The Drivers of ESG Index Outperformance:

A Transatlantic Analysis of US and European Markets

By

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ABSTRACT

The purpose of this study is to meticulously investigate the varying effects of diverse Environmental, Social, and Governance (ESG) integration approaches on the financial performance of securities within the European and US markets over the decade from 2013 to 2023. This research topic represents a valuable contribution to the existing literature, which it provides a more nuanced perspective on how ESG considerations should be intricately woven into the fabric of investment decision-making processes, serving as an actionable playbook for investors of ESG-related goals. The study exhaustively examines over 200 portfolio simulations, utilizing a comprehensive selection of 22 equity and bond indexes spanning both European and US markets. The findings reveal that a 'best-in-class', sector-relative selection approach based on ESG ratings typically outperforms in Europe. Conversely, an 'optimization-focused' approach that leans towards market-cap weighting based on ESG scores delivers superior performance in the US. A range of factors that potentially influence these differential outcomes are explored in depth. These include the unique regulatory environments across regions, the dynamic nature of markets, the varying preferences of investors, and the distinct sector compositions inherent to each region. Furthermore, the research acknowledges the pivotal role those emergent technologies, such as big data and artificial intelligence (AI), are playing in shifting the global investment landscape towards sustainable practices. To provide a future-oriented perspective, the study incorporates several practical applications of AI technology in the domain of ESG investing. These insights not only demonstrate the transformative potential of AI but also underscore the importance of technological adaptation in achieving sustainable investment outcomes.

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Contents

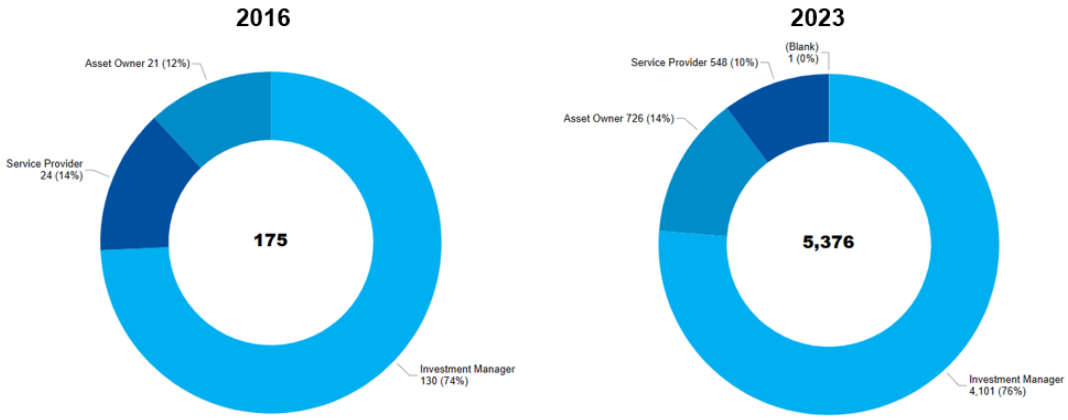
Glossary

Term	Definition
ESG Integration	Environmental, social and governance (ESG) integration is the practice of incorporating material ESG information into the investment process with the objective of improving the long-term financial outcomes of portfolios.
Best-in-class	The best-in-class approach for sustainable investing means finding the companies that are leaders in their sector in terms of meeting environmental, social and governance (ESG) criteria.
Market-cap-weighted	Market-cap-weighted, or market capitalization weighted, is a type of stock market index construction that is based on the market value of each company's outstanding shares. This method sums the value of all listed shares and multiplies it by the current share price.
Portfolio Optimization Simulations	A process that uses mathematical models and computational simulations to determine the best allocation of assets within an investment portfolio. This process seeks to maximize expected returns based on a given level of market risk, taking into account the investor's risk tolerance and investment goals.
ESG Rating	A measure used to assess a company's performance in environmental, social, and governance (ESG) areas. These ratings are typically provided by specialized ESG rating agencies such as Refinitiv, MSCI and Bloomberg.
ESG Score	a quantifiable measure that reflects a company's performance in terms of its Environmental, Social, and Governance (ESG) practices. These scores are typically provided by third-party ESG rating agencies and serve as an indication of a company's adherence to ESG standards and practices.
ESG Momentum	ESG momentum refers to the change or trend in a company's ESG (Environmental, Social, and Governance) performance over time. It's a concept used by investors to identify companies that are improving their ESG practices, irrespective of their absolute ESG scores or ratings.

I. Introduction

In 2016, UN Principles for Responsible Investment (PRI) were introduced as a guidance to promote consideration of ESG (environmental, social, and governance) factors into investment decisions. Since then, the number of signatory companies has grown from less than 100 to more than 5000, including asset owners, investment managers and service providers (Principles for Responsible Investment, 2023).

Figure I-1: Growth of PRI Signatories from 2016- 2023



The growing demand from both institutional and retail investors globally have led the asset management industry to shift its focus towards sustainable industries and companies, leaving companies that do not meet their investment requirements behind and even restrict from access to capital globally. The motivation behind the idea is that incorporating ESG factors into investment decisions not only addresses ESG concerns but is also increasingly perceived as a strategy that would yield superior risk-adjusted returns especially over the medium (3-5 years) to long term (5-10 years).

The current relevance and growing importance of the topic, along with the varying perspectives among scholars, have piqued our interest in exploring this subject further. This thesis will seize the opportunity to research and investigate the diverse perspectives among different scholars on ESG integrated investment and its potential to generate financial outperformance. Examining various scholarly viewpoints, with a potential lack of consensus and consistency in standards and definitions, analyzing differing integration approaches in distinct markets, and exploring the underlying reasons for outperformance are highly relevant for encouraging debate and innovation among asset management practitioners and investors, as well as for informing policy and regulatory decision-making. This thesis will commence by examining the pivotal literature and shifts in perspective within the ESG investing realm. The

objective is to glean insights from the latest research and state-of-the-art methodologies, while also identifying areas where consensus and consistency may be lacking. Then, a quantitative analysis will be added to test the prevalent key conclusions.

The quantitative analysis will compare the performance between traditional indexes and respective ESG-integrated indexes, demystify the factors that contribute to the outperformance of ESG indices. We seek to answer the question of which ESG integration approach performs best financially, as well as which performs best in terms of ESG criteria. We will investigate the underlying pillars and factors that contribute most significantly to overall ESG performance, while accounting for variations among different ESG data providers, integration approaches, regions, and sectors. We also anticipate challenges related to data availability, lack of standardization and limited resources, but view these as opportunities to identify potential gaps for future developments in the ESG investing space.

II. Data

The aim of this study is to derive data-driven insights by utilizing a comprehensive set of data sources, including index price data, sectoral distributions, and ESG scores. To ensure robustness and minimize potential biases, we selected indexes from multiple well-known ESG data providers, including MSCI, S&P Global, Bloomberg, and FTSE Russell. The index methodologies are discussed in detail in Chapter V, providing transparency and clarity on the data sources used in this study.

All indexes that were included in the following index performance analysis and portfolio optimization simulations are listed below:

Table II-1: List of All Index Included and Index's ESG Integration Approach

Geography	**Asset Class**	**Index Name**		**Approach**
Europe	Equity	1	MSCI Europe	Non-ESG
		2	MSCI Europe - ESG Leaders	Best-in-class selection of top 50% of ESG-rated companies in terms of free-float market cap per • GICS sector • Sub-region market cap weighted
		3	MSCI Europe - ESG Focus	Optimize index-level ESG score under tracking error and sector constraints
		4	MSCI Europe - ESG Universal Index	Market-cap weight-tilt from 0.5 to 2.0 depending on

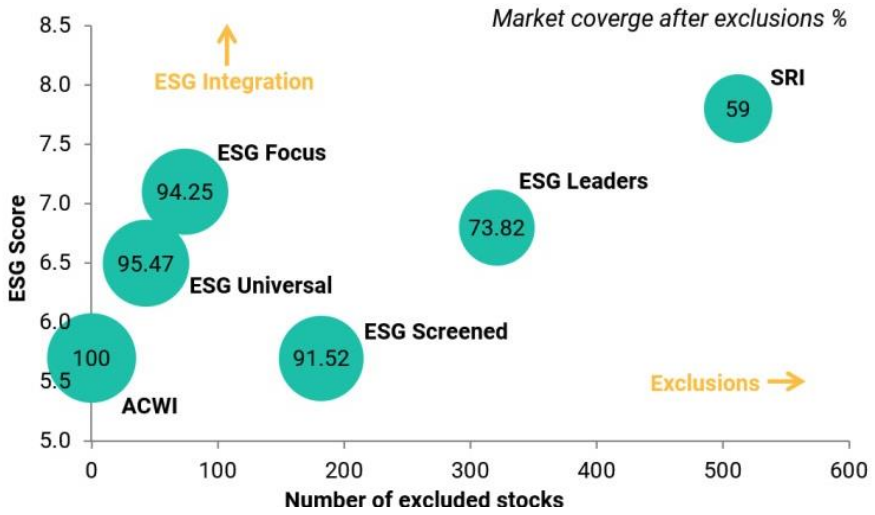
				• MSCI ESG rating • MSCI ESG momentum
		5	FTSE - Developed Europe	Non-ESG
		6	FTSE4Good - Europe	Positive Screening based on ESG Score • Each company in the research universe is given an FTSE ESG Score ranging from 0 to 5, with 5 being the highest score. Companies with an ESG Score of 3.3 or above are included Exclusion based on controversial business practices defined by FTSE • Exclude companies with controversial business practice including Tobacco, Weapons, Coal and certain Investment Trusts.
	Bond	7	Bloomberg Barclays Europe Aggregate Bond Index (EU AGG)	Non-ESG
		8	EU AGG - Weighted Index	Market-cap weight-tilt from 0.5 to 2.0 depending on • MSCI ESG rating • MSCI ESG momentum
		9	EU AGG - Sustainability	Best-in-class selection based on MSCI ESG Rating (Corporate and Government) • Rating BBB or higher • Exclude issuers with ESG Controversies Score <1 • not applied to MBS, ABS, and CMBS issues due to lack of ESG Ratings
USA	Equity	1	MSCI USA	Non-ESG
		2	MSCI USA - ESG Leaders	Best-in-class selection of top 50% of ESG-rated companies in terms of free-float market cap per • GICS sector

