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The Comparison of the performances of different portfolios, composed following traditional and ESG-related allocation rules.

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DEDICATION

This thesis work is dedicated to the Almighty God who is my strength and protector as well as my family and loved ones for their prayers, sacrifices and encouragement throughout my study journey.

God bless you all!

ACKNOWLEDGEMENT

Big Thank you to the Most High God for his grace, mercies and providing me with all the needed strength and abilities necessary to successfully accomplish this research.

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ABSTRACT

The growth of Environmental, Social, and Governance (ESG) investing has challenged traditional approaches to portfolio construction rapidly, which historically focused exclusively on the trade-offs between risk and return. Investors today are increasingly expected to consider not only financial performance, but also the broader environmental and social consequences of their investment decision. This thesis investigates whether portfolios constructed using ESG-related allocation rules differ in performance from traditional portfolios built without sustainability considerations. Based on classical investment theory, particularly Modern Portfolio Theory (MPT) and the Capital Asset Pricing Model (CAPM), which were developed before sustainability risks became a major concern. This research explores the important and practical question: Can ESG considerations be meaningfully incorporated into portfolio strategies without weakening the foundations of traditional risk-return analysis?

This thesis explores this question by comparing the performance of portfolios built using ESG-related allocation rules with that of traditional portfolios that do not explicitly account for sustainability factors. The study goes beyond much of the existing literature by focusing on the 2020–2024 period, a time marked by exceptional market events, including the COVID-19 crisis, the subsequent recovery, the inflation-driven downturn, and the more recent normalization of financial markets. Examining ESG portfolios in such a volatile and rapidly changing environment allows for a more realistic assessment of how these strategies behave under stress as well as in recovery phases.

The research adopts a quantitative comparative approach that combines theoretical discussion with empirical analysis. Two widely used exchange-traded funds are selected as practical and investable proxies: the SPDR S&P 500 ETF Trust (SPY), representing a traditional market portfolio, and the iShares ESG Aware MSCI USA ETF (ESGU), representing an ESG-integrated portfolio. Using monthly data, the analysis evaluates portfolio performance through standard financial measures such as returns, volatility, Sharpe ratios, and maximum drawdowns. These indicators are complemented by sustainability metrics, including ESG ratings and carbon intensity, in order to assess both financial outcomes and ESG characteristics.

The results suggest that integrating ESG criteria does not come at the cost of weaker financial performance. Over the period examined, the ESG portfolio achieved stronger compound growth, slightly higher risk-adjusted returns, and showed greater resilience during market downturns, although it also experienced higher overall volatility. At the same time, it displayed a clearly stronger sustainability profile, reflected in higher ESG ratings, lower carbon exposure, and the exclusion of controversial industries.

Lastly, this thesis finds that ESG-integrated portfolio strategies can deliver competitive financial results while also improving sustainability outcomes. The study concludes that responsible investing is not necessarily in opposition to traditional portfolio theory, but can be viewed as a natural extension of established quantitative frameworks, allowing investors to account for additional dimensions of risk and long-term in today’s financial markets.

La rapida crescita degli investimenti Environmental, Social and Governance (ESG) ha messo in discussione gli approcci tradizionali alla costruzione del portafoglio, storicamente focalizzati esclusivamente sul compromesso tra rischio e rendimento. Oggi agli investitori viene sempre più richiesto di considerare non solo la performance finanziaria, ma anche le più ampie conseguenze ambientali e sociali delle proprie decisioni di investimento. Questa tesi analizza se i portafogli costruiti secondo criteri di allocazione ESG differiscono in termini di performance rispetto ai portafogli tradizionali privi di considerazioni legate alla sostenibilità. Sulla base della teoria classica degli investimenti, in particolare della Modern Portfolio Theory (MPT) e del Capital Asset Pricing Model (CAPM), sviluppati prima che i rischi legati alla sostenibilità diventassero una preoccupazione centrale, la ricerca affronta una questione importante e concreta: è possibile integrare in modo significativo le considerazioni ESG nelle strategie di portafoglio senza indebolire le fondamenta dell'analisi tradizionale rischio-rendimento?

La tesi affronta questo interrogativo confrontando la performance di portafogli costruiti secondo criteri ESG con quella di portafogli tradizionali che non tengono esplicitamente conto dei fattori di sostenibilità. Lo studio si distingue da gran parte della letteratura esistente concentrandosi sul periodo 2020–2024, caratterizzato da eventi di mercato eccezionali, tra cui la crisi da COVID-19, la successiva fase di ripresa, la correzione legata all'inflazione e la più recente normalizzazione dei mercati finanziari. L'analisi dei portafogli ESG in un contesto così volatile e in rapida evoluzione consente una valutazione più realistica del comportamento di queste strategie sia nelle fasi di stress sia nei periodi di recupero.

La ricerca adotta un approccio quantitativo comparativo che combina discussione teorica e analisi empirica. Vengono selezionati due exchange-traded funds ampiamente utilizzati come proxy pratiche e investibili: lo SPDR S&P 500 ETF Trust (SPY), rappresentativo di un portafoglio di mercato tradizionale, e l'iShares ESG Aware MSCI USA ETF (ESGU), rappresentativo di un portafoglio integrato ESG. Utilizzando dati mensili, l'analisi valuta la performance dei portafogli attraverso indicatori finanziari standard quali rendimenti, volatilità, indice di Sharpe e massimo drawdown. Tali indicatori sono affiancati da metriche di sostenibilità, tra cui rating ESG e intensità di carbonio, al fine di valutare congiuntamente risultati finanziari e caratteristiche ESG.

