analysis the performances of different theoretical investment portfolios were tested against multiple important factors in determining whether or not the hypotheses stand or not. More importantly the performance was tested in terms of historical data put up against market risk factors.

Investor demand is an important factor in this analysis as it is important to know if there is an actual demand for high-rated ESG investments and if the demand is sustainable or not. As noted by De Jong & diBartolomeo (2022), ESG investments might be highly driven by investor demand, thus, the price of sustainable assets is dependent on a constant number of demanding investors for this type of asset.

Investor behaviour could closely be linked to the demand in green investments. As long as the topic of being having a sustainable perspective and the need to change and maintain this perspective is constant, then investors could continue to support highly ESG-rated assets as well as the process of ESG rating. As long as there is a need for investors to fulfil the “warm glow” mentioned in section 2.2 more than the monetary motives, there is a chance that the demand will remain constant.

Greenwashing was another subject of interest as misleading stakeholders into investing in different assets might lead to significant losses in the investment, thus creating a link between trust and the overall demand of investors to continue investing in green investments. Highly linked to greenwashing, the ESG rating and rating agencies play an important role in this. The lack of transparency in company reports, or the withholding of it, combined with highly variable methods across all rating agencies, each with a different focus on certain aspects, are indicative of unsystematic risk and uncertainty.

In section 2.1, the selected research suggested that ESG investing yields higher than expected returns at a lower risk compared to other types of investing, assuming an inclusion to an index fund, and the sustainability recognition factor is disregarded and only the inclusion event is recognised. This would mean that assets independent of index funds perform worse than those boosted by indexation (De Jong & diBartolomeo, 2022).

Lastly, when selecting the assets to be used in the analysis, as mentioned in section 4.1.2, some ratings might raise some concerns, given that seemingly not sustainable companies might exhibit a large ESG score, due to high ratings in other criteria compensating for the lower ratings in others. This can possibly mislead investors with the purpose of investing for moral, personal reasons.

5.1 Conclusion

The results of the analysis combined with the discussed factors and concerns have pointed out the benefits and drawbacks of investing sustainably. Some of the benefits of investing in sustainable assets would include low volatility in returns, indicating a more stable option for holding long-term investments, without any significant positive returns. Lower ESG-rated portfolios, or mixed, perform slightly better in terms of returns but are highly susceptible to market-influence and increased volatility. The analysis concluded that the portfolios were all moving with the rest of the market, no type of investment being completely safe from systematic risk, and has shown that there was a historical decline in returns for all assets, respectively in the forecasted returns. Consequently, the interest lays on the difference in returns, whether they are significant, as the direction of all portfolios has remained the same. Should the market conditions be right, and, unlike in this analysis, the asset allocation be thought more thoroughly, high ESG portfolios could serve as a good means for a buy-and-hold strategy. In contrast, for short-term financial benefits, a mix of both low and high ESG-rated assets could prove beneficial.

On the other hand, many factors remain unanswered, and require different analysis methods and further exploration, raising new research questions to be answered. These factors are concerning as the topic of sustainable investments and ESG ratings is rather new in financial markets and not much is yet understood or discussed about all the possible implications.

5.2 Practical implications

This paper can contribute to the investors’ choice of assets when it comes to building portfolios, as monetary benefits, risks, and other implications have either been analysed or discussed to be considered. Hence, it can serve as an additional information source when it comes to making decisions in long-term investments. Depending on the type of investment strategy an investor might want to adopt, they can refer to this paper when choosing the assets in their portfolios.

5.3 Theoretical implications

As mentioned, the long-term implications of investing sustainably have not been examined thoroughly and there is a lack of information available when it comes to this new type of assets. The research paper aims to complete previous work on ESG investments and contribute to building a more

comprehensive case on how these investments perform and how they affect financial markets as well as the investors themselves.

5.4 Limitations

In terms of limitations, the main obstacles were time and the availability of data. Due to a restricted time frame, not all factors could be thought out and analysed in order to offer a complete analysis which considered all possible risks of investing in green assets. An analysis of the factors mentioned would have required additional models and methods of data collection, such as interviews or surveying.