				• Sub-region market cap weighted
		3	MSCI USA - ESG Focus	Optimize index-level ESG score under tracking error and sector constraints
		4	MSCI USA - ESG Universal Index	Market-cap weight-tilt from 0.5 to 2.0 depending on • MSCI ESG rating • MSCI ESG momentum
		5	S&P 500	Non-ESG
		6	S&P 500 - ESG	A market-cap-weighted index that is designed to measure the performance of securities meeting sustainability criteria, while maintaining similar overall industry group weights as S&P 500. Exclusion-based approach based on • Controversies in business activities as determined by Sustainalytics • Violations of international norms and standards • S&P DJI ESG Score: A company is excluded, if either of the following is satisfied: 1. S&P DJI ESG Score falls within the worst 25% of scores from the company's GICS industry group in the underlying index. 2. S&P DJI ESG Score falls within the worst 10% of scores in the company's underlying index.
	Bond Agg	7	Bloomberg Barclays US Aggregate Bond Index (US AGG)	Non-ESG
		8	US AGG - Weighted Index	Market-cap weight-tilt from 0.5 to 2.0 depending on • MSCI ESG rating • MSCI ESG momentum

		9	US AGG - Sustainability	Best-in-class selection based on MSCI ESG Rating (Corporate and Government) • Rating BBB or higher • Exclude issuers with ESG Controversies Score <1 • not applied to MBS, ABS, and CMBS issues due to lack of ESG Ratings
	Corporate Bond	10	Bloomberg Barclays US Corporate Bond Index	Non-ESG
		11	Bloomberg Barclays US Corporate Bond Index - ESG Weighted	Market-cap weight-tilt from 0.5 to 2.0 depending on • MSCI ESG rating • MSCI ESG momentum
		12	Bloomberg Barclays US Corporate Bond Index - Sustainability	Best-in-class selection based on MSCI ESG Rating (Corporate and Government) • Rating BBB or higher • Exclude issuers with ESG Controversies Score <1 • not applied to MBS, ABS, and CMBS issues due to lack of ESG Ratings

Market-cap weighting means that the index constituents are weighted according to their market capitalization, with larger companies having a greater impact on the index's performance. This means that the index's performance is primarily driven by the market value of the included companies.

Figure II-3: Comparison of the Variations among MSCI indexes



Several factors are considered when selecting which indexes to include：

- **Representation**: The indexes selected need to be representative of the broader market. Therefore, for equities, the analysis includes major indexes like the S&P 500 in the US or the FTSE – Developed Europe in Europe. For bonds, Barclays Capital Aggregate Bond Index series was included.

- **Geographic Coverage**: Since the study is comparing Europe and the US, it is important to select indexes that adequately represent these markets. For Europe, FTSE – Developed Europe index was selected to represent the performance of large and mid-cap companies in developed European countries, matching the large-cap companies in S&P 500.

- **Asset Class Coverage**: The indexes cover a range of asset classes in both equities (like large-cap, mid-cap, small-cap, growth, value) and bonds (government, corporate, high-yield, municipal).
- **ESG Focus**: Since the research is on different performance of ESG integration approaches, we included multiple indexes specifically designed with ESG considerations. This can provide a comparison between traditional and ESG-focused approaches. Common ESG integration approaches used by leading index providers are summarized in Table II-2 below.
- **Diversification**: we ensure that the indexes chosen to offer sufficient diversification in terms of sectors, types of companies, and bond issuers.

Table II-2: Summary of Common ESG Integration Approaches for Index Construction

No.	ESG Integration Approach	Description
1	Negative Screening	Involves excluding certain sectors, companies, or practices based on specific ESG criteria. For

		example, an investor might exclude companies involved in fossil fuels or tobacco.
2	Positive Screening	Focuses on investing in sectors, companies, or projects selected for positive ESG performance relative to industry peers.
3	Best-in-class or ESG Leaders	Involves selecting companies with high ESG ratings relative to their sector peers.
4	Optimization that aims to maximize market-cap weighted exposure to ESG factors	Constituents are selected to maximize exposure to higher ESG scores, subject to maintaining risk and return characteristics similar to the conventional Parent Index. Optimization maximizes the Index's exposure to ESG scores for a given predicted tracking error.
5	ESG Momentum	Involves investing in companies that are demonstrating improvement in their ESG performance, regardless of their absolute ESG scores.

Furthermore, to evaluate the ESG performance of the underlying assets in the selected indexes, we utilized ESG scores provided by Refinitiv, one of the most frequently used ESG scoring systems by investors, asset managers, and other stakeholders to evaluate companies' sustainability and social responsibility. This enables us to assess the impact of ESG considerations on portfolio performance and identify potential areas for improvement in sustainable investing practices.

By combining these data in index performance analysis and portfolio optimization simulations, we aim to derive actionable insights that can inform investment decision-making and contribute to the advancement of sustainable investing practices.

The study period spans from 2013 to 2023, encompassing a decade that witnessed significant economic and financial market events, such as the global financial crisis, the European sovereign debt crisis, and the COVID-19 pandemic. These events had a profound impact on financial markets and investment strategies, and analyzing portfolio performance over this period can provide insights into the resilience and effectiveness of investment strategies during times of crisis.

Moreover, the past decade has seen notable advancements in sustainable investing, with increased emphasis on environmental, social, and governance (ESG) factors and impact investing. Analyzing portfolio performance over the past decade can help identify emerging trends in sustainable investing and evaluate the impact of ESG factors on investment outcomes. By exploring the relationship between portfolio performance and ESG scores, this study aims to provide data-driven insights that can inform investment decisions and contribute to the ongoing development of sustainable investing practices.

III. Methodology

Starting the study with literature review acknowledges significant contributions from influential researchers and seminal works that have shaped the discourse on ESG integration and investment. The goal of the literature review is to demonstrate a comprehensive understanding of the prevailing theories, methodologies, and findings in this field. By critically evaluating past research, we highlight gaps and discrepancies that our study intends to address. Our review will concentrate on the most recent perspectives regarding ESG (Environmental, Social, and Governance) investment and its performance, along with an exploration of potential drivers that have been identified.

To derive sound and comprehensive conclusions on the research question, a variety of quantitative methods are employed to investigate the impact of different ESG integration approaches on the financial and ESG performance of equity and bond indexes across Europe and the United States. Chapter VI of this study presents the results of this quantitative analysis. The first half of Chapter VI compares and interprets the historical performance of the ESG-integrated indexes against their traditional counterparts. This analysis enables us to assess the potential impact of ESG factors on portfolio performance and identify any significant differences in sectoral distributions and risk exposures.

The second half of Chapter VI simulates multi-asset portfolios that maximize financial returns while considering constraints such as tracking errors. This portfolio optimization simulation aims to provide insights into the practical application of ESG considerations in portfolio construction and asset allocation decision-making. By comparing the performance of ESG-integrated portfolios against their traditional counterparts, we aim to identify optimal portfolio strategies that balance financial objectives with sustainability considerations.

To provide a more detailed understanding, all the statistical methods are further elaborated as followed:

- **Univariate Testing:** univariate testing can be used to evaluate the performance of a group of assets based on specific factors, such as annualized return, volatility, or

correlation. Univariate testing can be useful to understand the historical performance of a particular index or security in relation to a specific factor, compare the performance of different indexes or securities, and identify blatant trends or patterns in the data that may inform investment decisions.

- **Mean-Variance Optimization:** This is a widely used technique that involves maximizing the expected return of a portfolio while minimizing its variance. By utilizing this method, we can ensure similar risk level by constraining tracking errors between hypothetical portfolios, while investigate differences in the expected return among ESG-integrated portfolios.