I risultati suggeriscono che l'integrazione dei criteri ESG non comporta un peggioramento delle performance finanziarie. Nel periodo analizzato, il portafoglio ESG ha registrato una crescita composta più elevata, rendimenti corretti per il rischio leggermente superiori e una maggiore resilienza durante le fasi di ribasso dei mercati, sebbene accompagnati da una volatilità complessivamente più elevata. Allo stesso tempo, ha mostrato un profilo di sostenibilità nettamente migliore, riflesso in rating ESG più elevati, una minore esposizione al carbonio e l'esclusione di settori controversi.

In conclusione, questa tesi evidenzia come le strategie di portafoglio integrate ESG possano conseguire risultati finanziari competitivi migliorando al contempo gli outcome di sostenibilità. Lo studio conclude che l'investimento responsabile non è necessariamente in opposizione alla teoria tradizionale del portafoglio, ma può essere interpretato come una naturale estensione dei quadri quantitativi consolidati, consentendo agli investitori di considerare ulteriori dimensioni di rischio e valore di lungo periodo nei mercati finanziari contemporanei.

CHAPTER ONE

1.0 Introduction

1.1 Study's Background

Over the last ten years, Environmental, Social, and Governance (ESG) considerations have shifted from a relatively niche concern to a key pillar of modern investing. What began as a values-driven initiative is now firmly embedded in the mainstream, with institutional investors, asset managers, and regulators increasingly treating ESG factors as essential. As Thierry Roncalli points out, ESG investing has evolved beyond simply avoiding "bad" companies. It now functions as part of a broader ecosystem aimed at tackling major global issues like climate change, social inequality, and corporate responsibility.

Yet, despite this progress, traditional investment theory continues to form the backbone of portfolio management. Classic frameworks such as Harry Markowitz's Modern Portfolio Theory (MPT) and the Capital Asset Pricing Model (CAPM) still provide the tools many investors rely on to weigh risk and return. These models, however, were developed long before sustainability became a mainstream concern. As such, these factors are increasingly associated with financially material risks, such as regulatory exposure, climate transition costs, reputational shocks, and long-term operational resilience, which are not easily captured by traditional volatility-based measures. They don't account for non-financial elements like a company's carbon footprint, labour practices, or board diversity. This disconnect presents a real challenge: how can ESG data be incorporated into portfolio strategies without abandoning the well-established principles of risk-return optimization?

This is not just a theoretical dilemma. In practice, investors often wonder whether ESG integration might compromise returns or conversely, whether it could enhance long-term performance by identifying more resilient companies or avoiding future liabilities. Some believe there's a trade-off between sustainability and profitability, while others argue the two can be aligned. Adding to the complexity, ESG data is often inconsistent, non-standardized, and difficult to incorporate into quantitative models designed for financial metrics.

Figure 1.1 ESG Framework

The ESG framework consists of three key pillars; Environmental, Social, and Governance. That investors use to evaluate a company's sustainability and ethical impact. Environmental factors address a company's effect on the natural world, such as carbon emissions and resource management. Social criteria focus on relationships with employees, customers, and communities. Governance covers how a company is managed, including leadership structures and ethical practices. Understanding ESG is fundamental for integrating sustainability into investment decisions.

Environmental: How a company conserves the natural world through Climate change, Energy & Fuels, Co2 Emissions, Biodiversity, Deforestation and water use.

Social: How a company manages relationships with its stakeholders and the community through diversity, Equality. Employee relations, local communities, health & safety and training & education.

Governance: How a company is governed through Board structure, ethics, tax strategy, bribery, lobbying and risk management.

Figure 1.2 The United Nations Sustainable Development Goals (SDGs)

The Sustainable Development Goals (SDGs), established by the United Nations, represent a global blueprint to achieve a better and more sustainable future by 2030. These 17 goals address broad challenges like poverty, inequality, climate change, and peace. While the SDGs provide overarching targets, ESG investing translates these global ambitions into actionable criteria at the corporate and portfolio level, bridging global goals with financial markets.

These questions form the basis of this thesis. Specifically, it seeks to explore:

- Do ESG-integrated portfolios underperform, match, or outperform their traditional counterparts?
- Is there a meaningful trade-off between financial return and sustainability?
- And when it comes to portfolio construction, are simple exclusionary screens enough or are more sophisticated optimization techniques necessary?

To address these questions, this study is divided into three main sections. First, it reviews the foundational theories of portfolio management and examines how ESG principles interact with them. The second section outlines a range of portfolio allocation methods that integrate ESG scores, drawing on both filtering and optimization approaches, particularly those proposed by Roncalli and others. Finally, the third section presents an empirical comparison of traditional and ESG-based portfolios over a selected time frame, evaluating differences in return, risk, and sustainability metrics.

Ultimately, this thesis aims to bridge the gap between established financial theory and the evolving demands of sustainable investing. In a world where environmental and social issues are becoming more tightly linked to financial performance, understanding how to build portfolios that align with ESG goals without undermining core investment principles, has never been more important.

1.2 Problem Statement

As ESG (Environmental, Social, and Governance) issues have become more urgent in recent years, many investors are now looking to build portfolios that reflect not just financial goals, but also sustainability values. At the same time, traditional investment models like Modern Portfolio Theory (MPT) and the Capital Asset Pricing Model (CAPM) still form the foundation of most portfolio strategies. These models were created long before sustainability entered the conversation, and they focus solely on balancing expected returns against financial risk, typically measured by the volatility of returns. They don't account for important non-financial factors like a company's environmental impact, social responsibility, or governance practices.

