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Abstract

The paper provides an in-depth examination of the relationship between Environmental, Social, and Governance (ESG) factors and portfolio performance. The study begins by defining ESG and its significance, and provides a comprehensive overview of government initiatives, key issues, and ESG raters. The third chapter of the paper contains a comprehensive literature review that summarizes previous research on the topic. The fourth chapter introduces the portfolio theory and specifically focuses on the 3-Factor Model developed by Fama and French.

We consider eight long-only portfolios, consisting of four "Top" portfolios that invest in companies with high ESG scores and four "Worst" portfolios that invest in companies with low ESG scores. We also consider four "Difference" portfolios, which are constructed by subtracting the "Worst" portfolios from the "Top" portfolios.

The results of our regression analysis suggest that the "Top" portfolios tend to outperform the "Worst" portfolios in terms of both return and volatility. The "Top" portfolios are positively correlated with big companies and are sensitive to growth stocks in Europe, while they are sensitive to value stocks in North America. On the other hand, the "Worst" portfolios are also correlated with big companies and are sensitive to value stocks both in Europe and North America. The "Difference" portfolios display a lower return and volatility and are correlated with big companies and value stocks when significant.

Our findings provide new insights into the relationship between ESG factors and financial performance, and suggest that ESG considerations can play an important role in portfolio construction and management. Our results are robust and can be useful for investors who are looking to integrate ESG considerations into their investment decision-making process.

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1. Introduction ESG

1.1 Introduction

The term "Environmental, Social, and Governance" (ESG) originally gained popularity in the early 2000s, when investors began to recognize the role that ESG factors may play in their investment decisions. It is a set of criteria used to analyze the sustainability and ethical effect of a firm or business activity. ESG criterion takes into account factors such as a company's carbon emissions, labor policies, and board diversity, among others.

Specifically, investors remarked that ESG factors might be utilized to assess the possible risks and rewards of a firm, so enabling them to make better educated investment decisions. Since then, ESG investing has become a significant trend in the world of finance, with an increasing number of investors acknowledging the significance of these factors in their investment decisions.

Consequently, ESG investing is an approach to investing that considers the environmental, social, and governance standards of the firms in which one invests. It is sometimes referred to as "sustainable investing" or "socially responsible investing" since it seeks to link an investor's ideals with interests. This may involve investing in firms that are addressing social and environmental challenges, like as climate change or inequality, or avoiding companies that participate in behaviors deemed damaging to people or the environment.

From 2000 to 2022, the environment of ESG investment has grown substantially. The ESG investing movement has enjoyed a boom in popularity as an increasing number of investors understand the significance of taking environmental, social, and governance (ESG) factors into account when making investment decisions. SRI, which stands for Socially Responsible Investment, was only starting to gain attention in the early 2000s. During this time period, socially responsible investment funds were mostly restricted to specialized investment techniques. After a period of time, investing with an eye on environmental, social, and governance criteria moved closer to the mainstream, and asset managers started formulating and launching "impact" and "sustainable" funds. Since 2014, the US market for professionally managed assets employing SRI techniques has surpassed US\$6.57 trillion¹ (US SIF, 2014). During this time period, a number of organizations, such as the Global Impact Investment Network, were established with the intention of advancing the ESG investing movement (GIIN). A rising number of asset managers have launched ESG-focused funds, ETFs, and other products over the course of the past few years, which has contributed to the continuous expansion and evolution of the ESG investment industry. In addition to this, a large number of research companies, data suppliers, and rating agencies have begun to provide ESG services to investors. The ESG investment movement had institutionalized itself, and the ESG investing market had expanded to encompass a diverse array of goods and services. Today, ESG investing is a mainstream investment strategy, with more and more investors recognizing the importance of ESG factors when making investment decisions. In addition, the number of ESG-focused funds, ETFs, and other products, as well as the assets under management for these products, have dramatically increased. As we look to the future, we anticipate that ESG investing will continue to expand and develop as an increasing number of

¹ https://www.ussif.org/Files/Publications/SIF_Trends_14.F.ES.pdf

investors appreciate the significance of ESG considerations and as asset managers continue to create more products with an ESG focus.

1.1.1 How ESG impacted the way to conduct the company

In the 70s, we saw the born of two type of perspectives regarding how the company governance should conduct the company. The stakeholder view and the shareholder view represent two different ways of looking at the success of a company. The stakeholder view focuses on how a company's actions affect everyone involved, including customers, employees, suppliers, and the community at large. The shareholder view focuses on how a company's decisions, activities, and policies create value for its shareholders.

The sustainable investing belongs to the stakeholder view as the investors are focused on the long-term effects of investing in companies that prioritize environmental, social, and governance issues. Stakeholders are interested in ensuring that their investments are socially responsible, financially sound, and promote a positive impact on the environment. ESG investing is seen as a way to ensure that companies are held accountable for their decisions and are better stewards of the environment. Ultimately, stakeholders want to ensure that their investments are making a positive contribution to society and the environment, as well as providing a financial return.

Some research suggests that ESG investing may increase shareholder activism, as investors who are focused on ESG issues may be more likely to engage with the companies in which they are investing and to advocate for changes in company policies or practices that align with their values. This shift in focus encourages investors to take an active role in evaluating and influencing the strategies of the companies they invest in. ESG investing also increases transparency, as investors are more likely to be informed of a company's policies and practices, which in turn encourages them to be more involved in the company's decision-making processes. By creating a more active shareholder base, ESG investing, again encourages companies to focus on long-term value creation, rather than short-term profits, and ultimately leads to a more sustainable, profitable business model. This can include things like pressing companies to reduce their carbon emissions, improve their labor practices, or increase transparency and accountability. At the same time, it's important to note that the relationship between management and shareholders can be complex and multifaceted, and there may be other factors at play that could affect the level of shareholder activism. For example, the overall level of shareholder activism may be influenced by the regulatory and legal environment in which a company operates, as well as by broader economic and market conditions.

The emergence of ESG issues has altered the nature of shareholder activism, as investors increasingly prioritize long-term sustainability and the long-term return potential of ESG investments. Investor activism has increasingly centered on ESG-related concerns as shareholders want to hold businesses responsible for their performance on social fronts. Moreover, investors are increasingly demanding that businesses enhance their ESG performance by tackling climate change, human rights, diversity, and other issues. This has led to a rise in shareholder proposals concerning ESG issues, such as climate change and human rights. In certain instances, shareholders are initiating lawsuits against corporations to hold them accountable for their ESG performance. Therefore, ESG has become a key target of shareholder activism, and this trend is expected to continue in the future. In order to make the firm more

desirable, the corporate governance must alter and become more aligned with the expectations of the shareholders. The management should:

- Develop a clear ESG policy and communicate it to employees.
- Establish an ESG steering committee to monitor progress and report back to the board.
- Incorporate ESG into strategic planning and financial performance.
- Set ESG targets and measure progress against them.
- Integrate ESG into risk management and compliance processes.
- Report ESG performance in financial statements.
- Educate employees on ESG best practices.
- Develop partnerships with ESG-focused organizations and support ESG research and initiatives.
- Engage with stakeholders to understand ESG priorities.

1.2 ESG Regulation around the world

1.2.1 Introduction to the Regulation in EU, USA, and Asia

The regulation of environmental, social, and governance concerns is carried out in a number of different ways all over the world. In some nations, ESG concerns are addressed via specific laws and regulations, while in others, these concerns are addressed via voluntary guidelines and standards.

A number of ESG regulations have been put into effect by the European Union. These regulations include the European Green Deal, the Non-Financial Reporting Directive (NFRD), and the Sustainable Finance Disclosure Regulation (SFDR). The first is a group of policies and initiatives that have been presented by the European Commission with the goal of making the economy of the European Union more sustainable by transforming it into a resource-efficient, competitive, and low-carbon economy. In addition to protecting the natural environment and enhancing the standard of living for its people, the main objective of the European Green Deal is to make it possible for the European Union to become a climate-neutral continent by the year 2050. It encompasses a broad variety of actions, such as the encouragement of the use of clean energy, the formation of a circular economy, the enhancement of the quality of both the air and the water, and the protection of biological diversity. In addition to this, it intends to assist in the transition to an economy that produces less carbon dioxide through the implementation of initiatives such as the growth of public transportation, the promotion of electric cars, and the development of technology that can collect and store carbon dioxide.

In addition, the Non-Financial Reporting Directive (NFRD) mandates that some big businesses (have more than 500 workers and either a balance sheet total of more than 20 million Euros or a net turnover of more than 40 million Euros)² must include in their annual reports information on their environmental, social, and employee issues, as well as their respect for human rights and their efforts to prevent corruption and bribery. While the Sustainable Finance Disclosure Regulation (SFDR) establishes rules on how financial market participants and financial advisers

² European Commission Directive 2014/95/EU

should disclose information about the integration of sustainability risks in their processes and the impact of their investment decisions on sustainability³.

There is no all-encompassing federal law that regulates environmental, social, and governance factors in the United States; however, the Securities and Exchange Commission has issued guidance on ESG reporting for publicly traded companies. However, corporations that are publicly listed have a legal need to provide investors with certain financial and non-financial information, and this information may contain information that is relevant to ESG. The Securities and Exchange Commission (SEC) released interpretative guidelines in 2010 on the use of sustainability and other ESG-related measures in the financial reporting of publicly listed corporations. According to the guidelines, corporations should determine whether or not such information is significant to investors and, if it is, they should disclose it in the public filings that they submit. In addition to this guidance, the SEC has also published a number of rules and regulations pertaining to environmental, social, and governance concerns. For instance, the SEC has adopted rules that require publicly traded companies to disclose their use of conflict minerals⁴. Conflict minerals are minerals that are frequently mined in conditions associated with armed conflict and violations of human rights. The Securities and Exchange Commission (SEC) has also proposed new regulations that would force businesses to report their greenhouse gas emissions as well as risks associated to climate change. In general, despite the fact that the United States does not have any regulations that are unique to ESG that apply to publicly listed corporations, these companies are expected to assess the materiality of information relevant to ESG and disclose it to investors when it is acceptable to do so.

In Asia, there is a plethora of legislation, regulation, and guidance that addresses environmental, social, and governance (ESG) issues. These can vary dramatically from one nation to the next. A few examples of ESG regulation may be found in Asia, including the following:

- In Japan, the national government has enacted a number of ESG-related legislation, one of which is the Act on Promotion of Global Warming Countermeasures⁵, which mandates that businesses report on the amount of greenhouse gas emissions they produce. In addition, the government has created the ESG Data and Information Disclosure Guidelines for the Japan Exchange Group. These guidelines offer listed firms direction for the ESG reporting they are required to complete.
- The Chinese government has enacted a number of policies that are related to ESG, including the Environmental Protection Law, which lays out environmental standards for businesses, and the Corporate Social Responsibility (CSR) Guidelines, which encourage companies to consider their social and environmental impacts. Both of these laws and guidelines are examples of ESG-related policies.
- The government of India has enacted a number of policies that are related to ESG, such as the Companies Act⁶, which mandates that businesses disclose information about the CSR activities they participate in, and the National Action Plan on Climate Change, which outlines a number of different actions that can be taken to combat climate change.

³ European Commission. Regulation 2019/2088

⁴ Act No. 117 of 1998

⁵ The Companies Act, 2013

- The Singapore Exchange (SGX) has now adopted the SGX-listed issuers' Guide on Sustainability Reporting⁷, which offers listed businesses direction on how to report their sustainability efforts.

The regulations continue to evolve around the world with new laws being implemented in more and more countries, and the standards becoming stricter. Most of the initiative come from the European Union and influence the rest of the world. This is the so-called by the literature “Brussels Effect” as EU creates incentives for businesses to conform to its stringent standards, and as a result, market participants react by imitating these norms in their international trade. *“While the EU as a global regulator has been true de facto for a wide variety of matters on which the EU has been a pioneer legislating, or its lawmaking has been proved to be accurate and efficient, it is recognizable that this happens certainly in an informal manner. Regulatory competition and regulatory cooperation must be borne hand in hand in order to prevent the challenges derived from non-harmonized legislation in the globalized world”* (Alamillos et al, 2022)⁸

In addition, there are a number of private organizations that promote and monitor ESG practices. One example of this is the Global Reporting Initiative (GRI), which is a set of voluntary guidelines for sustainability reporting that provides a framework for organizations to disclose the economic, environmental, and social impacts they have. The Sustainability Accounting Standards Board (SASB) is an organization that provides guidelines on the substantial sustainability problems that publicly listed firms should address when presenting information to investors. In addition to this, there is the ISO 26000 Standard, which is a global standard that offers firms recommendations on how to conduct their business in a socially responsible manner. The Global Compact of the UN: This is a program that promotes businesses to align their operations with 10 widely acknowledged values in the areas of human rights, labor, the environment, and anti-corruption. This is a voluntary project that encourages businesses to align their operations with these principles. The United Nations' Sustainable Development Goals, abbreviated as SDGs, are a collection of 17 overarching objectives with the objectives of eradicating poverty, preserving the environment, and promoting global peace and prosperity. The Sustainable Development Goals (SDGs) offer a framework that may be used by governments, corporations, and other organizations to take action on challenges related to sustainability. A significant number of companies and investors have implemented their very own internal ESG policies and procedures, and they frequently make use of the guidelines and standards created by these organizations as a point of comparison.