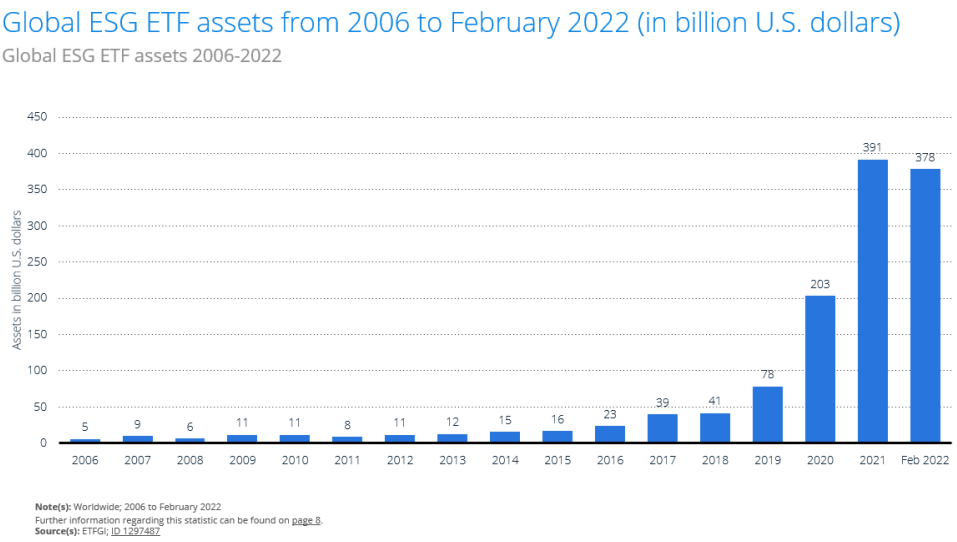
IV. Literature Review

In the early stages of ESG (Environmental, Social, and Governance) investing, the general viewpoint was that adopting such strategies might result in sacrificing financial performance. This was primarily due to the belief that the primary focus of ESG investing was on ethical, social, or environmental concerns rather than maximizing returns.

The skepticism around ESG investing was rooted in the notion that companies prioritizing ESG factors might face higher costs or miss out on profitable opportunities in certain industries, which could potentially lead to lower returns for investors.

However, as ESG investing has evolved over time, more research and evidence have emerged suggesting that incorporating ESG factors into investment decisions can lead to better risk management and long-term financial performance. The shift in perception has been driven by a growing awareness of the material impact that ESG factors can have on a company's financial health, as well as increased demand from investors for more sustainable and responsible investment options. In 2020, amidst a public health crisis and geopolitical tensions, ESG funds experienced steady inflows as they demonstrated better-than-average returns, even during a turbulent market year that saw the S&P 500 decline by 11%. Data provided by Morningstar Direct revealed that more than 70% of ESG funds across all asset classes outperformed their non-ESG counterparts during the first four months of the year. (Lefkovitz, 2023) This demonstration of resilience during the economy downturn and increasing awareness around topics such as climate change and boardroom diversity fuel more and more capital inflows from institutional investors. While only 20% of S&P 500 listed companies published sustainability reports in 2011, the number has increased to 81% as we entered in 2016 (Coppola 2016). Up to the middle of 2022, there are more than 1280 ESG ETFs available to investors in America, Europe, and the Asia Pacific, aggregating a total of $384.5 billion USD in assets, a tenfold increase from 2017.

Figure IV-2: Global ESG Asset from 2006 to 2022



Over the past five years, the increasing adoption of ESG investing by institutional capital and fund managers has led to heightened scrutiny and skepticism within the field. Researchers have been working diligently to unravel the complexities of ESG ratings and identify the main drivers behind the outperformance of ESG-integrated funds. Several crucial associations have emerged from recent studies, shedding light on the relationship between ESG factors and financial performance.

For example, ESG disclosures have been found to correlate with decreased capital constraints (Cheng, Ioannou, & Serafeim, 2014), reduced costs of capital (Dhaliwal, Li, Tsang, & Yang, 2011), and stock price volatility in response to mandatory ESG disclosure regulations (Grewal, Riedl, & Serafeim, 2017). These findings suggest that ESG disclosures offer valuable insights into a company's financial health and growth potential, while emphasizing the role of regulatory frameworks in influencing market reactions to ESG information.

Numerous studies have also shown that organizations with strong adherence to Environmental, Social, and Governance (ESG) principles tend to outperform their conventional counterparts on an aggregate level (Landier & Nair, 2009). While ever-evolving perspectives exist regarding the primary determinants of ESG performance, scholarly consensus generally posits that external environmental factors hold increased significance for negative ESG performance indicators. In comparison to positive ESG indicators, it is the influence of external elements that predominantly drives performance outcomes for negative ESG metrics(Crace and Gehman, 2022).

To gain a deeper understanding of this phenomenon, researchers have analyzed the three core components of ESG—Environmental (E), Social (S), and Governance (G)—separately.

The Governance component has been consistently linked to a company's financial performance since the early 2000s. As early as 2003, Gompers et al. (2003) found that firms with stronger shareholder rights demonstrated higher firm value, increased profits, faster sales growth, lower capital expenditures, and fewer corporate acquisitions. Although not as directly correlated with positive market-based financial outperformance, Governance has been shown to exhibit a distinct positive relationship with accounting-based financial performance, as indicated by future Return on Assets (ROA) and Market-to-Book (MTB) ratios (Cremers et al., 2005).

Conversely, the Environmental and Social components exhibit a more complex relationship with financial outperformance. Research results on their connection with financial performance differ depending on the specific timeframes examined, implying that the influence of Environmental and Social factors on financial performance may depend on various contextual variables. Increasingly, we are seeing controversial business practices, such as data privacy, to be closely related to financial performance and share prices, as seen in the case of Facebook in large-cap growth ETF (Loder, 2018). In a survey by Architas in 2021, "honest and transparent accountancy" was ranked the most vital ESG factor in 10 of the 11 global markets surveyed. This was followed by data protection and cyber-security, ranked as the second most important ESG factor in 8 of the 11 markets surveyed. The finding challenges the notion that the environmental factor – which many in the finance sector think of when discussing ESG – holds the most importance (Architas, 2020). Consequently, further investigation and analysis are warranted to better understand the intricate dynamics at play.

In additional to factor analysis, numerous industry participants are also delving into the underlying causes of performance associated with diverse ESG integration approaches. For example, MSCI, a highly esteemed data and index provider, is at the forefront of such explorations. Besides the most renowned approach——ESG ratings, MSCI also offers a wide range of ESG indexes designated to meet various investment objectives and philosophy. ESG Universal Indexes aim to enhance ESG profile while maintaining a risk and return profile similar to the underlying market. Employing a screening and exclusion-based approach, ESG Leader Indexes consist of companies with high ESG ratings relative to their sector peers. ESG Focus Indexes targe companies with positive momentum based on optimization on their ESG scores. Over the past decade, the overarching performance trend illustrates that various integration approaches exhibit optimal results under distinct conditions and for diverse investment approaches.

4.1 Conclusions on Current Works

Investment in ESG (Environmental, Social, and Governance) is still in its nascent stage. Despite numerous industry participants committing to the Principles for Responsible

Investment and enhancing their ESG disclosures, substantial uncertainty persists regarding whether the integration of ESG factors into portfolio construction will yield superior financial performance.

Intriguingly, data indicates that portfolios incorporating ESG principles have demonstrated a tendency to outperform their traditional counterparts especially during periods of market downturn. In some markets, the shared understanding of the significance of robust regulatory frameworks can shape market reactions to ESG information, potentially leading to elevated asset prices. However, the underlying factors driving this superior performance, as well as the most financially efficacious ESG integration approaches, remain to be definitively understood.

4.2 Thesis Goal

In this study, we draw inspiration from the body of work already extant in the relevant field of literature. The primary objective of this thesis paper is to delve into the effects of varying Environmental, Social, and Governance (ESG) integration approaches on the financial and ESG performance of equity and bond indexes in Europe and the US. This investigation is also stimulated by a recent study conducted by MIT's Sloan School of Management, which underscores that the choice of distinct data methodologies and sources can lead to substantial discrepancies among rating providers. To mitigate potential biases and inconsistencies inherent in individual indices, this paper will employ data from several index providers.

This research contributes to the existing literature, which has predominantly centered on ESG integration for equity securities and climate risk management. Our study expands this focus by exploring the impact of diverse ESG integration approaches on both equity and bond indices, while comparing their performance in Europe and the US This approach allows us to offer a more detailed perspective on the integration of ESG considerations into asset allocation decision-making. The results of this research can serve as a practical guide for investors pursuing ESG-related objectives.

Furthermore, this research will probe into the underlying dynamics fueling ESG and financial outperformance, providing a comprehensive analysis of the critical factors that contribute to their success. Notwithstanding the potential limitations in accessing third-party ESG index methodologies, the study will strive to scrutinize the constituent level and investigate the correlations between sectoral and geographical distribution and their corresponding performances.

Additionally, this thesis intends to illuminate a relatively uncharted area of ESG analytics, which holds significant interest for institutional investors. The insights derived from this research can equip institutional investors with the necessary knowledge to make informed decisions concerning ESG integration in their investment portfolios using AI technologies,

thereby leading to improved financial performance and a more significant environmental and social impact. Through this study, I aim to add to the ongoing discourse on the importance of incorporating ESG considerations into investment decision-making and establish a framework for future research in this field.

V. Overview of Index Methodologies

5.1 S&P 500 and S&P500 ESG

The S&P 500 ESG Index uses a combination of the exclusion approach and a best-in-class approach. The index is designed to measure the performance of companies within the S&P 500 that meet certain ESG criteria while maintaining a similar overall industry group weighting as the parent index.

First, the exclusion approach is applied, which removes companies involved in controversial business activities such as tobacco, controversial weapons, and thermal coal, as well as those that are not in compliance with the United Nations Global Compact principles.

After the exclusionary screening, a best-in-class approach is applied. Companies are assigned ESG scores based on their ESG performance relative to their industry peers. The index includes the top 75% of companies within each GICS (Global Industry Classification Standard) industry group, ranked by their S&P DJI ESG scores. This ensures that the index consists of companies with relatively strong ESG profiles compared to their peers.