From a quantitative perspective, classical portfolio models define risk almost exclusively in terms of return variability and historical co-movements between assets. This framework implicitly assumes that all financially relevant risks are reflected in past price dynamics. ESG-related risks, however, are often forward-looking structural and regime-dependent. Climate transition risk, governance failures and social controversies tend to materialize discontinuously and may affect downside risk, drawdowns and long-term resilience more than short-term volatility. This creates a modelling gap: while ESG factors are increasingly viewed as financially material, traditional portfolio tools offer no explicit mechanism to incorporate them into the optimization process.

This thesis explores that gap. It aims to better understand how ESG considerations can be meaningfully and systematically included in portfolio allocation without undermining the financial rigor that traditional investment theory relies on.

1.3 Objectives of the Study

In today's investment landscape, Environmental, Social, and Governance (ESG) factors are no longer seen as optional. Investors are increasingly paying attention to how companies manage issues like climate risk, labour practices, and ethical governance. However, many of the models that guide portfolio construction, such as Modern Portfolio Theory (MPT) and the Capital Asset Pricing Model (CAPM), were created before ESG became a mainstream concern. These traditional models focus mainly on financial risk and return, and often overlook non-financial elements that may impact long-term performance.

This study aims to bridge that gap by exploring how ESG considerations can be integrated into portfolio strategies in a way that still respects the fundamentals of traditional investment theory. In doing so, it hopes to offer practical insights for investors who want to align their portfolios with sustainability goals without sacrificing performance. To achieve this, the study focuses on several key objectives;

1. To empirically test how ESG integration affects portfolio outcomes in terms of returns, volatility, drawdowns and risk-adjusted efficiency and to assess whether ESG constraints systematically modify portfolio risk characteristics.
2. To explore methods for integrating ESG scores into portfolio construction.
3. To compare the performance of ESG integrated portfolios with traditional ones.
4. To assess the challenges of using ESG data in financial models.
5. To offer practical recommendations for building ESG aligned investment portfolios.

1.4 Research Questions

To guide the investigation into the integration of Environmental, Social, and Governance (ESG) factors within traditional investment frameworks, this study seeks to address the following research questions:

1. To what extent do classical portfolio frameworks capture the risk characteristics associated with ESG integration?
2. What approaches can be employed to integrate ESG scores into portfolio construction, and how do these methods vary in complexity and effectiveness?
3. How does the financial performance of ESG integrated portfolios compare to that of traditional portfolios in terms of returns and risk levels?
4. What are the key challenges associated with incorporating ESG data into quantitative portfolio models, particularly regarding data quality, consistency, and subjectivity?
5. Can the integration of ESG factors into portfolio allocation enhance long-term financial performance and contribute to more resilient investment outcomes?

1.5 Significance of the study

As sustainable investing becomes increasingly central to global financial markets, the need to align Environmental, Social, and Governance (ESG) considerations with traditional investment frameworks has become more pressing. This study is significant in that, it extends ESG portfolio analysis into the post-2020 market environment, providing updated empirical evidence across crisis, recovery and normalization regimes. By focusing on volatility, drawdowns and risk-adjusted performance, the research contributes to a more nuanced understanding of how ESG integration affects portfolio resilience and efficiency rather than only average returns.

The research offers valuable insights for investors, asset managers, and financial practitioners by providing practical approaches to embedding ESG factors into portfolio construction without compromising financial performance. It addresses key concerns, including performance trade-offs, data quality, and methodological limitations, helping to clarify how sustainability and profitability can coexist within investment decision-making.

In addition, this study contributes to the broader discourse on sustainable finance by exploring how ESG driven investment strategies can support long-term value creation while also contributing to global efforts to address issues like climate change, social inequality, and responsible governance. The findings aim to support both academic understanding and practical implementation in an evolving investment landscape.

1.6 Summary of Methodology

This study adopts a three-part methodology to explore the integration of ESG factors into portfolio construction.

First, a theoretical analysis introduction and discussion of the classical portfolio theory and the sustainability challenges.

Second, a proposal allocations based on the ESG scores.

Finally, an empirical analysis with a discussion of the results over a defined time period. Metrics such as return, risk (volatility), and ESG score profiles are used to assess performance. The results are analysed to determine whether ESG integration leads to improved, comparable, or compromised investment outcomes.

1.7 Scope of study

This study focuses on integrating Environmental, Social, and Governance (ESG) factors into traditional portfolio construction models. It is structured around three key components: a theoretical introduction and discussion of the classical portfolio theory and sustainability challenges, a proposal allocation based on the ESG scores, and an empirical analysis with discussion of the results within a defined time period.

The theoretical component reviews foundational investment models such as Modern Portfolio Theory (MPT) and the Capital Asset Pricing Model (CAPM), highlighting their limitations in addressing sustainability-related risks and opportunities.

The proposed allocation strategies use ESG scores to build investment portfolios, applying both screening and optimization techniques. These methods are designed to reflect both financial and sustainability objectives.

The empirical analysis is limited to a specific time period and relies on available ESG data, primarily from listed equities. The study does not cover private equity, real estate, or other asset classes. Additionally, ESG data is sourced from established providers, which may vary in scoring methodology and coverage.

This scope allows the study to provide focused insights into how ESG considerations can be systematically incorporated into portfolio construction, while recognizing certain data and methodological boundaries.

1.8 Assumptions

This study operates under several key assumptions. It assumes that the ESG data sourced from recognized providers is sufficiently reliable and relevant for portfolio construction and performance evaluation. It also assumes that the selected ESG metrics accurately reflect the sustainability and governance practices of the companies included in the portfolios.

The study presumes that the financial market data and classical portfolio theories employed remain valid and applicable within the timeframe analysed. Furthermore, it assumes that investors seek to balance financial returns with sustainability objectives, thereby valuing ESG integration as part of the investment decision process.

Finally, it is assumed that the models and methods used to integrate ESG factors are appropriate for capturing the complex interactions between financial performance and sustainability criteria.