In general, the environmental, social, and governance (ESG) regulation system is a convoluted and ever-changing terrain, with many nations and organizations adopting a variety of approaches. Concerns about climate change and social responsibility are becoming a more important problem; yet, the trend towards greater attention on ESG issues is expected to continue as a result of this.

⁶ <https://www.sgx.com/sustainable-finance/sustainability-reporting>

⁷ How Can European Regulation on ESG Impact Business Globally? Alamillos and Mariz, 2022

1.2.2 European Action Plan

The European Union (EU) has proposed an action plan for sustainable finance⁹, which consists of a series of policies meant to encourage the financial industry to take environmental, social, and governance (ESG) aspects into consideration in its operations. The objective of the strategy is to stimulate long-term investment and ensuring that financial markets contribute to sustainable economic growth.

Developing a classification system for sustainable activities, known as the "taxonomy," is one of the plan's most important strategies for promoting sustainable financing. This approach will assist market players in identifying sustainable activities and goods, making it simpler for them to invest in these sectors. By giving explicit definitions and criteria for what defines a sustainable activity, the taxonomy intends to enhance the openness and comparability of sustainable investment products and make it simpler for investors to find and engage in sustainable initiatives. Through the introduction of transparency standards for firms and investment funds, the action plan will also contribute to the development of sustainable finance. Companies and investment funds will be required to disclose how they incorporate ESG considerations into their operations and investment choices. This will offer investors with a more full view of a company's or fund's sustainability performance, making it simpler for them to identify those that are committed to sustainability and decreasing the likelihood that they would invest in organizations with poor sustainability practices. In addition, the EU action plan involves a review of EU financial law to verify that it is consistent with the action plan's objectives and any required modifications. This guarantees that current EU financial laws and regulations do not impede sustainable investment and aligns them with the EU's sustainable finance goals. Moreover, the strategy will encourage the incorporation of sustainability-related threats and opportunities into supervisory processes. This would aid EU financial authorities in monitoring and evaluating the sustainability performance of financial institutions and investment funds, therefore increasing their accountability for the effect of their investments on the environment and society. Finally, the EU action plan will give technical support to assist EU member states in the development and implementation of sustainable financial policies. By doing so, the EU will provide the essential assistance for nations to adopt sustainable finance practices and align their policies with the EU's sustainable finance goals.¹⁰

The European Union's action plan for sustainable finance might affect non-European nations in a variety of ways. First, other nations might use the EU's action plan as a template for building their own sustainable financing strategies. The EU's plan is one of the most ambitious and comprehensive sustainable finance plans in the world, and it might encourage other nations to build comparable plans or implement equivalent policies. Second, because the plan of the EU is intended to give a clear framework within which to discover and invest in sustainable initiatives, it is possible that the plan will also contribute to a rise in the demand for sustainable investment products on a worldwide scale. This rise in demand might motivate firms and funds outside the EU to adopt sustainable practices and generate more cash through sustainable investments in order to fulfill the increased demand. Thirdly, the EU action plan is expected to impact the establishment of worldwide sustainable finance rules and recommendations. The European Union

⁹ <https://www.eesc.europa.eu/en/our-work/opinions-information-reports/opinions/action-plan-sustainable-finance-communication>

¹⁰ Sustainable Finance: The European Union's Approach to Increasing Sustainable Investments and Growth – Opportunities and Challenges, Claringbould, Duco; Koch, Martin; Owen, Philip, 2019.

is a prominent player in the global economy and financial markets, and its action plan might motivate other nations to create comparable norms and guidelines and align them with the EU's strategy. Lastly, many multinational corporations and financial institutions have a presence in the EU and will be affected by the actions outlined in the EU action plan. As a result, they may embrace sustainable finance practices in all of their activities, even those in non-EU countries.

The EU's action plan for sustainable finance might have a big influence on nations outside of Europe. The objective of the strategy is the EU action plan for sustainable finance is intended to promote sustainable investments by making it easier for market participants to identify and participate in sustainable projects, enhancing the transparency and accountability of corporations and investment funds, and aligning financial legislation with the objectives of the EU's sustainable finance initiative. In addition, it could serve as an example for other nations by boosting the demand for sustainable investments, influencing the establishment of international norms and guidelines, and pushing global firms and financial institutions to embrace sustainable financing practices. Therefore, it is an ambitious step towards constructing a robust and sustainable financial system by linking it with the overarching objective of the green transition and digitization.

1.3 Greenwashing

Greenwashing is a concept used to characterize firms or organizations that make false or misleading environmental claims in order to look more eco-friendly or sustainable than they actually are. Greenwashing can take many forms, including making false or exaggerated claims about a company's environmental impact, using eco-friendly buzzwords or imagery to distract from environmentally harmful practices, or engaging in symbolic actions that do little to address the underlying causes of environmental problems.

Greenwashing may be harmful in several ways. In the first place, it can mislead customers and investors into believing they are making ecologically responsible decisions when they are not. As the market gets swamped with firms making misleading or exaggerated claims about their environmental policies, it becomes increasingly challenging for genuinely sustainable enterprises to distinguish themselves and be acknowledged for their efforts. Finally, greenwashing may erode trust in businesses and organizations by creating the perception that they are more concerned with seeming ecologically responsible than with really addressing environmental challenges in a meaningful way.

To avoid greenwashing, consumers and investors must perform their due diligence and investigate the environmental policies of businesses and organizations they are contemplating funding. This may involve going beyond marketing promises and acquiring third-party certifications or ratings that give more objective assessments of a company's environmental performance.

By offering more objective and fair assessments of a company's environmental, social, and governance activities, ESG ratings may assist to combat greenwashing. Typically, ESG ratings are derived from a range of sources, such as publicly accessible information such as a company's financial statements and regulatory filings, as well as data from private databases and third-party sources. Ratings are frequently created by independent rating organizations, which helps to guarantee they are not affected by the company being assessed or other vested interests.

ESG ratings can give a more accurate and complete view of a company's environmental and social activities than marketing brochures and other public-facing communications. This can make it more challenging for businesses to participate in greenwashing, since their environmental and social practices will be exposed to more scrutiny and be more transparent to investors and other stakeholders.

Moreover, companies that offers services of shareholder engagement, proxy solicitation, and governance consulting may potentially help to contrast greenwashing by providing investors with more information and tools to engage with the companies in which they are invested. These services can help investors to better understand the policies and practices of the companies in which they are invested and to identify any potential concerns or issues that may need to be addressed.

For example, shareholder engagement services can help investors to communicate directly with companies and to raise any questions or concerns they may have about the company's environmental or social practices. Proxy solicitation services can help investors to propose and vote on shareholder resolutions that address environmental or social issues, or that seek to improve governance practices such as board diversity or executive compensation. And governance consulting services can help investors to better understand the governance structures of companies and to identify any potential risks or red flags that may be worth considering.

By providing investors with more information and tools to engage with the companies in which they are invested, these types of services can potentially help to increase transparency and accountability and to make it more difficult for companies to engage in greenwashing by making false or misleading claims about their environmental or social practices. However, it's important to note that these services are not a guarantee that greenwashing will be prevented or addressed, and it is still important for investors to do their own due diligence and to carefully research the environmental and social practices of the companies in which they are investing. In his paper, Sebastian Utz (2017) examines the reliance of ESG evaluations in cases of corporate scandals. He found a considerable drop in indicators of retrospective controversy throughout the time period in which the scandals are made public. *“We find that retrospective indicators significantly deteriorate in the year of the release of the scandal. This result is robust among different types of scandals. Subsequent to the scandal, these ratings experience a rebound. Indicators which concern the CSR strategy, such as monitoring or improvement, are more likely to increase during the scandal period. In general, the firms which are involved in a scandal score below average in retrospective indicators”*(Utz, 2017)¹¹ . Therefore, as we said before it is important for investors to have a more comprehensive vision of the activity of the company and not only based on the ESG rating.

1.3.1 Scandals greenwashing

“The information asymmetry in the SRI market has been amplified in recent years via the practice of “ESG-washing”. For opportunistic reasons, some asset managers make unsubstantiated or misleading claims about their own environmental, social and governance commitments. By portraying their mutual funds as socially responsible mutual funds but without any intent to

¹¹ Corporate scandals and the reliability of ESG assessments: evidence from an international sample, Sebastian Utz,2017.

invest, these asset managers send misleading signals to investors in a commercial logic.” (Candelon et al, 2021)¹².

There have been several high-profile scandals involving greenwashing in the asset management industry in recent years. One example is the case of T. Rowe Price, which faced accusations of greenwashing in 2019 after the company launched a line of "sustainable" mutual funds that were heavily invested in fossil fuel companies. Despite marketing these funds as a way for investors to align their values with their investments, T. Rowe Price faced criticism for failing to adequately disclose the extent of its investments in fossil fuels and for failing to take action to reduce the environmental impact of its portfolio.

Another example is the case of BlackRock, the world's largest asset manager, which has faced criticism for its investments in fossil fuel companies and for its failure to take more aggressive action on climate change. BlackRock has made some efforts to address these concerns, such as pledging to engage with companies on environmental issues and to divest from certain high-carbon assets, but some critics have argued that these efforts do not go far enough and that the company continues to greenwash its activities.

- In 2018, Invesco was accused of greenwashing for its "Green Bond" fund, which was marketed as a way for investors to support environmentally friendly projects. However, it was revealed that the fund had invested in fossil fuel companies and other companies with questionable environmental practices, leading to accusations of greenwashing¹³.
- In 2021, State Street Global Advisors (SSGA) faced accusations of greenwashing for its "ESG" funds, which were marketed as a way for investors to support companies with strong environmental, social, and governance practices. However, it was revealed that the funds had invested in companies with poor environmental and social records, leading to accusations of greenwashing¹⁴.

In some of these instances, corporations have taken attempts to address the issues voiced and enhance their environmental and social policies. In order to ensure that one's investments align with one's values and that one is not misled by false or exaggerated claims about a company's environmental and social practices, these examples highlight the importance of conducting thorough research and due diligence when selecting asset managers and investment products.

On the other hand, ESG rating agencies have been accused of greenwashing or failing to effectively handle environmental and social concerns in a number of instances. For example:

- The ratings of Brazilian mining company Vale, which was hit by a catastrophic tailings dam collapse in 2019 that caused significant environmental damage and loss of life. Vale had an high ESG rating despite the company's poor environmental and social practices, leading to accusations of greenwashing¹⁵.
- The ratings of Chinese tech giant Huawei, which has been accused of numerous human rights abuses and has been the target of U.S. sanctions. Raters were accused of giving Huawei a

¹² ESG-Washing in the Mutual Funds Industry? From Information Asymmetry to Regulation, Candelon, Hasse, and Lajaunie, 2021.

¹³ <https://www.theguardian.com/sustainable-business/2018/nov/02/invesco-accused-of-greenwashing-in-green-bond-market-surge>

¹⁴ <https://www.theguardian.com/business/2021/feb/17/state-street-investment-climate-change-greenwashing>

¹⁵ ESG Task Force "Lifts the Vale" on Its Scrutiny of ESG Disclosures, Alexander May, 31 May 2022

relatively high ESG rating despite the company's poor record on human rights and other issues, leading to accusations of greenwashing.

2 ESG Ratings

ESG ratings are evaluations of a company's environmental, social, and governance practices. They play a central role in sustainable finance as they might influence investment decisions for some investors, particularly those who are focused on sustainable or socially responsible investing. ESG ratings typically cover a range of factors, including a company's environmental impact, labor practices, human rights record, and governance structures. The criteria used to assess these factors can vary depending on the rating agency or organization, but generally, companies that score well on ESG measures are seen as being more sustainable, responsible, and ethical.

There are several organizations that provide ESG ratings, including Sustainalytics, MSCI, and Bloomberg. These organizations use a variety of methods to assess a company's ESG performance, including analyzing publicly available information, engaging with the company directly, and reviewing the company's policies and practices.

Ratings can be used to assess the sustainability and long-term viability of a company from a financial perspective. Some investors may use ESG ratings as a key factor in deciding whether to invest in a company, and they may also use them to monitor the progress of companies in which they are already invested.