An equivalent index to the S&P 500 ESG Index in Europe is the MSCI Europe ESG Leaders Index. The MSCI Europe ESG Leaders Index consists of large and mid-cap companies across 15 developed markets countries in Europe that have high environmental, social, and governance (ESG) performance relative to their sector peers.

Like the S&P 500 ESG Index, the MSCI Europe ESG Leaders Index uses a best-in-class approach, selecting companies with high ESG ratings while maintaining the broad market's industry group weights. The MSCI ESG Leaders Indexes target a 50% sector representation within each sector of the parent index while aiming to maintain at least 50% of the market capitalization of each of the GICS sectors.

5.2 MSCI and MCSI ESG Index Series

The MSCI USA Index is a broad, market-cap-weighted index that represents the performance of large and mid-cap companies in the United States. It aims to capture 85% of the publicly available total market capitalization. The methodology used for the MSCI USA Index is based on the Global Industry Classification Standard (GICS), which classifies companies into industry sectors and groups. The index is reconstituted and rebalanced on a semi-annual basis.

Utilizing an index methodology similar to the MSCI USA, the key distinction between the MSCI EU lies in the geographical regions each index represents.

Meanwhile, the MSCI ESG Index series is designed to capture the performance of public companies exhibiting robust ESG ratings while maintaining risk and return characteristics comparable to the parent MSCI Index. Although the ESG Index employs the same GICS classification as the parent MSCI Index, it distinguishes itself by integrating ESG factors into its selection process.

MSCI offers an array of ESG-oriented indexes tailored to accommodate diverse investor preferences and objectives. Among these indexes are the MSCI USA ESG Focus Index and the MSCI USA ESG Leaders Index. Both indexes strive to reflect the performance of American companies possessing robust ESG profiles, yet they exhibit distinct methodologies and goals.

The ESG Focus Index is designed to optimize ESG exposure within a specified tracking error range. This objective is achieved by prioritizing the inclusion of companies with superior ESG ratings in order to maximize the index's overall ESG score. Furthermore, the index employs an optimization process for allocating weights to the chosen constituents. This approach amplifies the weight of companies with higher ESG ratings while reducing the weight of those with lower ratings, thereby maximizing ESG exposure within the tracking error constraints of the parent index, MSCI USA.

In contrast, the ESG Leaders Index adopts a more exclusion-based methodology. This index targets the top 50% of companies boasting the highest ESG ratings within each sector, while maintaining sector weights analogous to those of the parent index. A comprehensive comparison of the variations among MSCI indexes is presented previously in Chapter 2, Figure II-2.

5.3 FTSE – Developed Europe and FTSE4Good - Europe

The FTSE Developed Europe Index is a stock market index that represents the performance of large and mid-cap companies in developed European countries. The FTSE Developed Europe Index includes countries such as the United Kingdom, France, Germany, Switzerland, and others that meet FTSE Russell's criteria for developed markets. The index is market-capitalization weighted, meaning that companies with a larger market cap have a bigger impact on the index's performance. It's a commonly used benchmark for investors looking to track the performance of developed European equities.

FTSE4Good Europe Index specifically includes European companies that meet certain ESG criteria. The index is designed to measure the performance of companies demonstrating strong ESG practices and applies exclusionary screens based on industry and ESG criteria. The companies in the FTSE4Good Europe Index are therefore a subset of those in the FTSE

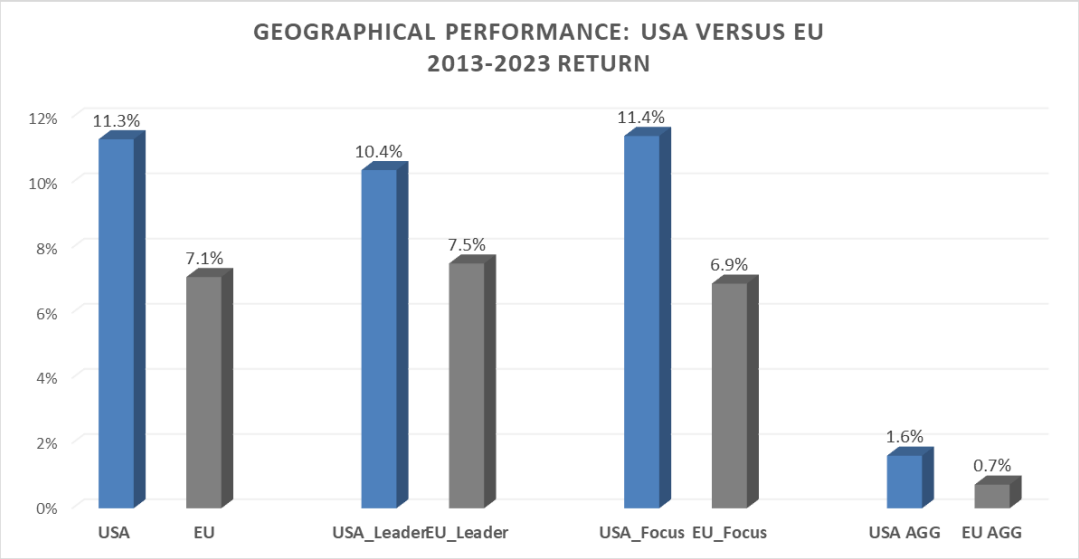
Developed Europe Index. Similar to the S&P ESG Index in the United States, it uses a combination of market-cap weighting and best-in-class exclusion criteria based on environmental, social, and governance (ESG) factors.

VI. Empirical Analysis

6.1 Index Performance Interpretation

Geographical Performance: US versus EU

Figure VI-1: USA VS EU Geography Performance Interpretation



The United States (US) has consistently demonstrated superior performance compared to European regions, encompassing both equity and bond markets across conventional and ESG-integrated indexes.

Based on the index performance from 2013 to 2023, it is evident that investing in US equities has been more profitable than their European counterparts. For conventional indexes, MSCI USA achieved an annualized mean return of 11.3%, whereas MSCI EU was 7.1%. Surprisingly, S&P500 outperformed FTSE Developed Europe by 7.7% in the past decade. For ESG-integrated indexes specifically, the MSCI US ESG Focus showed an impressive annualized mean return of 10.4%, closely matching its benchmark index, the MSCI USA. However, the MSCI Europe ESG Leader boasted an annualized mean return of 6.7%, surpassing MSCI Europe by 0.5%. As for bond indexes, USA AGG Bond index has an annualized mean return of 1.6%, where as EU counterpart only realized 1.7%.

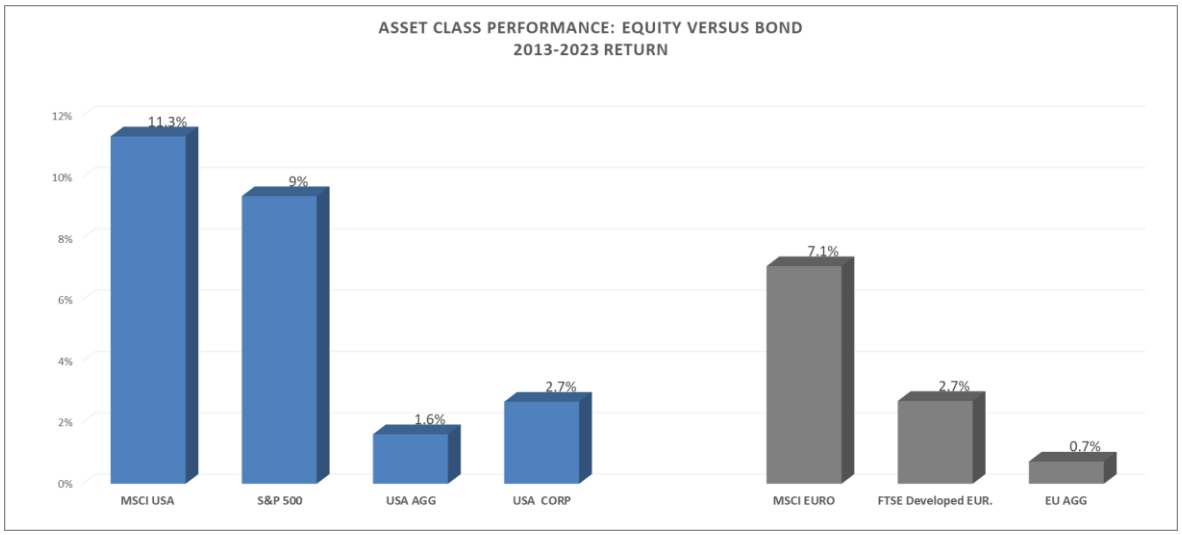
Analysis of index performance from 2013 to 2023 reveals that investments in US equities have yielded higher returns than their European equivalents. In terms of conventional indexes, the MSCI USA delivered an annualized average return of 11.3%, while the MSCI EU stood at 7.1%. Notably, the S&P 500 outpaced the FTSE 100 by 7.7% over the past decade. Focusing on

ESG-integrated indexes, the MSCI US ESG Focus exhibited an impressive annualized average return of 10.4%, closely mirroring its benchmark index, the MSCI USA. Conversely, the MSCI Europe ESG Leader registered an annualized average return of 6.7%, surpassing the MSCI Europe by 0.5%. In the bond market, the USA AGG Bond index achieved an annualized average return of 1.6%, whereas its European counterpart realized 1.7%.