1.9 Limitations

While this study aims to provide a comprehensive analysis of ESG integration within traditional portfolio frameworks, several limitations must be acknowledged. First, the research is constrained by the availability and quality of ESG data, which can vary significantly across providers and industries. This variability may affect the consistency and accuracy of ESG scores used in portfolio construction.

Second, the study focuses primarily on publicly traded equities and does not extend to other asset classes such as fixed income, real estate, or private equity. As a result, the findings may not be directly applicable to all investment contexts.

Third, the empirical analysis covers a specific time frame, which may limit the ability to generalize results across different market cycles or economic conditions. Additionally, the study assumes that past performance can be indicative of future outcomes, which may not always hold true.

Finally, the methodological choices regarding ESG integration techniques, such as screening and optimization methods, reflect current best practices but may not capture all possible approaches, limiting the scope of analysis.

1.9.1 Challenges of the study

This study faces several challenges inherent in integrating ESG factors into traditional portfolio construction. One significant challenge is the quality and consistency of ESG data. ESG information is often qualitative, sourced from various providers with differing methodologies, leading to inconsistencies and difficulties in comparing scores across companies or industries.

Another challenge lies in the methodological complexity of incorporating ESG criteria into quantitative models originally designed for financial metrics alone. Balancing ESG objectives with risk-return optimization requires sophisticated techniques that may increase model complexity and computational demands.

The study is also limited by the availability and coverage of ESG data, particularly for certain markets or smaller companies, which may impact the generalizability of the results.

Finally, there is the conceptual challenge of defining materiality, deciding which ESG factors are most relevant to financial performance and how to weight them appropriately within portfolio decisions. This subjectivity can influence the effectiveness of ESG integration and investor outcomes.

Despite these challenges, this research seeks to provide meaningful insights into overcoming such obstacles and advancing sustainable investment practices.

1.9.2 Organization of the study

Three sections make up this study. An introduction is provided in the first chapter. It includes the study's background, Problem statement, Objectives of the study, Research questions, Significance of the study, limitations and assumptions. Chapter 2 discusses the review of the Literature. An effort is being made to review and do research on relevant literature related to the topic. The third chapter focuses on the analysis with the discussion of the results. This addresses sources of information, research instruments and techniques, and work structure.

CHAPTER TWO

2.0 Literature review

2.0.1 Introduction

This chapter introduces the theoretical background necessary for understanding the integration of Environmental, Social, and Governance (ESG) factors into portfolio design. It begins with an overview of classical portfolio theory, as discussed in Investments by Bodie, Kane, and Marcus, and then explores the emerging role of ESG considerations in modern investment strategy. The chapter concludes by proposing ESG-based portfolio allocation techniques, including filtering and optimization methods. Finally, it discusses the quality of ESG data and its connection to broader sustainability frameworks like the UN Sustainable Development Goals (SDGs). All figures in this chapter are author's own conceptual illustrations created for explanatory purposes. They are based on theoretical models and frameworks discussed in the literature (e.g., Markowitz, 1952; Sharpe, 1964; Bodie et al., 2021). No empirical data were used to produce these diagrams.

However, the literature broadly agrees that ESG factors are increasingly financially relevant, there is no consensus on their implications for portfolio construction. In particular, scholars diverge on whether ESG integration weakens or enhances portfolio efficiency. One strand of literature argues that ESG criteria primarily act as constraints that reduce the investment universe, limit diversification opportunities and may lead to an inward shift of efficient frontier. In contrast, a growing body of research suggests that ESG integration can improve risk-adjusted performance by capturing financially material sustainability risks and enhancing long-term portfolio resilience. This lack of agreement concerning the effects of ESG on efficiency, diversification and risk dynamics motivates the comparative analysis undertaken in this thesis and frames the empirical investigation that follows.

2.1 Classical Portfolio Theory

2.1.1 Modern Portfolio Theory (MPT)

Harry Markowitz's Modern Portfolio Theory (1952), foundational in finance, emphasizes the trade-off between risk and return. Markowitz (1952) proposed that investors should construct portfolios not by focusing on individual assets in isolation, but by considering how assets interact with one another in terms of risk and return. His model shows that the goal of portfolio selection is to achieve the best possible trade-off between expected return and risk, measured by the variance of portfolio returns.

Formally, this means choosing a combination of assets that either maximises expected return for a given level of risk, or minimises risk for a desired level of return. The optimal combinations of assets that satisfy this condition form what is known as the **efficient frontier, the** set of portfolios offering the highest attainable return for each level of risk.

Markowitz's framework demonstrates that diversification holding assets that are not perfectly correlated can significantly reduce overall portfolio risk. This insight laid the foundation for Modern Portfolio Theory and remains central to contemporary investment management.

According to Bodie, Kane, and Marcus (2021), investors should seek to construct portfolios that maximize expected return for a given level of risk, or equivalently, minimize risk for a desired level of expected return.

Also, from a traditional portfolio theory perspective, as formalized by Markowitz (1952) and later systematized by Bodie, Kane, and Marcus (2021), any restriction on the investment universe mechanically reduces diversification opportunities and may lead to an inward shift of the efficient frontier. This view implies that ESG constraints potentially come at the cost of financial efficiency.

However, this interpretation is not universally accepted. Pedersen, Fitzgibbons, and Pomorski (2021) challenge the notion that ESG integration necessarily weakens portfolio efficiency, proposing instead an "ESG-efficient frontier" in which sustainability considerations improve risk-adjusted performance by incorporating financially material long-term risks. Similarly, Khan, Serafeim, and Yoon (2016) provide empirical evidence that firms with strong performance on material ESG issues significantly outperform their peers.