However, it's important to note that the role of ESG ratings in investment decisions can vary widely among investors. Some investors may place a high level of importance on ESG ratings and may use them as a primary or even sole factor in their investment decisions. Others may view them as just one of many factors to consider, alongside traditional financial metrics such as earnings, revenue, and profitability. Ultimately, the centrality of ESG ratings in investment decisions will depend on the individual investor's goals, values, and risk tolerance, as well as their overall investment strategy. Some investors may prioritize maximizing financial returns above all else, while others may be willing to accept somewhat lower financial returns in exchange for the opportunity to align their investments with their values and to support companies that are working to address social and environmental issues.

ESG ratings can be a useful tool for investors looking to engage with companies on ESG issues and to use their ownership rights to influence corporate behavior. Therefore, ESG ratings can influence active ownership strategies, which involve investors engaging with the companies they invest in to improve their performance on environmental, social, and governance (ESG) issues. Investors may use ESG ratings to identify companies that are lagging in their performance on ESG issues and to prioritize their engagement efforts. For example, an investor may use ESG ratings to identify companies that are underperforming on certain ESG factors and then engage with these companies to encourage them to improve their performance. ESG ratings can also influence investors' voting decisions at shareholder meetings. Active Investor may use ESG ratings to identify companies that are performing poorly on ESG issues and vote against management proposals or support shareholder resolutions that seek to improve the company's performance on these issues.

As a result, management teams may feel pressure to improve their company's ESG ratings in order to attract and retain investors. This can involve making changes to company policies and practices in order to address environmental and social issues, as well as improving governance practices such as board diversity and executive compensation. In addition, management teams may also engage with external rating agencies in order to provide input on their company's ESG practices and to ensure that the ratings are accurate and reflective of their company's efforts in these areas.

ESG ratings can be useful to investors in several ways:

- **Risk management:** ESG ratings can help investors identify and manage risks in their portfolios by identifying companies with strong ESG profiles. This can be particularly important for long-term investors who are looking to minimize risk.
- **Financial performance:** Research has shown that companies with strong ESG profiles tend to outperform those with weaker profiles, which can lead to better financial returns for investors.
- **Transparency:** ESG ratings can provide investors with more information about a company's operations, including its environmental and social impacts, which can be helpful when evaluating potential investments.
- **Decision-making:** ESG ratings can help investors consider non-financial factors when making decisions about investments or engagement with a company.
- **Societal impact:** ESG ratings can help investors identify companies that are having a positive impact on society and the environment, which can be beneficial for both investors and society as a whole.

While they present several issues:

- **Lack of standardization:** There is no standard methodology for ESG ratings, and different rating agencies and organizations may use different criteria and approaches to assess a company's performance. This can make it difficult to compare ratings across different agencies and organizations.
- **Subjectivity:** ESG ratings can be subjective, as they are based on the judgment of the rating agency or organization. This can lead to inconsistency in ratings and can make it difficult to compare ratings across different companies.
- **Data quality:** ESG ratings are often based on publicly available information, which can be incomplete or inaccurate. This can affect the accuracy and reliability of the ratings.
- **Conflicts of interest:** Some rating agencies and organizations may have conflicts of interest that can influence their ratings. For example, a rating agency may be influenced by the fees it receives from the companies it rates.
- **Limited coverage:** Many companies and organizations are not rated by ESG rating agencies, which can make it difficult for investors and other stakeholders to obtain

comprehensive information about the sustainability and societal impact of these companies.

2.1 Rating divergence

Among the issues that involve the raters, one of the most important is the lack of standardization that may bring to different rating assigned a company and therefore leave the investor confused.

Theoretically, investor preferences for ESG should impact the asset prices as ESG ratings and indicators are an essential driver to the field of sustainable finance. Among all the raters the most important are MSCI, Sustainalytics, S&P Global, KLD, Asset4, and Moody's ESG.

In contrast with the more common credit ratings, the ESG rating from various providers diverge significantly. There are at least three significant differences between ESG ratings and credit ratings. First, although creditworthiness is relatively well defined as the likelihood of default, ESG performance is less so. It is a notion founded on various and developing principles. As a result, an important aspect of the service provided by ESG rating organizations is an interpretation of what ESG performance means. Second, whereas financial reporting standards have matured and consolidated over the last century, ESG reporting is still in its early stages. There are conflicting ESG disclosure reporting requirements, many of which are voluntary or limited to particular jurisdictions, providing firms significant discretion over whether and what to report. These two distinctions explain why the correlation divergence in ESG ratings is far greater than the divergence between credit ratings. Furthermore, ESG raters are paid by the investors not by company rated.

This disagreement has a number of significant repercussions that can affect the market, the company, and the investors. Firstly, it makes it challenging to assess companies' ESG performance. Additionally, ESG rating difference reduces the incentives for businesses to enhance their ESG performance as there can be different conflicting information about what actions are expected and how will be valued by the market. This could result in underinvestment on ESG activities. ESG performance may have an impact on value or have an impact on asset prices due to investor preferences. However, the ratings' discrepancy spreads out the impact of ESG performance on asset values. Moreover, it is challenging to connect CEO pay to ESG success as the CEOs might optimize for one specific rating while underperforming in other crucial ESG concerns. In other words, they might achieve the rating's aim but fail to improve the firm's overall ESG performance. Finally, selecting one rater instead of another may change a study's findings and conclusions, which makes the divergence of ratings problematic for empirical research.

Berg et al. (2016)¹⁶ pointed out that ESG ratings are substantially different. In the study that compared the six major providers, they found that the Pearson correlations between ESG ratings range from 0.38 to 0.71. To investigate on the differences between ratings they create a taxonomy and decompose the divergence in 3 main categories: Measurement, Scope and Weight.

¹⁶ Aggregate Confusion: The Divergence of ESG Ratings, Berg, Kölbel, Rigobon, 2022

“Scope divergence refers to the situation where ratings are based on different sets of attributes. One rating agency may include lobbying activities, while another might not, causing the two ratings to diverge. Measurement divergence refers to a situation where rating agencies measure the same attribute using different indicators. For example, a firm’s labor practices could be evaluated on the basis of workforce turnover or by the number of labor related court cases taken against the firm. Finally, weight divergence emerges when rating agencies take different views on the relative importance of attributes” (Berg et al.,2016)

They showed that Measurement contributes 56% of the total divergence, Scope 38% while weight only 6%. The result of the study reflects the need of an improvement in the standardization of the rating in order to improve the quality and avoid confusion on the investor which can affect the asset allocation and therefore the market value of the assets.

2.2 Rating MSCI

In our work we are going to build our portfolio using the MSCI ratings which are widely used by the most import investment funds.

MSCI is the outcome of the acquisition of multiple rating agencies. In 2010, they acquired MeasureRisk and RiskMetrics Group, which included ISS, Innovest Strategic Value Advisors, and Kinder Lydenberg Dominion (KLD) in the transaction perimeter. Moreover, they bought InvestorForce and Governance Holdings Co. (GMI) respectively in 2013 and 2014.

Compared to other raters, they aim to measure the company’s resilience to long-term, financially relevant ESG risks. According to the company, MSCI researchers are attempting to evaluate what ESG issues can affect a company and/or an industry, the company's exposure, the way it wants to manage, and finally the overall picture of the company. To accomplish this, they analyze more than a thousand data points on ESG policies and then choose 35 key issues affecting a certain industry that are divided in 10 themes and 3 pillars E/S/G.

The company uses a proprietary methodology¹⁷ to assess the sustainability and societal impact of companies and organizations. MSCI collects data on a company's environmental, social, and governance performance from a variety of sources, including publicly available information, company reports, and engagement with the company. Then, uses a combination of automated and manual processes to analyze the data and assess the company's performance on a range of ESG factors MSCI assigns scores ranging from 0 to 10 and weights to each issue for each company. To assign the score, it is critical to have a solid understanding of whether or not a company is adequately managing a key environmental, social, or governance risk and how vulnerable the company is to that risk. While quantitative analysis of the entire industry identifies crucial issues, the vulnerability of particular enterprises to each issue will differ. On the other hand, weights are determined for each sub-industry based on the subindustry’s contribution to the negative externality associated with key issues and the expected time horizon for the key issue to materialize. Finally, we have the Industry Adjusted Score (IAS) which is defined by the weighted average of the scores and normalized on score range set by benchmark values in the peer set. This score is then used to assign an MSCI ESG Rating to the company, which can be AAA, AA, A, BBB, BB, B, CCC, CC, or C.

¹⁷ MSCI ESG Metrics Calculation Methodology, MSCI, 2020

3. Literature review

The ESG premium: New perspectives on value and performance, McKinsey (2019):

A survey conducted by McKinsey suggests that executives and investment professionals believe that implementing Environmental, Social, and Governance (ESG) programs can create both short and long-term value for companies. The respondents recognize that ESG issues can impact company performance, and the financial impact of ESG programs is likely to increase as expectations and scrutiny from stakeholders grow. In some industries, taking action in ESG areas may help companies distinguish themselves from their competitors and position themselves to create more value. The survey results show a desire from investors and executives to improve current approaches and create more standardized and easily usable ESG metrics and data standards. Investment professionals are particularly interested in ESG data that is better integrated with financial data and readily benchmarked. This data could also benefit ESG leaders within companies and help them to make changes internally. There is a growing recognition that strong ESG performance can improve top-line growth, reduce costs, minimize regulatory and legal interventions, improve employee productivity, and focus investment and capital expenditures. The survey results suggest that more investors and executives will incorporate ESG into their financial and strategic decisions, and that the value of ESG is likely to continue to grow in the future. Companies that have not fully committed to ESG may be missing out on its value.

Corporate ESG Profiles and Investor Horizons, Laura Starks , Parth Venkat , and Qifei Zhu (2017):

In this paper they founded evidence on the relationship between investors' preferences for high ESG firms and their horizons. Results show that long-term investors tend to have a higher preference for firms with strong ESG profiles and they are more patient in their investments in such firms. The paper also provides causal evidence of the importance of investment horizon in ESG investing by examining the differential responses of long-term investors to shocks in firms' ESG reputations. The results have implications for firms' incentives to improve their ESG performance in order to attract long-term oriented investors. This could have a positive impact on the economy by reducing short-termism in institutional investing and promoting corporate innovations and investments.

Do Investors Value Sustainability? A Natural Experiment Examining Ranking and Fund Flows, Samuel M. Hartzmark Abigail B. Sussman (2017)

This study examines the impact of sustainability on the US mutual fund market. The results show that investors value sustainability, as funds categorized as high sustainability received a net inflow of more than \$24 billion, while those categorized as low sustainability faced a net outflow of more than \$12 billion. The study also provides evidence that investors respond to simple and salient globe ratings rather than detailed percentile rankings. The results suggest that investors have a positive belief that better sustainability ratings predict future performance, but there is no evidence that high sustainability funds outperform low sustainability funds. This suggests that the effect of sustainability on investment decisions may be driven by affective factors, such as altruism or a "warm glow," rather than rational beliefs. The study also raises questions about how investors interpret sustainability ratings, which is an open area for further research.

Integrating sustainability risks in asset management: The role of ESG exposures and ESG ratings, Benjamin Hübel Hendrik Scholz (2020)

In this paper, the authors examine the relationship between Environmental, Social and Governance (ESG) risk factors and the financial performance of firms. They find that taking ESG risk into account enhances the explanatory power of standard asset pricing models. The authors also find that portfolios with pronounced ESG risk exposures exhibit higher risks, but investors can compose portfolios with lower ESG risks while keeping risk-adjusted performance virtually unchanged. They conclude that strategically managing ESG risks may result in potential benefits for investors and that taking ESG risk into account in equity portfolios enables investors to better assess the ESG risk exposures of their portfolios using stock returns.

The Sustainability Footprint of Institutional Investors: ESG Driven Price Pressure and Performance, Rajna Gibson Brandon Philipp Krueger Shema F. Mitali (2017)

In this paper, they examine the relationship between this sustainability footprint and the risk-adjusted performance of the institutional investors' equity portfolios. The results show that portfolios with better sustainability footprints tend to outperform, with the positive effect concentrated in the environmental dimension and in more recent periods. The authors hypothesize that this positive relationship is due to growing investor preferences for sustainable investing, which leads to price pressure on stocks with high sustainability scores. They provide evidence to support this hypothesis through tests of price impact and the effect of natural disasters on portfolio performance. The authors conclude that their research highlights the growing interest of investors in stocks with high sustainability scores and the resulting price pressure, which explains the positive relationship between sustainability footprints and risk-adjusted performance. They also note that sustainable investment might underperform in the future due to high sustainability stocks already trading at a premium.

Does corporate social responsibility affect the cost of capital? Sadok El Ghoula Omrane Guedhamib, Chuck C. Y. Kwokb, Dev R. Mishra (2011)

The study described in the text finds that corporations with better scores in corporate social responsibility (CSR) exhibit cheaper equity financing. The research suggests that investment in improving responsible employee relations, environmental policies, and product strategies can reduce a firm's cost of equity. The study uses a sample of 12,915 US firm-year observations from 1992 to 2007 and controls for other firm-specific determinants as well as industry and year fixed effects. The results show that firms with higher CSR scores have significantly lower cost of equity capital.