This reveals that US equities have been more profitable than European equities across both conventional and ESG-integrated indexes, with bond indexes showing relatively similar returns.

Asset Class Performance: Equity versus Bond

Figure VI-2: Equity VS Bond Asset Class Performance Interpretation



Within the United States, we can see equity indexes perform better than bond indexes by around 7-10%, and corporate bonds (Bloomberg Barclays US Corporate Investment Grade Index) performs significantly better than government bonds (Bloomberg Barclays US Aggregate Bond Index). In Europe, a considerable disparity is observed in the performance of equity indexes, with the MSCI EU exceeding the FTSE Developed Europe Index by over 5%. The most significant variation in returns for EU equity and bonds reaches 6.5%, but still slightly lower than the difference observed between US equity and bond performance.

A deeper examination of the Sharpe ratio offers valuable insights into the risk-adjusted performance comparison between equity and bond indexes. A higher Sharpe ratio signifies superior risk-adjusted performance, suggesting that the investment has yielded higher returns in proportion to the risk involved. As displayed in the table below, the MSCI USA Focus achieves the highest risk-adjusted performance among equity indexes, while US corporate bond indexes exhibit the most favorable risk-adjusted performance within the bond index category. The risk-adjusted performance gap remains substantial between the MSCI USA and US Corporate Bond indexes, suggesting that equities have provided better risk-adjusted returns compared to

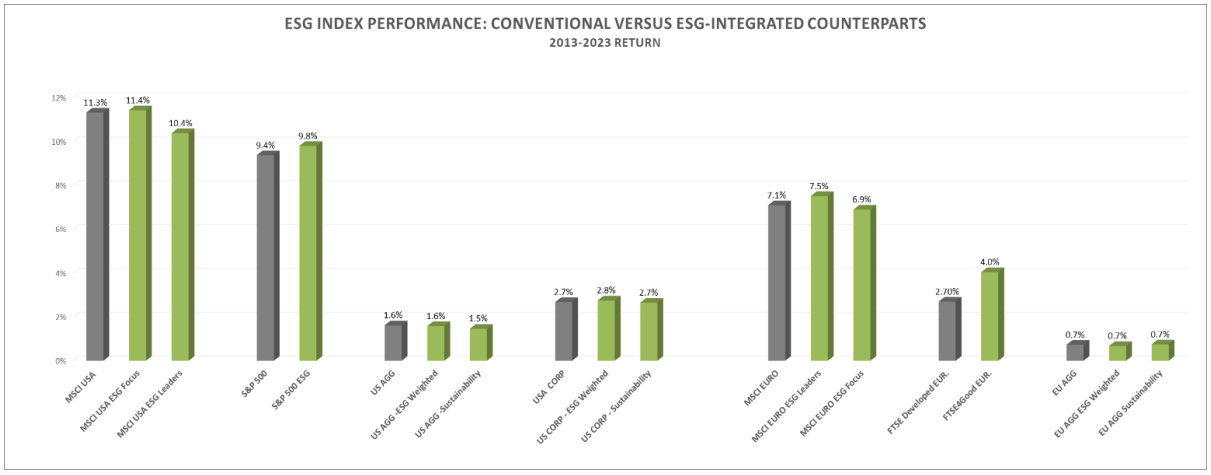
corporate bonds over the past decade. Conversely, the FTSE Developed Europe and EU AGG fall among the ranks with the lowest Sharpe ratios. This observation is consistent with the conclusions drawn from examining the annualized mean returns of these indexes.

Table VI-3: Sharpe Ratios of Conventional Non-ESG Indexes

NO.	Index Name	Asset Class	Sharpe Ratio
1	MSCI USA	Equity	0.64
2	S&P 500	Equity	0.55
3	MSCI EU	Equity	0.44
4	USA Corp	Bond	0.33
5	USA_AGG	Bond	0.17
6	FTSE DEVELOPED EUROPE	Equity	0.12
7	EU_AGG	Bond	-0.05

ESG Performance: Conventional versus ESG-Integrated Counterparts

Figure VI-4: Conventional Non-ESG VS ESG Performance Interpretation



A closer comparison between ESG indexes and their conventional counterparts reveals that ESG-integrated indexes have generally shown higher returns, particularly in Europe. For equity indexes, MSCI EU ESG Leader outperforms its conventional counterpart by 0.4%, while FTSE4Good outshines FTSE Developed Europe by over 1%. Similarly, in the US, the S&P 500 ESG outperforms the S&P 500 by a 0.4% margin. However, for bond indexes, ESG-integrated indexes exhibit returns that are quite similar to those of their conventional parent indexes in both the US and Europe, indicating comparable performance between the two categories. These results suggest that investing in ESG-integrated indexes can offer investors not only the satisfaction of supporting sustainable investments but also potentially higher returns, especially in equity assets. Delving into the nuances of various ESG integration approaches, it becomes evident that the approach centered on optimizing ESG scores, as exemplified by the Bloomberg Barclays US

Aggregate ESG Weighted Bond Index and the MSCI US Corporate ESG Weighted Bond Index, tends to deliver slightly higher returns compared to the sector-relative selective inclusion method used by Bloomberg EU Aggregate Sustainability Index and the MSCI EU Corporate Sustainability Bond Index.

To further evaluate the return on per unit of risk among ESG integrated indexes, MSCI USA ESG Focus Index has the highest Sharpe ratio, indicating that it has provided the highest return per unit of risk among the equity indexes analyzed. On the other hand, the MSCI Europe ESG Focus Index has the lowest Sharpe ratio among equity indexes, implying that it has provided the lowest return per unit of risk. Comparing all the bond indexes, USA Corporate ESG Weighted Bond index has the best risk-adjusted performance and EU Aggregated ESG Weighted Bond Index has the lowest Sharpe ratio. This finding suggests that investing in US bonds has been more profitable than investing in bonds in Europe.

Table VI-5: Sharpe Ratios of All Indexes

NO.	Index Name	Asset Class	Sharpe Ratio
1	MSCI USA - ESG Focus	Equity	0.65
2	**MSCI USA**	Equity	**0.64**
3	MSCI USA - ESG Universal	Equity	0.60
4	MSCI USA - ESG Leader	Equity	0.59
5	S&P500 ESG	Equity	0.57
6	**S&P500**	Equity	**0.55**
7	MSCI EU - ESG Leader	Equity	0.49
8	MSCI EU - ESG Universal	Equity	0.45
9	**MSCI EU**	Equity	**0.44**
10	MSCI EU - ESG Focus	Equity	0.43
11	USA Corp - ESG Weighted	Bond	0.35
12	**USA Corp**	Bond	**0.33**
13	USA Corp - Sustainability	Equity	0.33
14	FTSE4good_EU	Equity	0.27
15	**USA_AGG**	Bond	**0.17**
16	USA_AGG - ESG Weighted	Bond	0.16
17	USA AGG- Sustainability	Bond	0.14
18	**FTSE Developed Europe**	Equity	**0.12**
19	EU - Sustainability	Bond	-0.04
20	**EU_AGG**	Bond	**-0.05**
21	EU_AGG- ESG Weighted	Bond	-0.07

When it comes to downside risk, all equity indexes, whether traditional or ESG-integrated counterparts, demonstrated similar maximum declines, ranging from 33% to 35%. This implies that in the event of a market downturn, investors in these indexes may experience a substantial loss of one-third to one-half of their initial investment.

Table VI-6: Maximum decline of All US Indexes

Index Name	Asset Class	Maximum Decline
MSCI USA	Equity	-34%
MSCI USA - ESG Leaders	Equity	-34%
MSCI USA - ESG Focus	Equity	-34%
MSCI USA - ESG Universal	Equity	-33%
S&P 500	Equity	-34%
S&P 500 - ESG	Equity	-33%
Bloomberg Barclays US Aggregate Bond Index (US AGG)	Bond	-18%
US AGG - Weighted Index	Bond	-19%
US AGG - Sustainability	Bond	-18%
Bloomberg Barclays US Corporate Bond Index	Bond	-22%
Bloomberg Barclays US Corporate Bond Index - ESG Weighted	Bond	-21%
Bloomberg Barclays US Corporate Bond Index - Sustainability	Bond	-22%

Table VI-7: Maximum decline of All Europe Indexes

Index Name	Asset Class	Maximum Decline
MSCI Europe	Equity	-35%
MSCI Europe - ESG Leaders	Equity	-32%
MSCI Europe - ESG Focus	Equity	-35%
MSCI Europe - ESG Universal	Equity	-34%
FTSE - Developed Europe	Equity	-37%
FTSE4Good - Europe	Equity	-35%
Bloomberg Barclays Europe Aggregate Bond Index (EU AGG)	Bond	-20%

EU AGG - Weighted Index	Bond	-20%
EU AGG - Sustainability	Bond	-20%

With respect to downside risk, there is a notable disparity among bond indexes, as evidenced by the US Aggregate AGG index displaying a maximum decline of -18%, while the US Corporate Bond index exhibits a more substantial decline of -22%. Interesting to note, the integration of ESG strategies appears to have an opposite effect on the maximum decline of the US Aggregate AGG and US Corporate bond indexes. Specifically, integrating ESG strategies into the US Aggregate Bond index is seen to increase its maximum decline, while the opposite is observed for the US Corporate bond index. These findings suggest that the impact of ESG integration on downside risk may vary depending on the index and investment approach.