This divergence highlights a central disagreement in the literature: whether ESG criteria primarily restrict the opportunity set, or whether they enhance portfolio efficiency by improving risk pricing and resilience.

The central concept is diversification: by combining assets with imperfect correlations, investors can reduce overall portfolio risk. The efficient frontier represents the set of optimal portfolios, and investors' preferences (reflected in indifference curves) determine their final choice.

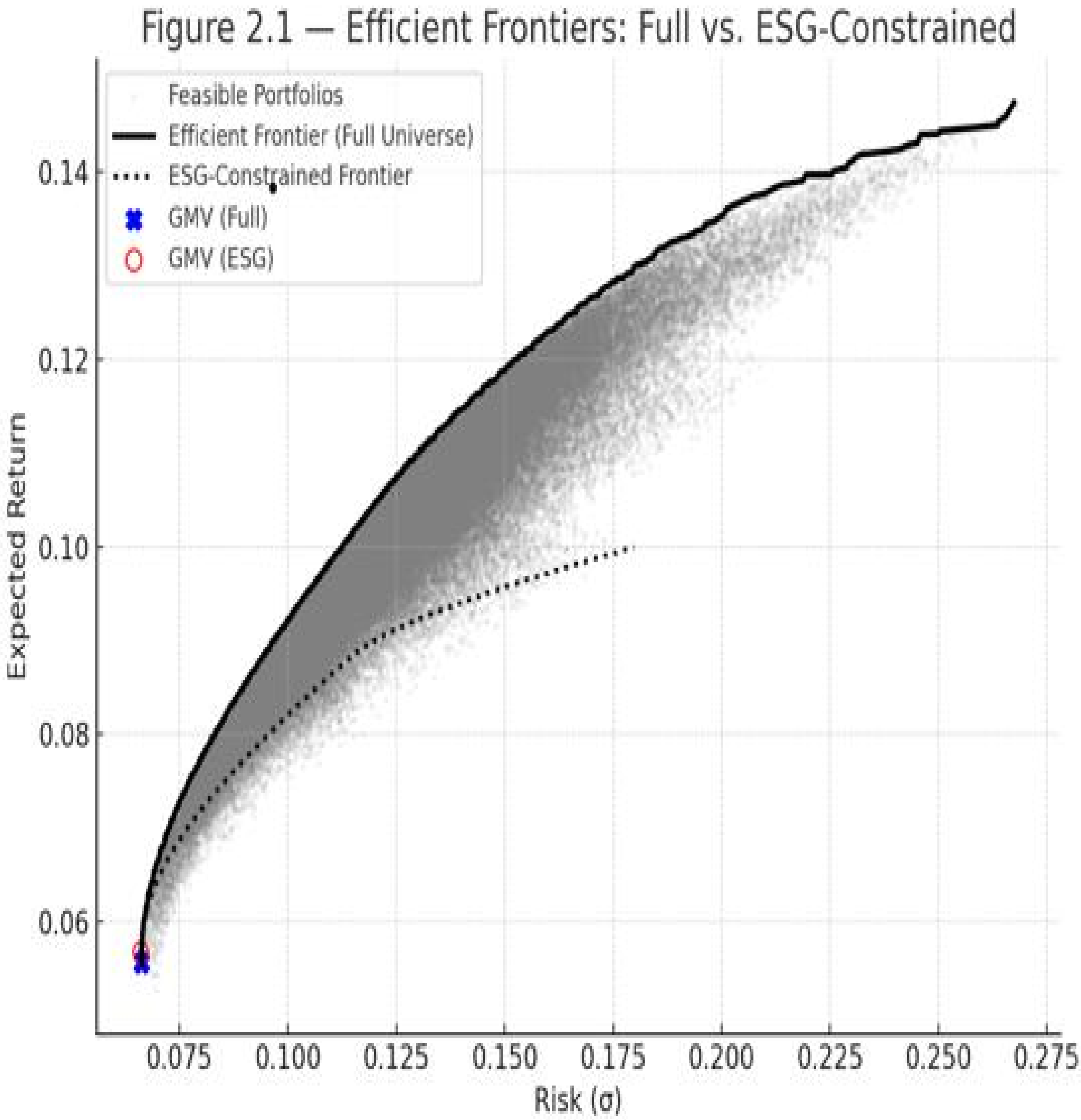


Figure 2.1 — Efficient Frontiers: Full vs. ESG-Constrained
Feasible Portfolios
Efficient Frontier (Full Universe)
ESG-Constrained Frontier
GMV (Full)
GMV (ESG)
Expected Return
0.14
0.12
0.10
0.08
0.06
0.075
0.100
0.125
0.150
0.175
0.200
0.225
0.250
0.275
Risk (σ)

Mean–Variance Opportunity Set and Efficient Frontiers (Markowitz Framework).

Each point represents a feasible portfolio of risky assets, defined by its expected return (vertical axis) and risk (horizontal axis, measured by standard deviation). The solid curve is the efficient frontier, the set of portfolios offering the highest expected return for a given level of risk. The "X" marks the global minimum-variance (GMV) portfolio, the least risky possible combination of risky assets. Diversification is combining assets with imperfect correlations which allows portfolios to achieve lower risk than any single asset alone. When ESG criteria exclude some assets, diversification opportunities may shrink, correlations may rise, and the efficient frontier often shifts inward (dashed curve), implying a potential trade-off between return and risk. This loss of efficiency can be understood in simple terms as the natural outcome of introducing extra restrictions into the portfolio selection process. In traditional portfolio theory, investors are free to combine all available assets to find the mix that gives the best trade-off between risk and return. Once ESG criteria are applied, however, the choice set becomes smaller because some companies or industries are excluded, or because portfolios must meet certain sustainability thresholds. With fewer combinations available, the range of possible outcomes narrows and the efficient frontier moves inside the original one. In practice, this means that for the same level of risk, an ESG-constrained portfolio may deliver slightly lower returns, or that achieving a given return may involve taking on more risk. This does not necessarily imply that ESG investing is inefficient; rather, it reflects the tighter boundaries within which these portfolios are constructed. Over the long term, these restrictions can also help manage non-financial risks and align investments with broader sustainability goals.