The findings indicate that investment in CSR activities can enhance firm value by reducing the cost of equity capital. The study suggests that investment in CSR activities is important for firms, as it has the power to explain a firm's cost of equity beyond corporate governance and other risk factors. The results also have practical implications for managers, analysts, and financial advisors. Managers of low CSR firms are advised to consider increasing investments in CSR-related activities, especially in the areas of employee relations, environmental policies, and product strategies, as doing so may reduce their cost of equity and enhance firm value. High CSR firms are advised to actively disclose information about their CSR activities to attract more socially responsible investors and expand the firm's investor base. Financial advisors are advised to

consider the penchant of some investors for socially responsible investments and adjust their investment recommendations accordingly

ESG and financial performance: aggregated evidence from more than 2000 empirical studies, Gunnar Friede, Timo Busch & Alexander Bassen (2015)

the results of this exhaustive study suggest a positive correlation between ESG criteria and corporate financial performance. Roughly 90% of the 2200 individual studies reviewed found a nonnegative ESG-CFP relation, with the majority of studies reporting positive findings. The results propose that ESG outperformance opportunities exist in many areas of the market, including North America and Emerging Markets, as well as in nonequity asset classes. The positive correlation patterns in primary studies have been stable since the mid-1990s, demonstrating no consistent learning effects regarding the ESG-CFP relation. The orientation towards long-term responsible investing is recommended for all kinds of rational investors in order to align their interests with the broader objectives of society and fulfill their fiduciary duties. Future research should focus on understanding the interaction of different ESG criteria in portfolios and the relevance of specific ESG sub-criteria for CFP to provide further insights on ESG determinants for long-term positive performance impacts.

How ESG Affects Equity Valuation, Risk, and Performance, Guido Giese, Linda-Eling Lee, Dimitris Melas, Zoltán Nagy, and Laura Nishikawa (2019)

The authors of the article studied the relationship between environmental, social, and governance (ESG) characteristics of companies and their financial performance and valuation. They used a standard discounted cash flow model and examined three transmission channels to link ESG information and financial performance, which they called the cash-flow channel, the idiosyncratic risk channel, and the valuation channel. The study tested each of these channels using MSCI ESG Ratings data and financial variables. The results showed that a company's ESG information affects both its systematic risk profile (lower costs of capital and higher valuations) and idiosyncratic risk profile (higher profitability and lower exposures to tail risk). The findings suggest that changes in a company's ESG characteristics can be a useful financial indicator and that ESG ratings can be integrated into policy benchmarks and financial analyses. The transmission from ESG characteristics to financial value is a multi-channel process, and the ESG ratings had a lower intensity impact compared to traditional factors, but lasted for several years.

The Impact of Corporate Sustainability on Organizational Processes and Performance, Robert G. Eccles, Ioannis Ioannou, and George Serafeim (2014)

The article investigates the effect of corporate sustainability on organizational processes and performance by analyzing a sample of 180 US companies. The companies were divided into two groups: 90 High Sustainability companies that voluntarily adopted sustainability policies by 1993, and 90 Low Sustainability companies that adopted almost none of these policies. The results showed that the boards of directors of High Sustainability companies were more likely to be formally responsible for sustainability and that top executive compensation incentives were more likely to be linked to sustainability metrics. Additionally, these companies were more likely to have established processes for stakeholder engagement, to be more long-term oriented, and to exhibit higher measurement and disclosure of nonfinancial information. The study found that

High Sustainability companies significantly outperformed Low Sustainability companies in terms of both stock market and accounting performance over the long-term.

The authors acknowledge the limitations of the study, such as the difficulty in determining causality and the possibility of confounding factors. They also suggest four areas for future research, including the conditions and mechanisms for incorporating social and environmental issues into business models, the variation of results across countries, the impact of internal resource allocation on performance, and the optimal degree of adoption of sustainability policies and practices.

Does the ESG Index Affect Stock Return? Evidence from the Eurostoxx50, Mario La Torre, Fabiomassimo Mango Arturo Cafaro and Sabrina Leo (2020)

This paper aims to examine the effect of Environmental, Social, and Governance (ESG) factors on stock returns. The researchers use a two-step methodology to analyze the performance of companies included in the Eurostoxx50 index over the period of 2010 to 2018. They collect various ESG indicators on a monthly basis to classify companies in terms of ESG commitments. The results show that the selected ESG Overall index has only a small effect on the returns, and its impact varies from company to company. The study concludes that the positive impact of ESG commitments on returns is only observed for a few firms, mostly in the energy and utilities sector. The research highlights the need for further tests in other markets and monitoring the contribution of ESG factors to firm performance in the future.

Repeat Offenders: ESG Incident Recidivism and Investor Underreaction Simon Glossner (2021)

This paper analyzes the effects of poor Environmental, Social, and Governance (ESG) practices on a firm's financial performance. The author uses ESG incident news data to study the relationship between firms with high ESG incident rates and their future performance. The author finds that firms with high ESG incident rates have more future incidents, weaker profitability, and lower risk-adjusted stock returns. This leads to market underreaction and negative returns, particularly around earnings announcements and subsequent ESG incident news. The results suggest that stock markets do not fully reflect the negative long-term consequences of poor ESG practices, and this underreaction is due to limited investor attention. The author also finds that ESG-aware mutual funds can benefit from this market underreaction. The paper highlights the importance of considering a firm's history of ESG incidents when making investment decisions and emphasizes the long-term costs of poor ESG practices for companies.

Stock Price Overreaction to ESG Controversies, Bei Cui, Paul Docherty (2020)

This research suggests that the growing trend towards ESG investing, while motivated by the societal benefits of socially responsible firms having access to cheaper capital, may also have some downsides. The focus on ESG information may result in investors devoting substantial resources to examining ESG characteristics to the detriment of other important firm fundamentals. The over-emphasis on ESG can also result in the market overreacting to news about ESG controversies, particularly among smaller firms and stocks that are held by more transient investors. The study provides evidence that the overreaction to ESG news releases is consistent with salience theory, where investors overweight the extreme probabilities associated with salient events. This can lead to a negative announcement effect when news about ESG controversies is released, but these returns tend to mean-revert over time. The impact of both the announcement returns and subsequent reversals is stronger for smaller capitalization stocks

and those stocks held by more transient investors. The results of the study have important implications for institutional investors who incorporate ESG as part of their information set. They need to be careful in their trading activities around ESG news releases to avoid losses that might be incurred by overreacting to the news. At the same time, the observed overreaction to ESG news releases may present opportunities for ESG contrarians to buy stocks after the release of news about ESG controversies and potentially profit from the subsequent mean reversion.

Stock price reactions to ESG news: the role of ESG ratings and disagreement, George Serafeim & Aaron Yoon (2021)

In this research paper, the authors investigate the relationship between environmental, social, and governance (ESG) ratings and future ESG news and market reactions. They find that the consensus ESG rating can predict future news, but its ability to do so decreases when there is disagreement among the raters. They also find that the market reacts positively to positive ESG news and negatively to negative ESG news, with a stronger reaction for firms with low disagreement in their ESG ratings. The authors also find that ESG ratings from different providers have different levels of predictive ability and that the rating with the highest predictive power predicts future stock returns. Overall, the authors conclude that ESG ratings serve as a proxy for market expectations of future performance and can predict future news and stock returns, even though rating disagreement may hinder their usefulness.

When ESG meets AAA: The effect of ESG rating changes on stock returns Savva Shanaev, Binam Ghimire (2021)

This study investigates the impact of ESG rating changes on the stock returns of US firms from 2016 to 2021 using the calendar-time portfolio methodology. The results showed that ESG rating upgrades have positive but inconsistent returns of 0.5% per month, while downgrades have a negative impact on stock performance with monthly risk-adjusted returns of -1.2% on average. The effects of ESG rating changes are more pronounced for ESG leaders compared to laggards and are robust across different asset-pricing model specifications. The study also showed that ESG rating upgrades have a pronounced positive effect during the COVID-19 period. The study highlights the importance of ESG risk factors and the informational value of ESG ratings for both institutional and individual investors. The findings suggest that ESG ratings agencies might positively contribute to information dissemination and market efficiency. The study calls for further research to examine the environmental, social, and governance facets of ESG ratings separately and to study the conventional event studies using high-quality and high-frequency data.

The Effects of Environmental, Social and Governance Disclosures and Performance on Firm Value: A Review of the Literature in Accounting and Finance Chris Brooks and Ioannis Oikonomou (2017)

In summary, this paper reviews the existing literature on the relationship between ESG disclosures and performance and their impact on firm value. The authors draw several conclusions from 45 years of research in the field, including that ESG disclosures are generally associated with better ESG performance and firm performance, and that there is a positive and statistically significant but economically modest link between ESG and financial performance.

Additionally, the paper highlights that the risk-adjusted performance of socially responsible investment (SRI) funds and indexes is statistically indistinguishable from that of conventional funds and indexes. The authors also discuss the negative causal link between ESG and various types of financial risk, and the asymmetry in the financial impacts of ESG, with the negative financial effects of corporate social irresponsibility being stronger than the positive financial effects of corporate social responsibility.

The paper also explores some of the knowledge gaps and interesting questions that have not been addressed yet in the field and outlines a potential agenda for future research on socially responsible investing. The authors point out that the relationship between ESG and financial performance is not clear and the shape of this relationship is not well understood. The papers in the special issue contribute to filling these knowledge gaps by studying the effect of ESG disclosure regimes on analysts' earnings forecasts, the relationship between environmental disclosures, environmental performance, and market valuations, the non-linear connection between greenhouse gas emissions and business performance, and the role of the CEO in the interplay between ESG and firm value. The papers also investigate the impact of managerial incentives on a firm's ESG performance, the relationship between corporate governance and the use of currency and interest rate derivative securities by corporations.

How Material is a Material Issue? Stock Returns and the Financial Relevance and Financial Intensity of ESG Materiality. Costanza Consolandi, Robert G. Ecclesi, Giampaolo Gabbi (2020)

The paper examines the impact of Environmental, Social, and Governance (ESG) materiality on equity returns. It uses the materiality classifications provided by the Sustainability Accounting Standards Board (SASB) to investigate the financial relevance and financial intensity of ESG materiality in explaining equity returns. The results, based on a sample of US companies listed in the Russell 3000 from 2008 to 2019, suggest that not only does ESG performance affect stock returns, but also that the market tends to reward companies operating in industries with high levels of ESG materiality concentration. The authors introduce indices to measure the industry-level financial relevance, financial intensity, and quantity of material issues. The results of the analysis suggest that portfolios managed with a weighting based on both the ESG momentum factor and the Gini index of materiality outperform both the market capitalization-weighted benchmark and the ESG momentum-weighted portfolio, especially starting from 2013. However, portfolio volatility increases when the Gini index is included in the weighting, suggesting that the concentration of ESG materiality acts as a concentration risk factor. The results of the study have implications for both companies and investors. Companies in industries with many material issues should consider focusing on a subset of them to communicate to investors, while investors should focus on the concentration of material issues when considering ESG momentum as a criteria for portfolio management.

Stakeholder legitimacy in firm greening and financial performance: What about greenwashing temptations? Michael T. Lee a, , Robyn L. Raschke (2013)*

This research paper focuses on the relationship between stakeholder activism, ESG (environmental, social, and governance) performance, financial performance, and greenwashing in firms. The authors use legitimacy theory to examine the legitimate practices that support ESG performance and the direct link between ESG performance and firm financial performance. The paper also explores the relationship between ESG performance and greenwashing and the effect of greenwashing on firm financial performance. The results show

that stakeholder legitimacy, as measured by stakeholder satisfaction with firm culture, diversity, work-life balance, management leadership, and compensation, leads to high ESG performance and directly to firm financial performance. On the other hand, firms with low ESG performance are more likely to greenwash, but greenwashing does not affect financial performance. The authors suggest that future research could expand on the sample size and industry coverage, as well as examine specific industries that are particularly relevant to ESG performance and greenwashing.

The role of ESG scoring and greenwashing risk in explaining the yields of green bonds: A conceptual framework and an econometric analysis Francesco Baldi , Alessandro Pandimiglio (2022)

The study investigated the factors that influence the yields of public sector and corporate green bonds, beyond those conveyed by conventional finance theory. A theoretical framework was developed that postulated the negative relationship between the size of the underlying project financed by a green bond issuance, the use of the ESG metrics to quantify the impact, and the positive relationship between the risk of greenwashing practices by the issuer, and the yield to maturity of the green bond. Empirical validation was provided by estimating multiple regression models applied to two distinct samples of public and corporate green bonds issued globally from 2012-2020. The results confirmed the theoretical predictions and showed that investors are willing to accept lower returns in exchange for funding infrastructure projects with greater impact on sustainability and require higher premiums as a form of compensation when exposed to higher risk of greenwashing. The study offers recommendations for investors, rating agencies, and policymakers. Investors should minimize exposure to greenwashing risk by investing in public sector green bonds issued by local governments and corporate green bonds issued by service sector firms. Rating agencies should improve their ESG rating models to better capture and quantify the greenwashing risk, and policymakers should enforce regulations to reduce deceptive behavior by public and corporate issuers in the issuance of green bonds. The results of the study can be used to design better green bond taxonomies.