Data collection has been rather problematic on two variables: financial data (returns) and ESG scores. Colleting ESG scores is difficult in the sense that there are multiple agencies offering ESG consulting, using different methods. These methods are often not entirely transparent or offered publicly without monetary compensation. Thus, the ESG scores chosen from LSEG were the only available option given the current resources. Additionally, the ESG score could only be chosen as a constant variable. The lack of dynamism in its value over time in the analysis could not yield any results about its impact on the portfolio returns.

Financial data had to be chosen based on these ESG scores as to create portfolios. The issue with the financial data was the large scale of analysis and the availability to easily import and process all the data. Consequently, the package chosen in R Studio to import the data functions with Yahoo Finance, limiting the reliability of the data to one source only. The data was weighted as being equal in all portfolios, thus the results might differ given different weights for the assets involved.

5.5 Future research

As for the continuation of this research, all factors included in the discussion should be further explored. New models should be built, combined and ultimately analysed to conclude with a definitive answer to the benefits and drawbacks of sustainable investing. In addition, the current model used for the analysis of historical data and the one used to forecast the returns of these portfolios could be further adjusted and improved to provide a more accurate representation of the past and future.

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7. APPENDIX

Title and (Author)	Discussed Concept

Does ESG investing improve risk-adjusted performance? (Véronique Le Sourd)	Risk adjusted performance measuring (Investment Analysis)
Behavioural Finance (William Forbes)	Understanding basic behaviours when it comes to investors' choices.
Government and markets: Toward a New Theory of Regulation (Balleisen & Moss)	Regulation theory-based literature with a focus on markets.
Determinants of individual sustainable investment behavior - A framed field experiment (Gutsche, G., Wetzel, H., Ziegler, A)	theoretical reasoning for sustainable attitudes in investors
Do Investors Care about Impact? (Heeb, F., Kölbel, J.F., Paetzold, F., & Zeisberger, S.)	theoretical reasoning for sustainable attitudes in investors
Why do Retail Investors Pick Green Investments? A Lab-in- the Field Experiment with Crowdfunders. (Siemroth, C., Hornuf, L)	theoretical reasoning for sustainable attitudes in investors
New trends in asset management: From Active Management to ESG and Climate Investing (Bolognesi, E.)	previous relevant work on ESG investing models used to measure performance
Risks related to Environmental, social and Governmental Issues (ESG). (De Jong, M., & diBartolomeo, D.)	a paper discussing the risks of ESG investing with pros and cons
For whom does it pay to be a moral capitalist? Sustainability of corporate financial performance of ESG investment (Gubareva, M., Umar, Z., Соколова, T., & Antonyuk, V.)	analysis on the risk-return of socially responsible investments
ESG Disclosure and Sustainability Transition: a new metric and Emerging trends in responsible Investments (Pompella, M., & Costantino, L.)	a discussion on the level and type of disclosure companies have regarding sustainability
ESG Disclosure and Idiosyncratic Risk in Initial Public Offerings (Reber, B., Gold, A., & Gold, S.)	Discussion on the impact ESG factors have on Initial Public Offerings