2.1.2 Efficient frontier implications for portfolio construction and risk management

The efficient frontier is a foundational concept in portfolio theory, illustrating the optimal balance between risk and return. It guides investors in constructing diversified portfolios that maximize expected returns for a given level of risk, or minimize risk for a desired return level. By encouraging asset combinations based on their overall contribution to portfolio variance, it promotes more efficient and informed investment decisions.

In terms of risk management, the efficient frontier helps quantify optimal risk exposure, identify performance benchmarks, and evaluate how the inclusion of a risk-free asset or ESG constraints may affect portfolio efficiency. When ESG considerations are incorporated, the frontier may shift, reflecting the integration of non-financial risks such as climate, governance, or reputational issues.

Overall, the efficient frontier provides a strategic foundation for constructing portfolios that are not only financially optimized but also aligned with broader sustainability objectives in modern investment practice.

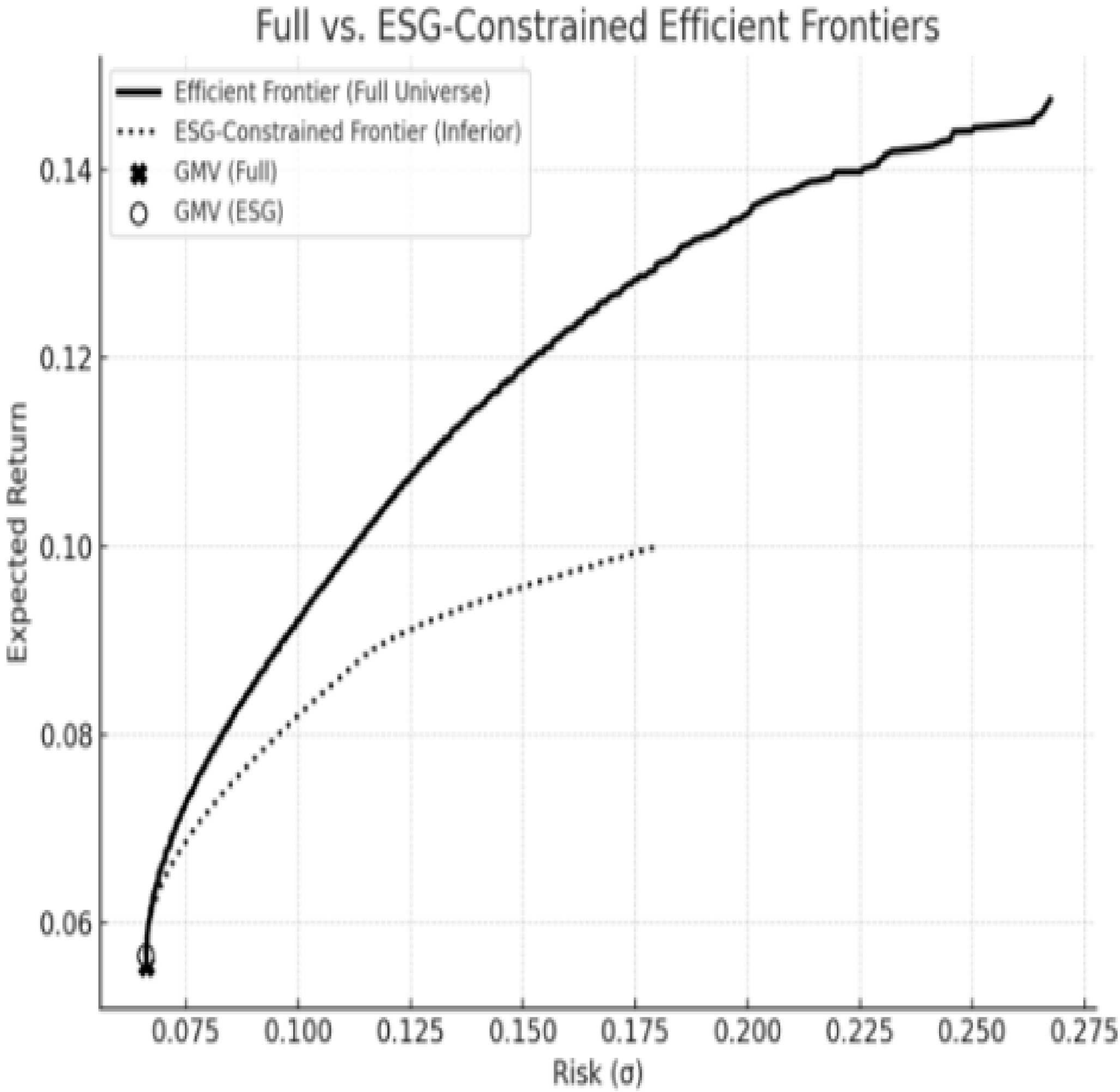

Full vs. ESG-Constrained Efficient Frontiers
Efficient Frontier (Full Universe)
ESG-Constrained Frontier (Inferior)
GMV (Full)
GMV (ESG)
Expected Return
Risk (σ)
0.06
0.08
0.10
0.12
0.14
0.075
0.100
0.125
0.150
0.175
0.200
0.225
0.250
0.275

Figure 2.2

Figure 2.2 illustrates how environmental, social, and governance (ESG) considerations affect investment decisions from a practical perspective. In traditional portfolio theory, investors aim to construct portfolios that offer the highest possible return for a given level of risk. This balance is known as the efficient frontier which assumes that all financial assets are available and chosen purely based on risk and return characteristics.