A closer examination of selected bear market periods reveals that equity indexes that integrate ESG strategies have demonstrated an minor advantage in equity and corporate bond index during market downturns triggered by sudden economic and social crises, such as the COVID-19 pandemic. ESG-integrated indexes have shown smaller losses compared to their traditional counterparts, highlighting the potential benefits of ESG integration in times of market stress. However, during cyclical bear markets such as the 2018 subprime mortgage recession, the performance of ESG-integrated indexes was mixed, with varying results across different ESG strategies. While some indexes performed similarly to their traditional counterparts, others showed better results. These findings suggest that ESG integration may provide investors with a more resilient cushion during market downturns triggered by unexpected events but may not necessarily lead to superior returns during all types of bear markets.

While ESG integration generally provides a positive addition to financial performance, achieving effective outperformance and downside risk protection requires careful consideration of the specific ESG integration methods used. For instance, within the MSCI USA ESG index series, the US ESG Universal Index exhibits a 0.7% smaller maximum decline in comparison to its conventional counterparts, while the US ESG Leaders Index experiences a 0.2% larger maximum decline. This highlights the importance of understanding the nuances of various ESG integration approaches to attain a more resilient investment portfolio.

In conclusion, an initial analysis on the index performance shows that ESG-integrated indexes have generally performed similarly or slightly outperformed in bull markets, while significantly outperformed during economic and social crisis. Cumulatively, over the period from 2013 to 2023, ESG-integrated indexes, encompassing a range of strategies from exclusion-based to ESG score optimization, have demonstrated improved performance, with annualized mean returns surpassing their non-ESG counterparts by 1% in both the US and Europe. In

addition, different ESG-integration approaches also yield different levels of outperformance in the US and Europe. The integration approach based on a negative screening and exclusion of constituents below certain levels of ESG rating and an avoidance on controversial practices performs better in Europe, and the approach based on an optimization on ESG score performs better in the US. We will further dig into the differences in index construction methods and composition and probe the reasons behind these differences in Chapter VI.

Sectoral Performance

To go deeper into the difference in sectoral distribution of conventional indexes and its ESG-integrated counterparts, I chose S&P 500 and S&P 500 ESG as an example to conduct more in-depth analysis. The goal is to identify potential differences in sectoral weightings and performance between the conventional and ESG-integrated index. This could shed light on how ESG considerations might influence sector representation and consequently, investment outcomes, in major market indices.

The largest allocation differences between the ESG Index and the S&P 500 Index are observed in Information Technology (+6.2%), Communication Services (-1.9%),, Industrials (-2.2%). The overweight in Information Technology and the relatively balanced allocations in high-performing sectors such as Health Care and Financials could have contributed to this outperformance. The specific companies within these sectors, and their ESG ratings, can also play a significant role. On the other hand, underweights in sectors like Communication Services and Industrials would have detracted from performance if those sectors performed well during this period. Furthermore, the constituents excluded from the benchmark index demonstrate a lower sectoral distribution in Technology (-22.9%) and Healthcare (-2.3%), while displaying a considerably higher distribution in Industrials (8.1%) and Communication Services (7.1%).

Table VI-8: Sectoral Difference(Market Capitalization Weights) between S&P 500, its ESG counterpart and Constituents Excluded

No.	Sector Name	S&P 500 Index	S&P 500 ESG Index	Difference (ESG -S&P 500)	Constituents excluded from ESG Index	Difference (Excluded - ESG)
1	Information Technology	31.4%	37.5%	6.2%	14.7%	-22.9%
2	Health Care	13.3%	13.9%	0.6%	11.6%	-2.3%
3	Financials	12.8%	12.5%	-0.3%	13.5%	1.0%
4	Consumer Discretionary	9.9%	8.2%	-1.7%	14.4%	6.1%
5	Industrials	8.3%	6.2%	-2.2%	14.2%	8.1%
6	Consumer Staples	7.5%	7.7%	0.2%	7.0%	-0.6%
7	Communication Services	4.9%	3.0%	-1.9%	10.1%	7.1%

8	Energy	4.4%	4.7%	0.2%	3.9%	-0.8%
9	Utilities	2.6%	1.5%	-1.1%	5.7%	4.2%
10	Materials	2.5%	2.6%	0.0%	2.4%	-0.1%
11	Real Estate	2.3%	2.3%	-0.1%	2.5%	0.3%

Table VI-9: Sectoral Difference (Number of Companies) between S&P 500 and its ESG counterpart

NO.	Sector Name	S&P 500	S&P 500 - ESG	Difference
1	Industrials	76	38	38
2	Information Technology	66	33	33
3	Consumer Discretionary	53	30	23
4	Utilities	30	9	21
5	Financials	73	53	20
6	Health Care	65	45	20
7	Materials	30	18	12
8	Consumer Staples	36	25	11
9	Communication Services	21	11	10
10	Real Estate	30	22	8
11	Energy	23	18	5
		503	302	

Table VI-10: Sectoral Difference (ESG Score) between Constituents retained in S&P 500 ESG Index and Constituents Excluded

NO.	Sector Name	Average ESG Score - Companies Retained	Average ESG Score - Companies Excluded	Difference (Retained – Excluded)
1	Consumer Discretionary	57.51	45.89	11.62
2	Financials	50.40	43.20	7.20
3	Industrials	56.64	51.08	5.55
4	Information Technology	60.32	50.32	10.00
5	Utilities	63.66	62.82	0.84

✧ Due to limited data availability from MSCI, ESG Score from Refinitiv is used for sectoral analysis

Our findings reveal that companies that have been retained in the S&P 500 ESG Index consistently demonstrate higher average ESG scores compared to those that have been

excluded. A closer analysis of the top five sectors with the highest number of removed companies—specifically, Healthcare, Materials, Consumer Discretionary, Information Technology, and Financials—we observe a substantial divergence in ESG scores between companies that have been retained in the index and those that have been excluded. Concurrently, our analysis of the financial performance of these sectors reveals that Information Technology, Materials, Healthcare, and Consumer Discretionary have emerged as the top-performing sectors over the past decade, seen from data provided in Table VI-9. This suggests that, at least at the sector level, if investors include companies that prioritize ESG factors, they might be more likely to experience financial success in the long term. This could be due to a variety of reasons, such as improved risk management, enhanced brand reputation, or increased operational efficiency through sustainable practices. (Whelan, 2020)

Table VI-11: Sectoral Performance of S&P 500 Index(2013-2023)

Sector Name	Performance - 10 Year
Information Technology (.GSPT)	435.39%
Health Care (.GSPA)	180.13%
Consumer Discretionary (.GSPD)	159.88%
Industrials (.GSPI)	125.13%
Financials (.GSPF)	106.74%
Materials (.GSPM)	94.08%
Consumer Staples (.GSPS)	88.94%
Utilities (.GSPU)	74.83%
Communication Services (.GSPL)	19.40%
Energy (.GSPE)	2.83%
Real Estate (.GSPRE)	--
S&P 500 ® Index (.SPX)	154.36%

High ESG scores in these sectors could reflect that companies with strong ESG performance are more capable of adapting to changing market conditions, regulations, and consumer preferences. This adaptability may provide a competitive advantage, allowing these companies to outperform their peers in the long run.

6.2 Portfolio Optimization Simulation

Optimization Methodology

The portfolio optimization simulation is designed to quantitatively evaluate a variety of asset allocation strategies over the past decade. The simulation's output provides a spectrum of

potential portfolio performances, which can be analyzed to comprehend the trade-offs between risk and return. Due to the fluctuating returns across different asset classes over time, portfolios may deviate from their intended allocations. Consequently, I have incorporated an annual rebalancing process at the end of each year.

- ***Indexes Included in the Simulation:***

Consistent with the previous index analysis, we used 12 indexes from the US market, 10 indexes from the Europe market to conduct simulations:

- **Portfolios from the US**

	NO. (US Bond)	1	2	3	4	5	6
NO.(US Equity)		**USA AGG**	**USA AGG - ESG Weighted**	**USA AGG - Sustainability**	**USA CORP Bond**	**USA CORP - ESG Weighted**	**USA CORP - Sustainability**
1	**MSCI USA**	0.4*MSCI USA + 0.6*USA AGG	0.4*MSCI USA + 0.6*USA AGG - ESG Weighted	0.4*MSCI USA + 0.6*USA AGG - Sustainability	0.4*MSCI USA + 0.6*USA CORP Bond	0.4*MSCI USA + 0.6*USA CORP - ESG Weighted	0.4*MSCI USA + 0.6*USA CORP - Sustainability
2	**MSCI USA ESG Leaders**	0.4*MSCI USA ESG Leaders + 0.6*USA AGG	0.4*MSCI USA ESG Leaders + 0.6*USA AGG - ESG Weighted	0.4*MSCI USA ESG Leaders + 0.6*USA AGG - Sustainability	0.4*MSCI USA ESG Leaders + 0.6*USA CORP Bond	0.4*MSCI USA ESG Leaders + 0.6*USA CORP - ESG Weighted	0.4*MSCI USA ESG Leaders + 0.6*USA CORP - Sustainability
3	**MSCI USA ESG Focus**	0.4*MSCI USA ESG Focus + 0.6*USA AGG	0.4*MSCI USA ESG Focus + 0.6*USA AGG - ESG Weighted	0.4*MSCI USA ESG Focus + 0.6*USA AGG - Sustainability	0.4*MSCI USA ESG Focus + 0.6*USA CORP Bond	0.4*MSCI USA ESG Focus + 0.6*USA CORP - ESG Weighted	0.4*MSCI USA ESG Focus + 0.6*USA CORP - Sustainability
4	**MSCI USA ESG Universal**	0.4*MSCI USA ESG Universal + 0.6*USA AGG	0.4*MSCI USA ESG Universal + 0.6*USA AGG - ESG Weighted	0.4*MSCI USA ESG Universal + 0.6*USA AGG - Sustainability	0.4*MSCI USA ESG Universal + 0.6*USA CORP Bond	0.4*MSCI USA ESG Universal + 0.6*USA CORP - ESG Weighted	0.4*MSCI USA ESG Universal + 0.6*USA CORP - Sustainability
5	**S&P 500**	0.4*S&P 500 +	0.4*S&P 500 + 0.6*USA AGG - ESG Weighted	0.4*S&P 500 + 0.6*USA AGG - Sustainability	0.4*S&P 500 +	0.4*S&P 500 + 0.6*USA CORP	0.4*S&P 500 + 0.6*USA CORP - Sustainability