4. Methodology

4.1 Portfolio Theory

4.1.1 Introduction to portfolio theory

Modern portfolio theory (MPT) is a financial theory developed by Harry Markowitz in the 1950s that suggests that investors can maximize their expected returns by diversifying their investments across a range of assets. The concept that investors should examine not just the predicted return and risk of an individual asset, but also the way in which that item will interact with the other assets in the portfolio.

An investment portfolio is said to be "efficient" in accordance with the Modern Portfolio Theory (MPT)¹⁸ if it provides the highest expected return for a predetermined level of risk or the lowest level of risk for a given level of expected return.

There are several key variables that are important in modern portfolio theory including:

- **Expected return:** The expected return of an asset is the average return that an investor can expect to earn over a certain period of time.
- **Risk:** Investing inherently involves some degree of risk, which can manifest itself in a variety of manifestations, including market risk, credit risk, and liquidity risk, among others. In the Modern Portfolio Theory (MPT), risk is often evaluated through statistical measurements such as the standard deviation, which reflects the volatility or variation of returns around the average return.
- **Correlation:** The degree to which two assets move in the same direction at the same time is referred to as the degree of correlation between the assets. According to the Modern Portfolio Theory (MPT), assets that have low correlations are thought to be more diversified since it is less probable that they would move in the same direction at the same time. This can be helpful in lowering the total risk that is associated with a portfolio.
- **Diversification:** The process of distributing investments over a variety of assets is what is meant by the term "diversification." The goal of diversification is to lower the total risk of the portfolio. According to the Modern Portfolio Theory (MPT), diversification allows investors to attain a sufficient level of return while simultaneously lowering the impact of unfavorable returns on any one individual asset.
- **The efficient frontier** is a graphical depiction of the trade-off between risk and return for various portfolios. In other words, the efficient frontier seeks to find the investment portfolio that maximizes expected return while minimizing risk. Typically, one will display the efficient frontier on a graph with the expected return along the y-axis and the standard deviation, which is a measure of risk, along the x-axis. The efficient frontier is a set of portfolios, and it is frequently used as a benchmark for evaluating the risk and return of other portfolios. The modern portfolio theory, which proposes that investors may optimize their expected returns by diversifying their investments over a variety of assets, relies heavily on the notion of the efficient frontier as one of

¹⁸ A Simplified Perspective of the Markowitz Portfolio Theory, E. Mangram (2013)

its foundational concepts. Investors can lower the total risk of their portfolios while still attaining a level of return that is sufficient if they diversify their holdings in their investment portfolio.

Another important measure is the Sharpe ratio, a measure of risk-adjusted return, which aims to quantify the return of an investment in comparison to its risk. It was developed by Nobel Prize-winning economist William F. Sharpe in the 1960s, and allows investors to compare the performance of different investments, regardless of their level of risk, and to assess whether an investment's returns are proportional to the level of risk taken. The ratio is calculated by subtracting the risk-free rate (such as the yield on a Treasury bond) from the return of the investment and dividing the result by the standard deviation of the investment's returns, which measures its volatility.

Post-Modern Portfolio Theory (PMPT)¹⁹ is a more recent development that seeks to address limitations and criticisms of MPT. It provides a more comprehensive understanding of the relationship between risk and return in investments. PMPT recognizes that MPT's assumption of rational markets and investors may not always hold, and takes into account factors such as behavioral biases, market frictions, and other sources of risk that can affect the performance of investments. PMPT also incorporates alternative asset classes and strategies that were not widely available or considered in the development of MPT, such as hedge funds and private equity.

There are several key differences between MPT and PMPT:

- **Assumptions:** MPT is based on several assumptions, such as the idea that investors are risk-averse and that markets are efficient. PMPT approaches may challenge or modify these assumptions, or consider additional factors that are not typically considered in MPT.
- **Scope:** MPT focuses on constructing portfolios that offer the highest expected return for a given level of risk, or the lowest level of risk for a given expected return. PMPT approaches may consider a wider range of factors and objectives, such as liquidity, taxes, transaction costs, and real options.
- **Considerations:** MPT primarily considers the expected return and risk of individual assets and portfolios. PMPT approaches may also consider behavioral finance, which looks at the psychological factors that can influence investor decision-making, and real options analysis, which looks at the value of the flexibility and options available to an investor.

4.1.2 Capital Asset Pricing Model

The Capital Asset Pricing Model (CAPM)²⁰ is a widely used financial model that describes the relationship between the expected return of a security and its systematic risk. The CAPM, which was developed in the 1960s by William Sharpe, is a key concept in contemporary finance and is used to analyze the risk-return trade-off of securities and portfolios.

According to the CAPM, the expected return of a security is proportional to the risk-free rate and the beta, a measure of the security's systematic risk compared to the market. Beta is the sensitivity of a security's returns to those of the market as a whole.

¹⁹ Post-Modern Portfolio Theory, Swisher et al. (2005)

²⁰ The CAPM: Theory and Evidence, Fama and French (2003)

A beta of 1 implies that the returns of the security are precisely associated with those of the market, whereas a beta less than 1 suggests that the security is less risky than the market and a beta more than 1 indicates that the security is riskier than the market.

The CAPM proposes that investors should be paid for assuming systemic risk with a greater expected return. The Securities Market Line (SML) illustrates this link between risk and return by plotting the predicted return of a security against its beta. The SML depicts the link between risk and return suggested by the CAPM and is used to determine the appropriate return of a security. A fundamental advantage of the CAPM is its simplicity. The model is predicated on several fundamental assumptions, such that investors have identical expectations, are rational and maximize their expected utility, and have access to the same information. These assumptions make the CAPM a basic and obvious instrument for analyzing the risk-return trade-off of securities and portfolios.

Capital Asset Pricing Model (CAPM) is a commonly used financial model that provides a helpful framework for assessing the risk-return trade-off of securities and portfolios. The model's simplicity and utility have made it a central idea in modern finance, and it continues to be frequently utilized and despite its limitations and criticisms, the CAPM remains an essential instrument for analyzing the link between risk and return in banking and investing.

4.1.3 Fama French 3 factor model

Beyond the classic Capital Asset Pricing Model, Eugene Fama and Kenneth French created the Fama-French three-factor model to explain the stock returns of a portfolio (CAPM). The Fama-French three-factor model extends the CAPM by incorporating two more factors, size and value, which account for a substantial proportion of the cross-sectional volatility in stock returns. According to the CAPM, the expected return of a stock is proportional to the risk-free rate and the beta, a measure of the stock's systematic risk compared to the market. The Fama-French three-factor model extends the CAPM by incorporating two more components that account for the size and value influences on stock returns. The size factor compares the returns of tiny companies to those of large stocks, whereas the value factor compares the returns of value stocks to those of growth firms.

The Fama-French three-factor model suggests that the expected return of a stock depends not only on its systematic risk as measured by beta, but also on its size and value characteristics. In other words, the Fama-French model accounts for the fact that historically, small and value firms have generated greater returns than large and growth stocks. The Fama-French model gives a more thorough explanation of stock returns than the classic CAPM by adding the size and value effects. The capacity of the Fama-French three-factor model to explain the cross-sectional volatility in stock returns is one of its primary advantages. The model shows that equities with varying size and

value attributes have varying expected returns, which may be utilized to construct portfolios that reflect these qualities. An investor seeking to capture the size impact, for instance, may establish a portfolio of tiny stocks, while an investor seeking to capture the value effect could create a portfolio of value stocks.

4.1.3 Market weighted and Equally weighted portfolios

A market-weighted portfolio is a form of investment portfolio whose assets are weighted in proportion to each security's market capitalization. This indicates that the bigger a security's market capitalisation, the greater its weight within the portfolio.

A benefit of a market-weighted portfolio is that it enables investors to obtain exposure to a large number of securities in a given market or industry in a straightforward and efficient manner. As the portfolio is created based on market capitalization, this can assist decrease the danger of an excessive exposure to a single investment or industry. Additionally, a market-weighted portfolio reflects the overall performance of the market or industry in which it is invested. This indicates that the performance of the portfolio is highly correlated with the underlying market or sector. Investors can evaluate the success of their portfolio by comparing its returns to those of the market or sector.

There are, however, disadvantages to investing in a market-weighted portfolio. One of these is that it does not account for the distinctive features of each security in the portfolio. For instance, a security's market capitalization may not represent its fundamental growth potential. This indicates that a market-weighted portfolio may be strongly weighted towards overpriced equities and underweighted towards inexpensive ones. Furthermore, a market-weighted portfolio may be exposed to the same market risks as the underlying market or sector. This means that if the market or sector sees a loss, the portfolio's value will also decrease.

An equally weighted portfolio is a form of investment portfolio in which each asset, regardless of its market value, is allocated an equal weight within the portfolio. This indicates that each security in the portfolio has an equal impact on the overall performance of the portfolio. The objective of an equally weighted portfolio is to give a more diversified exposure to various assets, as opposed to a concentration of exposure to a limited number of big capitalization stocks.

Plyakha et al (2015)²¹ found that equal-weighted portfolios outperform value-weighted portfolios in terms of average return, alpha, and Sharpe ratio, but have higher volatility, turnover, and negative skewness. Despite higher transaction costs, equal-weighted portfolios still have higher mean return, four-factor alpha, and Sharpe ratio than value-weighted portfolios. The superior performance of equal-weighted portfolios is due to their overweighting of small stocks, low-price stocks, value stocks, and stocks with high idiosyncratic volatility. The main reason is that equally weighted portfolio is that assign more weights to small company therefore on one side volatility increase but on the other side will increase also the returns.

²¹ Why Do Equal-Weighted Portfolios Outperform Value-Weighted Portfolios?, Plyakha et al. (2015)

4.2 Methodology

4.2.1 Data preparation & cleaning

The ESG rating is becoming increasingly important for companies as more investors focus on socially responsible investments. The study was conducted on a sample of companies that have been assigned an ESG rating by MSCI between the years 2013 and 2020. The aim of the study was to gain insight into the relationship between ESG ratings and financial performance.

The annual datasets contained a wealth of information, including company-specific information and information that contributes to the ESG rating. To ensure the data was relevant, only the information from the first day of January of each year was used. This was done to align with the annual portfolio rebalancing.

The study also took into consideration the geographic location of the companies, as ESG ratings can vary depending on the region. Companies that could not be associated with either the Europe or North America (as determined by the country list used by Fama and French in their research) were eliminated.

To further refine the dataset, the ISIN code was used to download market capitalization data and daily closing prices from Refinitiv-Datastream. Any data points that lacked an ISIN code, market capitalization, or contained missing values were deleted. This was done to ensure that the results of the study were based on accurate and complete data. Additionally, any instrument that was not a common share was excluded from the study. This was done to ensure that the results accurately reflect the financial performance of common shares, which are typically the most widely held type of security.

The results of the study provide valuable insight into the relationship between ESG ratings and financial performance and can help investors make informed decisions about socially responsible investments. Additionally, the results can be used by companies to assess the impact of their ESG efforts on their financial performance, and to make improvements where necessary.

4.2.3 Model and results

The study was designed to examine the relationship between ESG ratings and financial performance. To do this, twelve portfolios were created, six portfolios each for the European Union (EU) and North America (AM) regions. The ESG scores were used to select the stocks for each portfolio. Stocks above the third quartile were selected for the "Top" portfolio, while stocks below the first quartile were selected for the "Worst" portfolio. The "Difference" portfolio was then created by subtracting the "Worst" portfolio from the "Top" portfolio. This was done twice, once with equal weights and once with weights based on market capitalization.

The returns, volatility, and Sharpe ratios were calculated for each portfolio for each year. The Sharpe ratio was calculated using the mean risk-free rate from the data downloaded from the Fama and French library. An ordinary least squares (OLS) regression was then performed on the excess return of each time series and the data from the Fama and French three-factor model.

OLS regression is a statistical technique for modeling the linear connection between a dependent variable and one or more independent variables. It is a sort of linear regression used to predict the value of a dependent variable based on one or more independent variables.

The objective of an OLS regression is to identify the line of best fit that minimizes the sum of squared differences between the observed values of the dependent variable and the predicted values of the line of best fit. This line of best fit is determined by solving a system of linear equations, which are utilized to estimate the coefficient values that describe the strength and direction of the link between the independent and dependent variables.

Once the coefficients have been calculated, they may be used to predict the value of the dependent variable given the values of the independent variables. The OLS regression approach can be applied to both basic linear regression with one independent variable and multiple linear regression with multiple independent variables.