However, when ESG principles are introduced into the portfolio construction process, the range of eligible investments becomes smaller. Certain companies or industries may be excluded due to poor ESG performance for instance, those involved in fossil fuels, tobacco or controversial labor practices. As a result, some high-return assets are no longer part of the investment universe.

This exclusion leads to a shift in the efficient frontier. It moves slightly inward or downward, meaning that the ESG-constrained portfolios may offer lower expected returns or require more risk to achieve the same return, compared to unconstrained portfolios. This reflects a potential efficiency loss in the short term, as investors give up some purely financial opportunities in exchange for other goals.

Yet, this trade-off must be seen in a broader context. By investing according to ESG criteria, investors are not only aligning their capital with societal and environmental values, but also managing non-financial risks such as exposure to environmental fines, regulatory pressure, or reputational damage. In this way, ESG investing can serve as a form of long-term risk management, helping portfolios become more resilient in the face of global sustainability challenges.

Therefore, while ESG integration may slightly reduce financial efficiency in traditional models, it introduces a new layer of strategic value: it supports sustainable investment practices and may lead to better outcomes over the long run, especially as markets and regulations continue to evolve.

The relationship between the efficient frontier and indifference curves explains how investors choose the portfolio that best matches their personal attitude toward risk. The efficient frontier represents the set of portfolios that achieve the highest expected return for each level of risk. It defines the boundary between what is attainable and what is not, any portfolio lying below this frontier is inefficient because there are other combinations of assets that can deliver higher returns for the same risk.

Indifference curves, on the other hand, capture the human side of investment decision-making. They reflect how much risk an investor is willing to take in exchange for a higher expected return. Each curve shows combinations of risk and return that provide the investor with the same level of satisfaction, or utility. Because investors are generally risk-averse, these curves slope upward: to accept more risk, an investor must be compensated with a higher expected return.

The point where an investor's highest attainable indifference curve touches the efficient frontier represents the optimal portfolio. At this tangency point, the investor achieves the best possible balance between risk and return given their preferences. A cautious investor with a low tolerance for risk will have steeper indifference curves and will choose a portfolio closer to the minimum-variance point, while a more risk-tolerant investor with flatter curves will select a portfolio further along the frontier that offers higher return but also higher volatility.

Together, the efficient frontier and indifference curves show that portfolio selection is not only about numbers and equations. It is also about psychology, behaviour, and personal comfort with uncertainty. The frontier defines what is financially possible, but the indifference curves define what is personally desirable.

To further assess the impact of ESG-related constraints on portfolio construction, a sector-weight comparison between the ESG portfolio and the unconstrained benchmark is presented below (from Figures 2.1 and 2.2). While the ESG portfolio is subject to screening and sustainability criteria, its overall performance remains broadly aligned with that of the benchmark. The table below helps explain how differences in allocation contribute to this outcome.

Figure 2.2.2 Sector Allocation Comparison: ESG Portfolio vs. Unconstrained Benchmark

Sector	ESG Portfolio (%)	Benchmark (%)	Difference (%)
Technology	28	22	+6
Energy	4	12	-8
Financials	14	16	-2
Healthcare	15	13	+2
Industrials	10	11	-1
Consumer staples	9	8	+1
Consumer Discretionary	11	10	+1
Utilities	5	5	0
Materials	4	3	+1

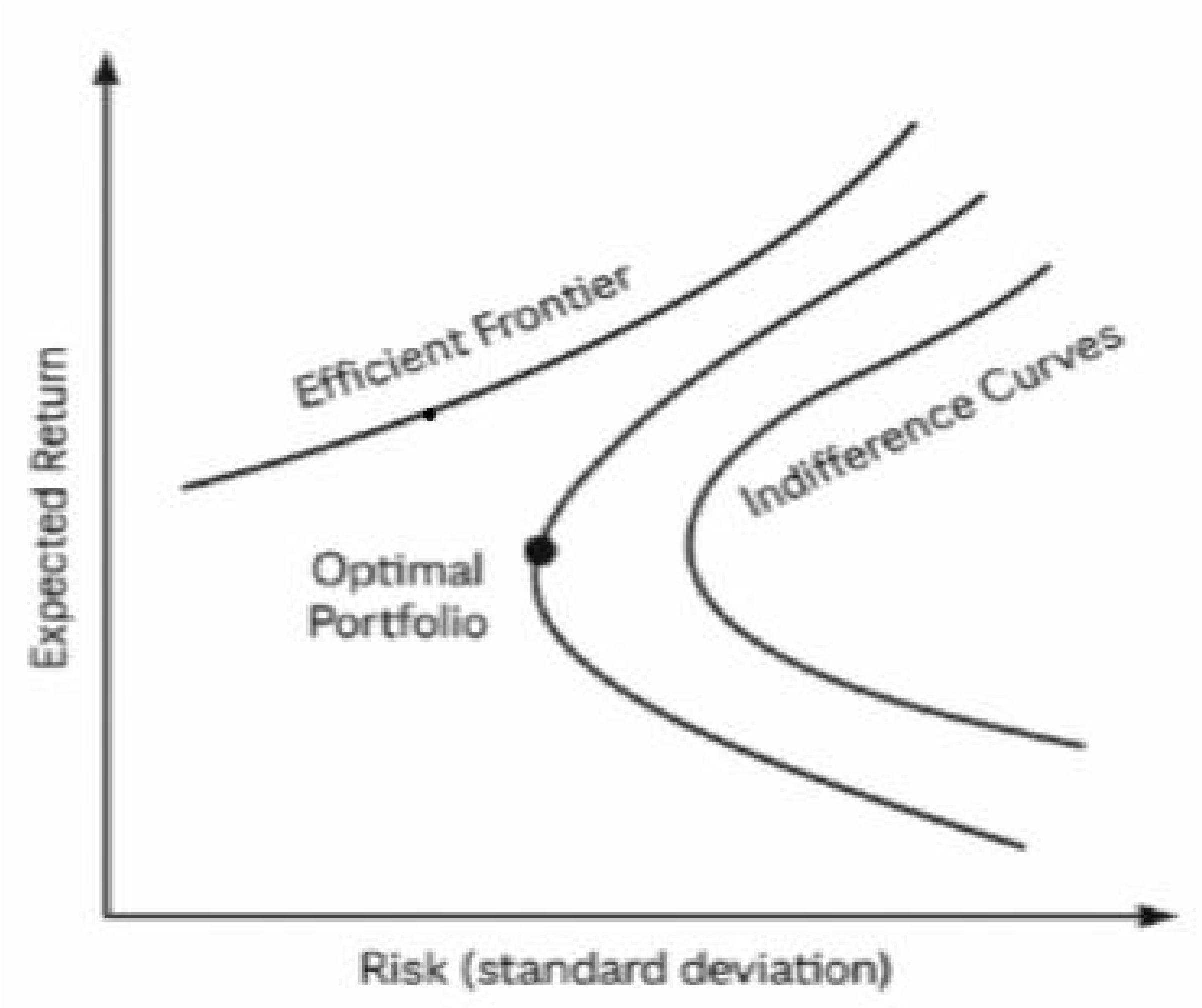
Figure 2.2.2 reports sector weights for the ESG-integrated portfolio and the unconstrained benchmark. Differences are calculated as ESG weight minus benchmark weight. Positive values indicate overweight positions, while negative values indicate underweight positions.