		0.6*USA AGG			0.6*USA CORP Bond	- ESG Weighted	
6	**S&P 500 ESG**	0.4*S&P 500 ESG + 0.6*USA AGG	0.4*S&P 500 ESG + 0.6*USA AGG - ESG Weighted	0.4*S&P 500 ESG + 0.6*USA AGG - Sustainability	0.4*S&P 500 ESG + 0.6*USA CORP Bond	0.4*S&P 500 ESG + 0.6*USA CORP - ESG Weighted	0.4*S&P 500 ESG + 0.6*USA CORP - Sustainability

- **Portfolios from the Europe**

	NO. (US Bond)	**1**	**2**	**3**
NO. (US Equity)		**EU AGG**	**EU AGG - ESG Weighted**	**EU AGG - Sustainability**
1	**MSCI Europe**	0.4*MSCI Europe + 0.6*EU AGG	0.4*MSCI Europe + 0.6*EU AGG - ESG Weighted	0.4*MSCI Europe + 0.6*EU AGG - Sustainability
2	**MSCI Europe ESG Leaders**	0.4*MSCI Europe ESG Leaders + 0.6*EU AGG	0.4*MSCI Europe ESG Leaders + 0.6*EU AGG - ESG Weighted	0.4*MSCI Europe ESG Leaders + 0.6*EU AGG - Sustainability
3	**MSCI Europe ESG Focus**	0.4*MSCI Europe ESG Focus + 0.6*EU AGG	0.4*MSCI Europe ESG Focus + 0.6*EU AGG - ESG Weighted	0.4*MSCI Europe ESG Focus + 0.6*EU AGG - Sustainability
4	**Europe - ESG Universal Index**	0.4*Europe - ESG Universal Index + 0.6*EU AGG	0.4*Europe - ESG Universal Index + 0.6*EU AGG - ESG Weighted	0.4*Europe - ESG Universal Index + 0.6*EU AGG - Sustainability
5	**EAFE ESG Focus**	0.4*EAFE ESG Focus + 0.6*EU AGG	0.4*EAFE ESG Focus + 0.6*EU AGG - ESG Weighted	0.4*EAFE ESG Focus + 0.6*EU AGG - Sustainability
6	**FTSE Developed Europe**	0.4* FTSE Developed Europe + 0.6*EU AGG	0.4* FTSE Developed Europe + 0.6*EU AGG - ESG Weighted	0.4* FTSE Developed Europe + 0.6*EU AGG - Sustainability
7	**FTSE4Good Europe**	0.4*FTSE4Good Europe + 0.6*EU AGG	0.4*FTSE4Good Europe + 0.6*EU AGG - ESG Weighted	0.4*FTSE4Good Europe + 0.6*EU AGG - Sustainability

- ***Asset Allocation Weighting Scheme:***

In this study, we examined four distinct combinations of equity and bond asset weights, assigning each group of asset allocation strategies a corresponding benchmark based on the

MSCI USA and US Aggregated Bond Index weights. Considering the prevailing low interest rate environment and the high volatility in the stock market from 2013 to 2023, I have allocated a higher weightage to bonds, ranging from 60% to 90%, as opposed to equities, which have been allocated a weightage between 10% and 40%. The table below provides an overview of these allocations and benchmarks:

NO.	Weights for Equity Index	Weights for Bond Index	Benchmark
1	40%	60%	0.4USA+0.6US AGG
2	30%	70%	0.3USA+0.7US AGG
3	20%	80%	0.2USA+0.8US AGG
4	10%	90%	0.1USA+0.9US AGG

Optimization Outcomes for US Index-Based Portfolio

In the United States, the highest total returns are observed in the '0.4MSCI USA ESG Focus + 0.6USA CORP Bond – ESG Weighted' portfolio, with a 6.3% return, while the lowest total returns are found in the '0.1MSCI USA ESG Focus + 0.9USA AGG' portfolio, with a 2.6% return. This suggests that higher allocations to 'MSCI USA ESG Focus' and 'USA CORP Bond – ESG Weighted' assets tend to deliver higher returns.

The highest information ratio is observed in the '0. 3MSCI USA ESG Focus_0.7 USA CORP Bond – ESG Weighted' portfolio, with an 83.2% ratio, while the lowest information ratio is found in the '0.1S&P 500_0.9USA CORP Bond' portfolio, with a 64.1% ratio. This suggests that portfolios with higher allocations to 'MSCI USA ESG Focus' and 'USA CORP Bond – ESG Weighted assets also tend to have a better risk-adjusted performance.

Excessive return, also referred to as "abnormal return" or "alpha," signifies the difference between a portfolio's actual return and its benchmark return, taking into account the portfolio's risk level. Through calculating the excessive returns of each asset allocation strategy, we were able to compare the performance of various asset allocation strategies in relation to their designated benchmarks.

During the 2012-2023 period, the asset allocation strategy consisting of 10% MSCI USA ESG Focus and 90% USA Corporate Bond ESG Weighted outperformed all other strategies in the US, delivering an excessive return of 1.1% above its benchmark (10% MSCI USA and 90% US Aggregated Bond Index). In contrast, the allocation of 40% S&P 500 and 60% USA Aggregated Sustainability Bond Index underperformed, with an excessive return of 0.8% below its benchmark (0.4% MSCI USA and 60% USA Aggregated Bond Index).

The disparity in excessive returns can be primarily attributed to the underperformance of the S&P 500 compared to the MSCI USA, as well as the lower-than-benchmark performance of the US Aggregated Bond Sustainability Index.

Interestingly, our portfolio simulation results on all indices show that the asset allocation strategy of 10% MSCI USA and 90% US Corporate Bond Sustainability Index has the highest hit ratio, yet it is accompanied by a relatively modest return. This suggests that this strategy may consistently generate positive returns, but the returns could be small. Despite the portfolio's impressive hit ratio, which signifies a greater frequency of periods with positive returns compared to its benchmark portfolio, it may have occasionally experienced substantial losses that counterbalance its gains, resulting in a diminished overall return. The factors contributing to the larger financial losses in index returns for the US Corporate Bond Sustainability Index remain unclear, as the index does not publicly disclose its constituent corporate bonds. However, it is worth noting that the ESG-weighted approach to integrating ESG factors into bond indexes outperformed the Sustainability approach during 2013-2023 in the US. The potential reasons for this improved performance could be attributed to factors such as flexibility, momentum consideration, broader issuer universe, and sector and industry exposure.

The ESG-Weighted index methodology offers a flexible weight-tilt range from 0.5 to 2.0 based on MSCI ESG ratings and MSCI ESG momentum. This adaptability enables a more nuanced approach to portfolio construction, allowing investors to overweight bonds with stronger ESG performance and underweight those with weaker ESG performance. In contrast, the Sustainability Bond index adopts a more rigid best-in-class selection approach, which may not fully capture the spectrum of ESG risks and opportunities across the bond universe.

Moreover, the ESG-Weighted index takes into account both MSCI ESG ratings and MSCI ESG momentum. By factoring in ESG momentum, the ESG-Weighted index can potentially identify issuers that are enhancing their ESG performance, leading to better risk-adjusted returns as these companies adapt to changing market conditions and more effectively manage ESG risks. On the other hand, the Sustainability Bond index does not explicitly incorporate ESG momentum into its methodology.

Additionally, the Sustainability Bond index methodology might exclude certain issuers due to their ESG Controversies Score being less than 1, which could limit the index's diversification. In comparison, the ESG-Weighted index employs a weight-tilt approach to a wider universe of issuers, facilitating better diversification and a more comprehensive assessment of ESG risks and opportunities.

Lastly, the ESG-Weighted index's market-cap weight-tilt approach fosters a more balanced exposure across various sectors and industries. This diversification may contribute to the ESG-Weighted index's superior performance relative to the Sustainability Bond index, particularly during the 2013-2023 period.

Optimization Outcomes for Europe Index-Based Portfolio

Now Looking at the results of asset allocation strategies conducted in Europe, we can see, portfolio with higher allocations to MSCI Europe ESG Leader Index generally have better performance. These portfolios tend to have higher total returns, lower volatility, and higher information ratios. For example, the portfolios "0.4MSCI EU ESG Leaders + 0.6EU AGG - Sustainability" and "0.4MSCI EU ESG Leaders + 0.6EU AGG" exhibit better performance characteristics compared to the others.