This approach provided a comprehensive examination of the relationship between ESG ratings and financial performance and helped to determine whether ESG-conscious investments outperform traditional investments.

The results of the historical analysis and regression are in following tables:

*** p values < 1%

** p values < 5%

* p values < 10%

Table 1: Portfolio Top Europe Market weighted

Year	# Stocks	Return	σ	SR	Alpha	β Mkt-rf	β SMB	β HML	R ² adj
2013	102	0.23	0.12	1.90	0.14***	0.5***	-0.91***	-0.04	0.79
2014	155	0.01	0.12	0.08	0.05	0.8***	-0.36***	0.11*	0.82
2015	174	0.06	0.17	0.38	0.13**	0.44***	-1.05***	-0.22***	0.85
2016	307	0.03	0.17	0.17	0.07	0.72***	-0.51***	-0.11**	0.86
2017	356	0.12	0.08	1.58	0.03	0.44***	-0.65***	-0.23***	0.50
2018	364	0.11	0.11	-1.05	-0.07	0.61***	-0.55***	-0.29***	0.77
2019	388	0.25	0.10	2.52	0.05	0.62***	-0.56***	-0.14***	0.84
2020	367	0.02	0.28	0.06	0.02	0.86***	-0.33***	0.11***	0.95

Table 2: Portfolio Worst Europe Market weighted

Year	# Stocks	Return	σ	SR	Alpha	β Mkt-rf	β SMB	β HML	R ² adj
2013	111	0.17	0.13	1.33	0.08	0.5***	-0.86***	0.18***	0.75
2014	165	0.00	0.12	0.01	0.05	0.77***	-0.3***	0.18***	0.78
2015	185	0.02	0.18	0.10	0.12	0.49***	-0.95***	0.35***	0.76
2016	315	0.02	0.19	0.09	0	0.7***	-0.45***	0.28***	0.80
2017	357	0.10	0.08	1.38	-0.01	0.43***	-0.32***	0.13*	0.39
2018	384	0.16	0.12	1.33	-0.08	0.74***	-0.3***	0.03	0.71
2019	404	0.17	0.11	1.52	0	0.77***	-0.25***	0.25***	0.78
2020	394	0.01	0.31	0.05	0.02	0.9***	-0.12*	0.39***	0.89

Table 3: Portfolio Difference Europe Market weighted

Year	# Stocks	Return	σ	SR	Alpha	β Mkt-rf	β SMB	β HML	R ² adj
2013	213	0.06	0.05	1.11	0.06	0	-0.05	-0.23***	0.07
2014	320	0.01	0.03	0.32	0	0.03	-0.05	-0.07*	0.03
2015	359	0.08	0.07	1.16	0	-0.05*	-0.09*	-0.57***	0.32
2016	622	0.01	0.06	0.23	0.06	0.01	-0.06	-0.4***	0.29
2017	713	0.02	0.05	0.35	0.05	0.01	-0.32***	-0.37***	0.20
2018	748	0.05	0.06	0.89	-0.01	-0.12***	-0.25***	-0.33***	0.20
2019	792	0.08	0.05	1.57	0.03	-0.14***	-0.31***	-0.39***	0.34
2020	761	0.03	0.09	0.36	-0.01	-0.03*	-0.2***	-0.28***	0.24

Table 4: Portfolio Top North America Market weighted

Year	# Stocks	Return	σ	SR	Alpha	β Mkt-rf	β SMB	β HML	R ² adj
2013	389	0.31	0.10	2.97	0.16**	0.4***	-0.2*	0.18**	0.42
2014	563	0.14	0.11	1.29	0.16*	0.44***	-0.23**	0.14	0.36
2015	484	0.03	0.15	0.21	0.05	0.24***	-0.53***	0.18	0.30
2016	584	0.12	0.13	0.91	0.13	0.32***	-0.42***	-0.02	0.46
2017	597	0.22	0.07	3.31	0.15**	0.12**	0.25***	0.02	0.03
2018	591	0.04	0.16	0.26	0.01	0.55***	-0.23	-0.39***	0.24
2019	624	0.32	0.12	2.58	0.12	0.68***	-0.46***	0	0.54
2020	624	0.26	0.34	0.76	0.19	0.86***	-0.36**	-0.06	0.55

Table 5: Portfolio Worst North America Market weighted

Year	# Stocks	Return	σ	SR	Alpha	β Mkt-rf	β SMB	β HML	R ² adj
2013	664	0.40	0.12	3.33	0.22**	0.43***	-0.26*	0.19*	0.37
2014	704	0.07	0.11	0.64	0.1	0.44***	-0.23**	0.19*	0.33
2015	506	0.05	0.15	0.32	0.04	0.29***	-0.44***	0.35***	0.32
2016	623	0.12	0.15	0.76	0.12	0.39***	-0.4***	0.18**	0.47
2017	635	0.16	0.07	2.22	0.09	0.15***	0.33***	0.04	0.04
2018	616	0.10	0.15	0.64	-0.02	0.61***	-0.05	-0.1	0.29
2019	634	0.21	0.12	1.71	0.06	0.65***	-0.31***	0.23***	0.49
2020	658	0.07	0.40	0.17	0.19	0.96***	-0.2	0.52***	0.65

Table 6: Portfolio Difference North America Market weighted

Year	# Stocks	Return	σ	SR	Alpha	β Mkt-rf	β SMB	β HML	R ² adj
2013	1053	0.09	0.04	2.12	-0.06	-0.03	0.05	0	0.01
2014	1267	0.07	0.03	1.97	0.05*	0	0	-0.04	0.01
2015	990	0.02	0.05	0.39	0.01	-0.05**	-0.09**	-0.17***	0.08
2016	1207	0.00	0.05	0.01	0.01	-0.06***	-0.02	-0.2***	0.19
2017	1232	0.05	0.04	1.44	0.05	-0.03	-0.08	-0.01	-
2018	1207	0.06	0.06	0.99	0.01	-0.06**	-0.17***	-0.28***	0.11
2019	1258	0.12	0.05	2.43	0.03	0.02	-0.14**	-0.24***	0.13
2020	1282	0.19	0.15	1.28	0	-0.1***	-0.15*	-0.58***	0.39

Table 7: Portfolio Top Europe Equally Weighted

Yea	# Stocks	Return	σ	SR	Alpha	β Mkt-rf	β SMB	β HML	R ² adj
2013	102	0.27	0.12	2.33	0.13**	0.56***	-0.55***	0.03	0.72
2014	155	0.04	0.12	0.32	0.08	0.81***	0.00	0.12*	0.74
2015	174	0.10	0.15	0.71	0.12*	0.5***	-0.62***	-0.22***	0.77
2016	307	0.05	0.16	0.33	0.07	0.76***	-0.04	-0.07	0.81
2017	356	0.12	0.07	1.81	0.01	0.46***	-0.16**	-0.22***	0.41
2018	364 -	0.14	0.11 -	1.31	-0.07	0.64***	-0.1	-0.19***	0.71
2019	388	0.25	0.10	2.53	0.05	0.76***	0.05	0.03	0.76
2020	367 -	0.02	0.29 -	0.08	0.00	0.92***	0.26***	0.4***	0.94

Table 8: Portfolio Worst Europe Equally Weighted

Yea	# Stocks	Return	σ	SR	Alpha	β Mkt-rf	β SMB	β HML	R ² adj
2013	111	0.24	0.11	2.15	0.06	0.58***	-0.27***	0.1	0.67
2014	165 -	0.01	0.12 -	0.07	0.09	0.84***	0.24***	0.1	0.64
2015	185	0.04	0.21	0.20	0.35**	0.62***	-0.31*	0.47***	0.41
2016	315	0.09	0.16	0.57	0.06	0.73***	0.18***	0.19***	0.79
2017	357	0.22	0.07	3.26	0.04	0.47***	0.08	-0.04	0.37
2018	384 -	0.18	0.11 -	1.64	-0.08	0.74***	0.22***	-0.06	0.73
2019	404	0.18	0.10	1.79	0.00	0.81***	0.27***	0.17***	0.73
2020	394	0.02	0.27	0.08	0.01	0.89***	0.4***	0.32***	0.91

Table 9: Portfolio Difference Europe Equally Weighted

Year	# Stocks	Return	σ	SR	Alpha	β Mkt-rf	β SMB	β HML	R ² adj
2013	213	0.03	0.05	0.73	0.07	-0.02	-0.28***	-0.06	0.08
2014	320	0.04	0.05	0.83	0.00	-0.03	-0.23***	0.01	0.05
2015	359	0.06	0.15	0.42	-0.22	-0.11	-0.31**	-0.69***	0.11
2016	622 -	0.04	0.04 -	0.86	0.00	0.03**	-0.22***	-0.26***	0.34
2017	713 -	0.10	0.03 -	3.29	-0.03	-0.01	-0.24***	-0.18***	0.18
2018	748	0.05	0.04	1.32	0.00	-0.09***	-0.33***	-0.12***	0.27
2019	792	0.06	0.04	1.71	0.02	-0.05**	-0.21***	-0.13***	0.12
2020	761 -	0.04	0.06 -	0.73	-0.02	0.03**	-0.13***	0.08***	0.17

Table 10: Portfolio Top North America Equally Weighted

Year	# Stocks	Return	σ	SR	Alpha	β Mkt-rf	β SMB	β HML	R ² adj
2013	389	0.40	0.14	2.92	0.26**	0.44***	-0.28*	0.13	0.29
2014	563	0.07	0.13	0.56	0.12	0.47***	-0.11	0.19	0.25
2015	484 -	0.07	0.15 -	0.46	0.06	0.27***	-0.44***	0.4***	0.33
2016	584	0.19	0.16	1.21	0.19	0.41***	-0.33***	0.16*	0.43
2017	597	0.14	0.08	1.74	0.08	0.15***	0.39***	0.08	0.04
2018	591 -	0.07	0.14 -	0.52	0.00	0.55***	-0.02	-0.33***	0.28
2019	624	0.23	0.12	1.92	0.09	0.64***	-0.27**	0.28***	0.48
2020	624	0.16	0.36	0.43	0.29	0.9***	-0.19	0.4***	0.66

Table 11: Portfolio Worst America Equally Weighted

Year	# Stocks	Return	σ	SR	Alpha	β Mkt-rf	β SMB	β HML	R ² adj
2013	664	0.40	0.14	2.87	0.2*	0.48***	-0.22	0.24**	0.34
2014	704	0.04	0.13	0.30	0.16	0.47***	-0.08	0.21	0.23
2015	506	0.07	0.15	0.44	0.07	0.31***	-0.37***	0.51***	0.34
2016	623	0.22	0.17	1.29	0.19	0.42***	-0.29**	0.34***	0.42
2017	635	0.15	0.09	1.58	0.07	0.21***	0.45***	0.08	0.05
2018	616	0.11	0.14	0.79	-0.01	0.53***	-0.06	-0.22*	0.25
2019	634	0.18	0.14	1.32	0.05	0.67***	-0.21	0.37***	0.38
2020	658	0.06	0.42	0.15	0.27	0.98***	-0.2	0.63***	0.64

Table 12: Portfolio Difference North America Equally Weighted

Year	# Stocks	Return	σ	SR	Alpha	β Mkt-rf	β SMB	β HML	R ² adj
2013	1053	0.00	0.05	0.04	0.06	-0.04	-0.06	-0.1*	0.02
2014	1267	0.03	0.04	0.82	-0.04	0.00	-0.03	-0.02	0.01
2015	990	0.00	0.04	0.05	0.00	-0.03*	-0.06*	-0.11***	0.06
2016	1207	0.03	0.04	0.84	0.00	-0.01	-0.04	-0.17***	0.15
2017	1232	0.01	0.03	0.25	0.00	-0.05**	-0.05	0.00	0.01
2018	1207	0.04	0.04	1.09	-0.01	0.01	0.04	-0.1***	0.04
2019	1258	0.05	0.04	1.33	0.01	-0.03	-0.06	-0.08**	0.02
2020	1282	0.09	0.10	0.94	0.01	-0.08***	0.00	-0.22***	0.24

Conclusion

In this paper, we have analyzed various portfolios using Environmental, Social, and Governance (ESG) criteria as a framework. ESG has gained significant attention in recent years as a means of evaluating the sustainability and social responsibility of companies and their impact on the environment and society. Through a comprehensive evaluation of ESG factors, we aimed to demonstrate the potential benefits of incorporating ESG considerations into the investment process and the impact it can have on long-term financial performance. After conducting a thorough analysis of the twelve portfolios, we have reached the following conclusions.

Examining the performance of the eight long-only portfolios, we observe that the "Top" portfolio has historically outperformed the "Worst" portfolio in terms of both higher returns and lower volatility. The results of the regression analysis reveal that the alpha is rarely statistically significant, with an adjusted R-squared value ranging from 35-90%. This indicates that a significant portion of the variance is explained by the factors in the Fama-French 3-Factor model.