Table 5. Preliminary Literature List

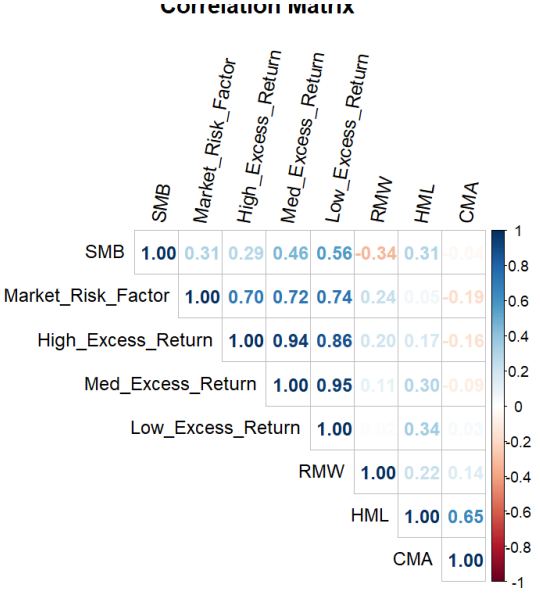

Figure 1. Correlation matrix of the combined returns with risk factors

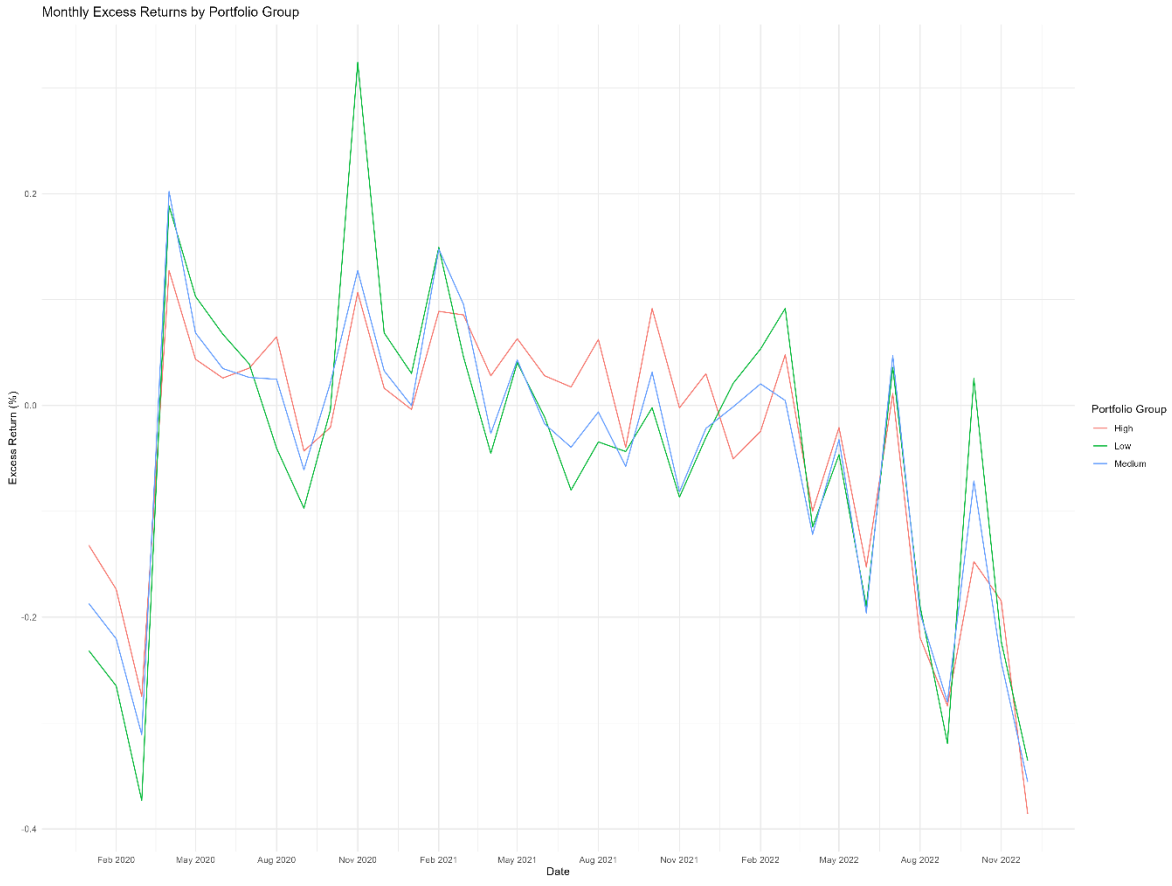

Figure 2. Historical return graph of all three excess returns

Figure 3. High ESG forecasted excess return

Figure 4. Low ESG forecasted return

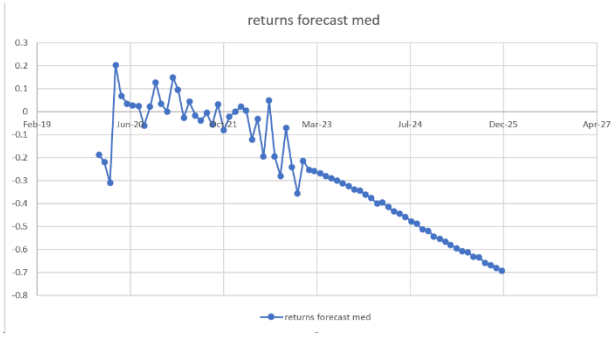

Figure 5. Medium ESG forecasted return