It is also worth noting that high water mark is generally higher for portfolios with higher allocations to MSCI Europe ESG Leader Index. This suggests that these portfolios have experienced higher peak values during the investment period, indicating the strong performance of the MSCI Europe ESG Leader Index in the Europe stock market.

In a marked divergence from trends observed in the United States, it has been noted that in Europe, indices adopting a "Best-in-Class" selection approach—predicated on the MSCI ESG Rating—manifest notably superior performance. This finding is in sharp contrast to the United States where indices that utilize a Market-cap weight-tilt, based on the MSCI ESG rating and momentum, tend to dominate in terms of performance.

This discrepancy in index performance extends also to the bond market. Specifically, bond indices in Europe that incorporate a ‘Sustainability’ approach, hinging on a Best-in-Class selection criterion grounded in the MSCI ESG Rating, demonstrate a propensity to outperform their counterparts that adopt a Market-cap weight-tilt, predicated on the MSCI ESG rating and momentum. This observation underscores a fascinating dichotomy in ESG investment approach efficacy across the two geographies, warranting a deeper examination of the driving factors behind these divergent performance trends. A variety of potential factors, including differences in regulatory environments, market dynamics, investor preferences, and sector composition, may contribute to this disparity.

Europe has been at the forefront of implementing strict environmental, social, and governance (ESG) regulations. Regulations like the EU's Sustainable Finance Disclosure Regulation (SFDR) have pushed for greater transparency and accountability in ESG investing, potentially making best-in-class ESG strategies more effective. This has encouraged European companies to prioritize ESG issues and enhance their ESG performance. Consequently, the ESG Leaders index, which selects the top 50% of ESG-rated companies per GICS sector and sub-region, could be capturing companies with better ESG performance and thus, better financial performance in Europe. Additionally, the European market tends to be more mature and stable compared to the US market, which is characterized by higher growth and innovation. The ESG Leaders methodology may be better suited to European market dynamics where ESG factors are more established and deeply entrenched, whereas the ESG Focus methodology, which optimizes

index-level ESG scores under tracking error and sector constraints, could be capturing companies that are rapidly improving their ESG performance in the US. Furthermore, European investors generally exhibit a stronger predilection for ESG investments than their US counterparts. This might translate into heightened demand for ESG-compliant firms in Europe, driving up the prices of bonds in companies that score highly on ESG factors and thus fostering improved performance for the ESG Leaders index in the region. Meanwhile, the ESG Focus index could appeal more to US investors, who increasingly seek ESG-oriented investments yet continue to prioritize financial performance and risk management. The sector composition within European and US markets could also play a role in the observed performance discrepancy. The ESG Leaders index methodology may be better suited to certain sectors that are more prevalent in Europe, while the ESG Focus methodology may work better with the sector composition in the US.

Lastly, ESG factors often play out over the long term. A best-in-class approach, which focuses on the companies with the highest ESG ratings, might be better positioned to benefit from these long-term trends. As shown in the evidence in a study published in 2016 by the Harvard Business School, titled “Corporate Sustainability: First Evidence on Materiality.”, The study found that firms with good performance on material sustainability issues significantly outperformed firms with poor performance on these issues, suggesting that investments in sustainability issues are shareholder-value enhancing. Furthermore, firms with strong performance on immaterial sustainability issues did not outperform. The best-in-class approach stands in contrast to a market-cap weight-tilt approach, which may be more susceptible to ephemeral market fluctuations, epitomized by phenomena like the surge of large-cap information technology firms in the United States.

In conclusion, our quantitative portfolio simulation reinforces the prevailing wisdom that incorporating Environmental, Social, and Governance (ESG) criteria into investment portfolio composition not only garners higher financial returns over the long haul, but also endows a greater resilience during periods of economic instability. However, our study adds a vital layer of nuance to this understanding, emphasizing the necessity for bespoke integration approaches in diverse geographical regions such as the United States and Europe.

Our findings highlight that, for both equity and bond assets within the American market, an ESG integration approach that aligns market capitalization with ESG scores and momentum can potentially yield returns that surpass the benchmark. On the other hand, a more discerning 'Best-in-class' approach, one that focuses on investment in firms with superior ESG ratings, can offer significantly enhanced returns within the European context.

This disparity in optimal investment strategies may be attributable to a multitude of intricate factors, inclusive of regional variations in regulatory mandates, divergent investor

inclinations and objectives, and unique market dynamics. As such, a 'one-size-fits-all' approach to ESG investment might be both oversimplified and sub-optimal, underscoring the importance of a nuanced, regionally tailored methodology when considering asset allocation strategies.

VII. AI Analytics and ESG Investment

The ongoing advancements in big data and artificial intelligence (AI) technologies are playing a pivotal role in steering the global investment landscape towards sustainability. These breakthrough technologies are revolutionizing investment strategies, enabling more efficient and effective decision-making.

Firstly, the significant improvement in data analysis driven by AI and big data technologies has reshaped the handling of voluminous and complex sustainability-related data. For instance, TruValue Labs, a leading asset management firm, leverages AI to process unstructured data from diverse sources in real-time. This sophisticated approach to data analysis provides instantaneous ESG metrics, empowering investors to promptly identify companies that adhere to ESG criteria, thereby streamlining investment decisions.

Secondly, AI algorithms have significantly enhanced risk assessment capabilities, utilizing data from a myriad of sources to predict potential risks and returns associated with various investments. One practical example involves analyzing data on climate change, land use, and weather patterns to anticipate the likelihood of wildfires. This predictive power can substantially impact the valuation of real estate or agriculture-related companies in fire-prone regions, thereby informing investment choices.

In addition, AI's application in automated reporting and compliance has made significant strides in ESG disclosure. AI automates the intricate process of reporting sustainability metrics and ensures compliance with relevant standards and regulations, thus alleviating the compliance burden on companies. Datamaran, a notable company in this space, uses AI to automate non-financial risk monitoring, including ESG and regulatory compliance issues, allowing corporations to stay abreast of potential ESG risks and align with global standards efficiently.

Moreover, AI's capacity to standardize the scoring and benchmarking process for companies based on their ESG performance has added another dimension to investment analysis. Platforms like MSCI ESG Research utilize AI to provide comprehensive ratings and indexes that gauge companies' ESG performance, simplifying the comparison of potential investment opportunities for investors.

Furthermore, AI models have shown great potential in predicting future sustainability trends, leveraging current data and historical patterns. Companies like Beyond Ratings harness machine learning to forecast future economic, social, and environmental trends that may impact financial markets. This foresight allows investors to adjust their portfolios proactively and navigate the ever-changing investment landscape.

AI's role in quantifying the impact of sustainable investments is also noteworthy. It achieves this by tracking and analyzing key performance indicators over time, providing investors with tangible proof of the positive impact of their investment decisions. Firms like Impact Cubed use AI to deliver detailed impact analysis of investment portfolios, encompassing aspects such as carbon footprint and gender equality. This innovative approach allows investors to visualize the real-world impacts of their sustainable investments.

Lastly, AI enhances transparency and trust in sustainable investments by providing accurate and timely tracking and analysis of key performance indicators. For instance, Impact Cubed utilizes AI to provide a comprehensive impact analysis of investment portfolios, fostering investor confidence by highlighting tangible impacts such as reduced carbon footprint and improved gender equality.

These real-world applications underscore the transformative potential of big data and AI in the domain of sustainable investment. The fusion of technology and sustainability is setting a new standard for investment strategies, marking the dawn of an era where finance and sustainability are inseparable. Looking ahead, just as Omar Selim articulated in his seminal work, "Sustainable Investing---A Path to a New Horizon", sustainable investing may indeed become the new norm. He vividly analogizes, "Sustainable investing stands to conventional finance as electric cars do to their fossil-fuel counterparts." This suggests a paradigm shift, where sustainable investing could ultimately overtake traditional methods, much like the surge of electric vehicles challenging the dominance of fossil fuel-based transportation.

VIII. Appendix

2013-2023 Performance for All Indexes in Europe

Name	Annualized Mean Return	Volatility	Maximum Decline	High Water Mark
MSCI USA	11%	18%	-34%	336%
MSCI USA ESG Leaders	10%	18%	-34%	314%

MSCI USA ESG Focus	11%	18%	-34%	343%
MSCI USA ESG Universal	7%	21%	-33%	224%
S&P 500	9%	18%	-34%	284%
S&P 500 ESG	10%	18%	-33%	293%
USA AGG	2%	4%	-18%	133%
USA AGG - ESG weighted	2%	4%	-19%	133%
USA AGG - Sustainability	1%	4%	-18%	131%
USA CORP Bond	3%	5%	-22%	150%
USA CORP Bond - ESG weighted	3%	5%	-21%	150%
USA CORP Bond - Sustainability	3%	5%	-22%	149%

2013-2023 Performance for All Indexes in United States

Name	Annualized Mean Return	Volatility	Maximum Decline	High Water Mark
MSCI Europe	7%	17%	-35%	204%
MSCI Europe ESG Leaders	8%	15%	-32%	213%
MSCI EURO ESG Focus	7%	17%	-35%	207%
MSCI EURO ESG Universal	3%	20%	-34%	139%
FTSE Developed Europe	3%	16%	-37%	120%
FTSE4good Europe	4%	16%	-35%	159%
EU AGG	1%	4%	-20%	131%
EU AGG ESG weighted	1%	4%	-20%	130%
EU AGG Sustainability	1%	4%	-20%	131%

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