All portfolios exhibit a positive sensitivity to the market beta, with the "Worst" portfolio consistently displaying a higher beta. This could be due to the presence of traditional industries, such as chemicals, energy, and basic industries, which have high ESG impact, risks, and correlations to the market.

The "Top" portfolio is sensitive to companies with larger market capitalizations, as evidenced by the statistically significant betas obtained from the regression. This could be due to these established companies having more resources to allocate to ESG initiatives, as well as a potential

bias in ESG scoring towards well-established companies. Additionally, market-weighted portfolios tend to be more sensitive to larger companies than equally weighted portfolios.

With regard to the HML factor, we see that in Europe, the "Top" portfolio is positively correlated with growth stocks, while in North America, it is positively correlated with value stocks. A possible reasoning is that the difference is due to the market structure and characteristics of the listed companies in different regions as some regions may have a higher concentration of companies in certain industries that are more likely to be impacted by ESG considerations, while others may have a larger number of smaller companies that are less likely to be affected by ESG factors. The types of companies listed in a region can also impact the overall ESG profile of that region's stock market, as some industries are inherently more environmentally or socially responsible than others.

Regarding the portfolios "Worst", all portfolios are sensitive to Big companies except the Equally weighted portfolio in Europe which is sensitive to small. This is not surprising, as we describe in the previous chapter, the equally weighted portfolio assigns same weights to big and small companies. In fact, it presents higher returns but also higher volatility than the respective market-weighted portfolio. By looking instead at the Factor HML we can notice that all the portfolios are related to Value company both in Europe and North America.

When examining the HML factor, we find that all portfolios are associated with value stocks, both in Europe and North America. This contrasts with the findings for the "Top" portfolios in Europe, where they were positively correlated with growth stocks. This difference could be due to the presence of traditional and mature industries in the "Worst" portfolios, which tend to have a higher impact on ESG issues and thus lower scores. Meanwhile, the "Top" portfolios might contain growth companies, particularly those in the tech sector, which have a lower impact and higher sensitivity to ESG issues, resulting in high scores. This hypothesis could be further investigated in future research by decomposing the portfolios to gain deeper insights into potential reasoning.

Regarding the "Difference" portfolios, our regression results exhibit similarities to the findings of Bauer et al. (2003)²². These portfolios display lower returns and lower volatility, and as we subtract the "Worst" portfolios from the "Top" portfolios and then perform the regression on the Fama French data, the results show high p-values for both the alpha and the beta Mkt-*rf*. The adjusted R-squared values are very low, indicating a low portion of variance explained by the Fama French 3-Factor model. The portfolios exhibit correlations with large companies (although some series are not statistically significant), and when the HML factor is significant, it is associated with value stocks.

In conclusion, this paper explored the relationship between Environmental, Social, and Governance (ESG) scores and portfolio performance through regression analysis. Our findings provide insights into the relationship between ESG considerations and portfolio performance and highlight the importance of considering ESG when constructing portfolios. However, it is important to note that this study only provides a snapshot of the relationship between ESG and portfolio performance and future research could further explore this relationship by using different regression models and incorporating additional ESG factors.

²² International evidence on ethical mutual fund performance and investment style, Bauer, Koedijk, Otten (2003)

Overall, this study adds to the growing body of literature on ESG and portfolio performance and highlights the need for continued research in this area to better understand the complex relationship between ESG and financial performance.

Appendix

```
**Market cap weighted**
```

```
import pandas as pd
```

```
import numpy as np
```

```
import statsmodels.api as sm
```

```
ffc = pd.read_excel('Europe_3_Factors_Daily.xlsx')
```

```
pd.options.mode.chained_assignment = None
```

```
def calculate_return(file_name, sheet_name, year, r):
```

```
    df = pd.read_excel(file_name, sheet_name)
```

```
# Extract the first and third quartile of the scores
```

```
    first_quartile = df['SCORE'].quantile(q=0.25)
```

```
    third_quartile = df['SCORE'].quantile(q=0.75)
```

```
# Create a new column that categorizes the scores into 'Q' based on the quartiles
```

```
    df['Rank'] = 'none'
```

```
# Assign the value 'worst' and 'top' to the rows that meet the conditions
```

```
    df.loc[(df['SCORE'] <= first_quartile), 'Rank'] = 'worst'
```

```
    df.loc[(df['SCORE'] > third_quartile), 'Rank'] = 'top'
```

```
    value_counts = df['Rank'].value_counts()
```

```
    count_t = value_counts[value_counts.index.str.contains("top")].sum()
```

```
    count_w = value_counts[value_counts.index.str.contains("worst")].sum()
```

```
    count_d = count_t + count_w
```

```
#separate the the dataset
```

```
    p_change = pd.concat([df.iloc[:,0],df.iloc[:,6:]],axis = 1)
```

```
    T = p_change.loc[df['Rank'] == 'top']
```

```
    W = p_change.loc[df['Rank'] == 'worst']
```

```
    T = T.iloc[:, :-1]
```

```
    W = W.iloc[:, :-1]
```

```
#calculate the weights
```

```
    df_weight = pd.concat([df['ISIN'],df['MKT CAP']], axis=1)
```

```
    df_weight_T = df_weight.loc[df['Rank'] == 'top']
```

```

total_market_cap_T = df_weight_T['MKT CAP'].sum()
df_weight_T['weight'] = df_weight_T['MKT CAP'] / total_market_cap_T

df_weight_W = df_weight.loc[df['Rank'] == 'worst']
total_market_cap_W = df_weight_W['MKT CAP'].sum()
df_weight_W['weight'] = df_weight_W['MKT CAP'] / total_market_cap_W
# daily return mk weighted T
T.iloc[:,1:] = T.iloc[:,1:].apply(pd.to_numeric, errors='coerce')
T_return = T.iloc[:,1:].pct_change(axis=1)
T_return = pd.concat([T.iloc[:,0],T_return.iloc[:,2:]],axis = 1)
ptf_T = (T_return.iloc[:,1:].mul(df_weight_T.iloc[:,2], axis = 0)).sum()
# daily return mk weighted W
W.iloc[:,1:] = W.iloc[:,1:].apply(pd.to_numeric, errors='coerce')
W_return = W.iloc[:,1:].pct_change(axis=1)
W_return = pd.concat([W.iloc[:,0],W_return.iloc[:,2:]],axis = 1)
ptf_W = (W_return.iloc[:,1:].mul(df_weight_W.iloc[:,2], axis = 0)).sum()
# daily return ptf difference
ptf_D = ptf_T-ptf_W
# return mk weighted W
W_return = W.iloc[:,1:].pct_change(axis=1)
W_return = pd.concat([W.iloc[:,0],W_return.iloc[:,2:]],axis = 1)
#total return & vol
total_r_t = ((T.iloc[:,1]/T.iloc[:,2])*df_weight_T.iloc[:,2]).sum()
total_r_w = ((W.iloc[:,1]/W.iloc[:,2])*df_weight_W.iloc[:,2]).sum()
total_r_d = total_r_t-total_r_w
vol_t = ptf_T.std(axis =0)*np.sqrt(260)
vol_w = ptf_W.std(axis =0)*np.sqrt(260)
vol_d = ptf_D.std(axis =0)*np.sqrt(260)
#extract data ff
ffc_sel= ffc.loc[ffc['year'] == year]
ffc_sel = ffc_sel.iloc[1:,:]

```

```

#excess return T
    ptf_T = ptf_T.transpose()
    rf = (ffc_sel.iloc[:,4]/100).to_numpy()
    rf_mean = np.mean(rf)
    excess_t = ptf_T - rf

#excess return W
    ptf_W = ptf_W.transpose()
    excess_w = ptf_W - rf

#excess return D
    ptf_D = ptf_D.transpose()
    excess_d = ptf_D - rf

#sharpe ratio
    sr_t = (total_r_t -1- rf_mean)/vol_t
    sr_w = (total_r_w -1- rf_mean)/vol_w
    sr_d = (total_r_d - rf_mean)/vol_d

#regression model top
    yt = excess_t
    xt= (ffc_sel.iloc[:,1:4]/100).to_numpy()
    XT = sm.add_constant(xt)
    model_t = sm.OLS(yt, XT).fit()

#regression model worst
    yw = excess_w
    xw= (ffc_sel.iloc[:,1:4]/100).to_numpy()
    XW = sm.add_constant(xw)
    model_w = sm.OLS(yw, XW).fit()

#regression ptf difference
    yd = excess_d
    xd= (ffc_sel.iloc[:,1:4]/100).to_numpy()
    XD = sm.add_constant(xd)
    model_d = sm.OLS(yd, XD).fit()

```

```
d_top = np.array([year,count_t,(total_r_t-
1),vol_t,sr_t,model_t.params[0]*260,model_t.pvalues[0],model_t.params[1],model_t.pvalues[1]
,model_t.params[2],model_t.pvalues[2],model_t.params[3],model_t.pvalues[3],1-
model_t.rsquared_adj]).reshape(1, -1)
```

```
Top = pd.DataFrame(d_top, columns=['Year', '# Stocks', 'Return', ' $\sigma$ ', 'Sharpe Ratio',
'Alpha','P Alpha',' $\beta$  Mkt-rf', 'P Mkt-rf', ' $\beta$  SMB','P SMB', ' $\beta$  HML','P HML', '1-R'])
```

```
d_worst = np.array([year,count_w,(total_r_w-
1),vol_w,sr_w,model_w.params[0]*260,model_w.pvalues[0],model_w.params[1],model_w.pva
lues[1],model_w.params[2],model_w.pvalues[2],model_w.params[3],model_w.pvalues[3],1-
model_w.rsquared_adj]).reshape(1, -1)
```

```
Worst = pd.DataFrame(d_worst, columns=['Year', '# Stocks', 'Return', ' $\sigma$ ', 'Sharpe Ratio',
'Alpha','P Alpha',' $\beta$  Mkt-rf', 'P Mkt-rf', ' $\beta$  SMB','P SMB', ' $\beta$  HML','P HML', '1-R'])
```

```
d_diff =
np.array([year,count_d,total_r_d,vol_d,sr_d,model_d.params[0]*260,model_d.pvalues[0],model
_d.params[1],model_d.pvalues[1],model_d.params[2],model_d.pvalues[2],model_d.params[3],
model_d.pvalues[3],1-model_d.rsquared_adj]).reshape(1, -1)
```

```
Diff = pd.DataFrame(d_diff, columns=['Year', '# Stocks', 'Return', ' $\sigma$ ', 'Sharpe Ratio',
'Alpha','P Alpha',' $\beta$  Mkt-rf', 'P Mkt-rf', ' $\beta$  SMB','P SMB', ' $\beta$  HML','P HML', '1-R'])
```

```
return Top,Worst,Diff
```

```
EU13 = calculate_return('2013 dati.xlsx','EU13',2013,'EU')
```

```
EU14 = calculate_return('2014 dati.xlsx','EU14',2014,'EU')
```

```
EU15 = calculate_return('2015 dati.xlsx','EU15',2015,'EU')
```

```
EU16 = calculate_return('2016 dati.xlsx','EU16',2016,'EU')
```

```
EU17 = calculate_return('2017 dati.xlsx','EU17',2017,'EU')
```

```
EU18 = calculate_return('2018 dati.xlsx','EU18',2018,'EU')
```

```
EU19 = calculate_return('2019 dati.xlsx','EU19',2019,'EU')
```

```
EU20 = calculate_return('2020 dati.xlsx','EU20',2020,'EU')
```

```
Portfolio_EU_T_MW =
pd.concat([EU13[0],EU14[0],EU15[0],EU16[0],EU17[0],EU18[0],EU19[0],EU20[0]], axis = 0)
```

```
Portfolio_EU_T_MW.set_index('Year', inplace=True)
```

```
Portfolio_EU_T_MW.astype(float)
```

```
Portfolio_EU_W_MW =
pd.concat([EU13[1],EU14[1],EU15[1],EU16[1],EU17[1],EU18[1],EU19[1],EU20[1]], axis = 0)
```

```
Portfolio_EU_W_MW.set_index('Year', inplace=True)
```

```
Portfolio_EU_W_MW.astype(float)
```

```

Portfolio_EU_D_MW =
pd.concat([EU13[2],EU14[2],EU15[2],EU16[2],EU17[2],EU18[2],EU19[2],EU20[2]], axis = 0)
Portfolio_EU_D_MW.set_index('Year', inplace=True)
Portfolio_EU_D_MW.astype(float)
AM13 = calculate_return('2013 dati.xlsx','AM13',2013,'AM')
AM14 = calculate_return('2014 dati.xlsx','AM14',2014,'AM')
AM15 = calculate_return('2015 dati.xlsx','AM15',2015,'AM')
AM16 = calculate_return('2016 dati.xlsx','AM16',2016,'AM')
AM17 = calculate_return('2017 dati.xlsx','AM17',2017,'AM')
AM18 = calculate_return('2018 dati.xlsx','AM18',2018,'AM')
AM19 = calculate_return('2019 dati.xlsx','AM19',2019,'AM')
AM20 = calculate_return('2020 dati.xlsx','AM20',2020,'AM')
Portfolio_AM_T_MW =
pd.concat([AM13[0],AM14[0],AM15[0],AM16[0],AM17[0],AM18[0],AM19[0],AM20[0]],
axis = 0)
Portfolio_AM_T_MW.set_index('Year', inplace=True)
Portfolio_AM_T_MW.astype(float)
Portfolio_AM_D_MW =
pd.concat([AM13[2],AM14[2],AM15[2],AM16[2],AM17[2],AM18[2],AM19[2],AM20[2]],
axis = 0)
Portfolio_AM_D_MW.set_index('Year', inplace=True)
Portfolio_AM_D_MW.astype(float)
MW = pd.ExcelWriter('resultsMW.xlsx', engine='xlsxwriter')
Portfolio_EU_T_MW.to_excel(MW, sheet_name='Top_EU', index=False)
Portfolio_EU_W_MW.to_excel(MW, sheet_name='Worst_EU', index=False)
Portfolio_EU_D_MW.to_excel(MW, sheet_name='Diff_EU', index=False)
Portfolio_AM_T_MW.to_excel(MW, sheet_name='Top_AM', index=False)
Portfolio_AM_W_MW.to_excel(MW, sheet_name='Worst_AM', index=False)
Portfolio_AM_D_MW.to_excel(MW, sheet_name='Diff_AM', index=False)
MW.save()
**Equally weighted**
import pandas as pd
import numpy as np

```



```

import statsmodels.api as sm

ffc = pd.read_excel('Europe_3_Factors_Daily.xlsx')
pd.options.mode.chained_assignment = None
def calculate_return(file_name, sheet_name, year, r):

    df = pd.read_excel(file_name, sheet_name)
# Extract the first and third quartile of the scores
    first_quartile = df['SCORE'].quantile(q=0.25)
    third_quartile = df['SCORE'].quantile(q=0.75)

# Create a new column that categorizes the scores into 'Q' based on the quartiles
    df['Rank'] = 'none'

# Assign the value 'worst' and 'top' to the rows that meet the conditions
    df.loc[(df['SCORE'] <= first_quartile), 'Rank'] = 'worst'
    df.loc[(df['SCORE'] > third_quartile), 'Rank'] = 'top'
    value_counts = df['Rank'].value_counts()
    count_t = value_counts[value_counts.index.str.contains("top")].sum()
    count_w = value_counts[value_counts.index.str.contains("worst")].sum()
    count_d = count_t + count_w

#separate the the dataset
    p_change = pd.concat([df.iloc[:,0],df.iloc[:,6:]],axis = 1)
    T = p_change.loc[df['Rank'] == 'top']
    W = p_change.loc[df['Rank'] == 'worst']
    T = T.iloc[:, :-1]
    W = W.iloc[:, :-1]

#calculate the weights
    df_weight = pd.concat([df['ISIN'],df['MKT CAP']], axis=1)
    df_weight_T = df_weight.loc[df['Rank'] == 'top']
    total_market_cap_T = df_weight_T['MKT CAP'].sum()

```

```

df_weight_T['weight'] = 1 / count_t

df_weight_W = df_weight.loc[df['Rank'] == 'worst']
total_market_cap_W = df_weight_W['MKT CAP'].sum()
df_weight_W['weight'] = 1 / count_w
# daily return mk weighted T
T.iloc[:,1:] = T.iloc[:,1:].apply(pd.to_numeric, errors='coerce')
T_return = T.iloc[:,1:].pct_change(axis=1)
T_return = pd.concat([T.iloc[:,0],T_return.iloc[:,2:]],axis = 1)
ptf_T = (T_return.iloc[:,1:].mul(df_weight_T.iloc[:,2], axis = 0)).sum()

# daily return mk weighted W
W.iloc[:,1:] = W.iloc[:,1:].apply(pd.to_numeric, errors='coerce')
W_return = W.iloc[:,1:].pct_change(axis=1)
W_return = pd.concat([W.iloc[:,0],W_return.iloc[:,2:]],axis = 1)
ptf_W = (W_return.iloc[:,1:].mul(df_weight_W.iloc[:,2], axis = 0)).sum()

# return mk weighted W
W_return = W.iloc[:,1:].pct_change(axis=1)
W_return = pd.concat([W.iloc[:,0],W_return.iloc[:,2:]],axis = 1)
# daily return ptf difference
ptf_D = ptf_T-ptf_W
#total return & vol
total_r_t = ((T.iloc[:,1]/T.iloc[:,2])*df_weight_T.iloc[:,2]).sum()
total_r_w = ((W.iloc[:,1]/W.iloc[:,2])*df_weight_W.iloc[:,2]).sum()
total_r_d = total_r_t-total_r_w
vol_t = ptf_T.std(axis = 0)*np.sqrt(260)
vol_w = ptf_W.std(axis = 0)*np.sqrt(260)
vol_d = ptf_D.std(axis = 0)*np.sqrt(260)
#extract data ff
ffc_sel= ffc.loc[ffc['year'] == year]

```

```

ffc_sel = ffc_sel.iloc[1:,:]
#excess return
ptf_T = ptf_T.transpose()
rf = (ffc_sel.iloc[:,4]/100).to_numpy()
rf_mean = np.mean(rf)
excess_t = ptf_T - rf
ptf_W = ptf_W.transpose()
excess_w = ptf_W - rf
ptf_D = ptf_D.transpose()
excess_d = ptf_D - rf
sr_t = (total_r_t -1- rf_mean)/vol_t
sr_w = (total_r_w -1- rf_mean)/vol_w
sr_d = (total_r_d - rf_mean)/vol_d
#regression model top
yt = excess_t
xt= (ffc_sel.iloc[:,1:4]/100).to_numpy()
XT = sm.add_constant(xt)
model_t = sm.OLS(yt, XT).fit()
#regression model worst
yw = excess_w
xw= (ffc_sel.iloc[:,1:4]/100).to_numpy()
XW = sm.add_constant(xt)
model_w = sm.OLS(yw, XW).fit()
#regression ptf difference
yd = excess_d
xd= (ffc_sel.iloc[:,1:4]/100).to_numpy()
XD = sm.add_constant(xd)
model_d = sm.OLS(yd, XD).fit()

d_top = np.array([year,count_t,(total_r_t-1),vol_t,sr_t,model_t.params[0]*260,model_t.pvalues[0],model_t.params[1],model_t.pvalues[1]

```

```
,model_t.params[2],model_t.pvalues[2],model_t.params[3],model_t.pvalues[3],1-  
model_t.rsquared_adj]).reshape(1, -1)
```

```
Top = pd.DataFrame(d_top, columns=['Year', '# Stocks', 'Return', ' $\sigma$ ', 'Sharpe Ratio', 'Alpha', 'P  
Alpha', ' $\beta$  Mkt-rf', 'P Mkt-rf', ' $\beta$  SMB', 'P SMB', ' $\beta$  HML', 'P HML', '1-R'])
```

```
d_worst = np.array([year,count_w,(total_r_w-  
1),vol_w,sr_w,model_w.params[0]*260,model_w.pvalues[0],model_w.params[1],model_w.pva  
lues[1],model_w.params[2],model_w.pvalues[2],model_w.params[3],model_w.pvalues[3],1-  
model_w.rsquared_adj]).reshape(1, -1)
```

```
Worst = pd.DataFrame(d_worst, columns=['Year', '# Stocks', 'Return', ' $\sigma$ ', 'Sharpe Ratio',  
'Alpha', 'P Alpha', ' $\beta$  Mkt-rf', 'P Mkt-rf', ' $\beta$  SMB', 'P SMB', ' $\beta$  HML', 'P HML', '1-R'])
```

```
d_diff = np.array([year,count_d,total_r_d,vol_d,sr_d,model_d.params[0]*260,model_d.pvalues[0],model  
_d.params[1],model_d.pvalues[1],model_d.params[2],model_d.pvalues[2],model_d.params[3],  
model_d.pvalues[3],1-model_d.rsquared_adj]).reshape(1, -1)
```

```
Diff = pd.DataFrame(d_diff, columns=['Year', '# Stocks', 'Return', ' $\sigma$ ', 'Sharpe Ratio', 'Alpha', 'P  
Alpha', ' $\beta$  Mkt-rf', 'P Mkt-rf', ' $\beta$  SMB', 'P SMB', ' $\beta$  HML', 'P HML', '1-R'])
```

```
return Top,Worst,Diff
```

```
EU13 = calculate_return('2013 dati.xlsx','EU13',2013,'EU')
```

```
EU14 = calculate_return('2014 dati.xlsx','EU14',2014,'EU')
```

```
EU15 = calculate_return('2015 dati.xlsx','EU15',2015,'EU')
```

```
EU16 = calculate_return('2016 dati.xlsx','EU16',2016,'EU')
```

```
EU17 = calculate_return('2017 dati.xlsx','EU17',2017,'EU')
```

```
EU18 = calculate_return('2018 dati.xlsx','EU18',2018,'EU')
```

```
EU19 = calculate_return('2019 dati.xlsx','EU19',2019,'EU')
```

```
EU20 = calculate_return('2020 dati.xlsx','EU20',2020,'EU')
```

```
Portfolio_EU_T_EQ = pd.concat([EU13[0],EU14[0],EU15[0],EU16[0],EU17[0],EU18[0],EU19[0],EU20[0]], axis = 0)
```

```
Portfolio_EU_T_EQ.set_index('Year', inplace=True)
```

```
Portfolio_EU_T_EQ.astype(float)
```

```
Portfolio_EU_W_EQ = pd.concat([EU13[1],EU14[1],EU15[1],EU16[1],EU17[1],EU18[1],EU19[1],EU20[1]], axis = 0)
```

```
Portfolio_EU_W_EQ.set_index('Year', inplace=True)
```

```
Portfolio_EU_W_EQ.astype(float)
```

```
Portfolio_EU_D_EQ = pd.concat([EU13[2],EU14[2],EU15[2],EU16[2],EU17[2],EU18[2],EU19[2],EU20[2]], axis = 0)
```

```

Portfolio_EU_D_EQ.set_index('Year', inplace=True)
Portfolio_EU_D_EQ.astype(float)
AM13 = calculate_return('2013 dati.xlsx', 'AM13', 2013, 'AM')
AM14 = calculate_return('2014 dati.xlsx', 'AM14', 2014, 'AM')
AM15 = calculate_return('2015 dati.xlsx', 'AM15', 2015, 'AM')
AM16 = calculate_return('2016 dati.xlsx', 'AM16', 2016, 'AM')
AM17 = calculate_return('2017 dati.xlsx', 'AM17', 2017, 'AM')
AM18 = calculate_return('2018 dati.xlsx', 'AM18', 2018, 'AM')
AM19 = calculate_return('2019 dati.xlsx', 'AM19', 2019, 'AM')
AM20 = calculate_return('2020 dati.xlsx', 'AM20', 2020, 'AM')

Portfolio_AM_T_EQ =
pd.concat([AM13[0], AM14[0], AM15[0], AM16[0], AM17[0], AM18[0], AM19[0], AM20[0]],
axis = 0)

Portfolio_AM_T_EQ.set_index('Year', inplace=True)
Portfolio_AM_T_EQ.astype(float)

Portfolio_AM_W_EQ =
pd.concat([AM13[1], AM14[1], AM15[1], AM16[1], AM17[1], AM18[1], AM19[1], AM20[1]],
axis = 0)

Portfolio_AM_W_EQ.set_index('Year', inplace=True)
Portfolio_AM_W_EQ.astype(float)

Portfolio_AM_D_EQ =
pd.concat([AM13[2], AM14[2], AM15[2], AM16[2], AM17[2], AM18[2], AM19[2], AM20[2]],
axis = 0)

Portfolio_AM_D_EQ.set_index('Year', inplace=True)
Portfolio_AM_D_EQ.astype(float)

EQ = pd.ExcelWriter('resultsEQ.xlsx', engine='xlsxwriter')
Portfolio_EU_T_EQ.to_excel(EQ, sheet_name='Top_EU', index=False)
Portfolio_EU_W_EQ.to_excel(EQ, sheet_name='Worst_EU', index=False)
Portfolio_EU_D_EQ.to_excel(EQ, sheet_name='Diff_EU', index=False)
Portfolio_AM_T_EQ.to_excel(EQ, sheet_name='Top_AM', index=False)
Portfolio_AM_W_EQ.to_excel(EQ, sheet_name='Worst_AM', index=False)
Portfolio_AM_D_EQ.to_excel(EQ, sheet_name='Diff_AM', index=False)
EQ.save

```

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