The ESG portfolio exhibits a structural underweight in the Energy sector and a relative overweight in Technology and Healthcare. This pattern is consistent with ESG screening mechanisms, which typically reduce exposure to carbon-intensive industries while favoring sectors associated with innovation, digital transformation, and comparatively stronger governance practices.

However, these allocation constraints limit the investable universe, they do not appear to significantly impair overall performance. The underweight in Energy reduces exposure to sectors characterized by environmental risk and commodity price volatility, while the overweight in Technology and Healthcare provides access to long-term growth drivers. These compensating effects help explain why the ESG portfolio's returns remain broadly in line with those of the unconstrained benchmark.

Therefore, the observed performance similarity does not imply identical portfolio composition. Rather, it reflects a rebalancing of sector exposures that offsets the potential efficiency costs associated with ESG constraints. The results suggest that ESG integration primarily reshapes the structure of portfolio allocation, without necessarily compromising the risk-return profile.

Figure 2.3


Efficient Frontier
Indifference Curves
Optimal
Portfolio
Expected Return
Risk (standard deviation)

2.1.3 Capital Asset Pricing Model (CAPM)

The Capital Asset Pricing Model (CAPM) builds on the foundations laid by Modern Portfolio Theory by seeking to explain why assets earn the returns they do. Rather than focusing only on how to combine assets efficiently, CAPM attempts to identify the source of returns in financial markets. It proposes a simple but powerful idea: investors are rewarded only for the risks they cannot avoid.

In a well-diversified portfolio, risks specific to individual companies can be reduced or eliminated, but risks that stem from broader economic forces such as recessions, inflation, or geopolitical shocks affect all assets to some degree. CAPM refers to these unavoidable influences as systematic risk, and the degree to which an asset responds to these movements is measured by its beta.

In this framework, investors are assumed to behave rationally and to have access to the same information, leading them to hold a similar view of the market. If everyone agrees on the risk and return outlook, and if markets operate without frictions such as taxes or trading costs, then all investors would naturally hold some combination of a risk-free asset and the overall market portfolio. Under such conditions, the expected return on any individual asset can be expressed as a function of the risk-free rate plus a premium that compensates for its beta, meaning the asset's sensitivity to the market as a whole. Assets more exposed to market movements are expected to offer higher returns as compensation for bearing greater systematic risk.

CAPM became highly influential not only because it offered a neat theoretical explanation for pricing assets, but also because it provided practical tools.

Investors and analysts gained a benchmark against which to judge whether a security offered fair compensation for its level of risk. Concepts such as the Security Market Line and the Sharpe ratio emerged from this framework and still underpin performance evaluation today.

Moreover, the model reinforced the logic of passive investing: if markets are efficient and fully reflect available information, then attempting to consistently outperform them becomes extremely difficult.

Despite its elegance, CAPM is not without limitations. The assumptions that all investors share the same information and expectations, can borrow freely at a risk-free rate, and face no market frictions are rarely true in practice. Markets are complex, investors have different beliefs and time horizons, and information is not always evenly distributed. More importantly, beta alone has often struggled to explain real-world asset returns, which has encouraged the development of multi-factor models that capture additional drivers of risk and performance.

These limitations become especially clear when viewed through the lens of sustainability. CAPM does not naturally account for environmental, social, or governance risks, many of which are long-term, non-linear, and not yet fully priced by markets. Climate transition risk, social controversies, and governance failures can materially affect asset values, but they may not manifest in historical data or be captured by beta. As investors increasingly recognise these dimensions of risk, the traditional CAPM framework appears too narrow, underscoring the need for expanded models that reflect both financial and sustainability-related realities.

2.1.4 Limitations of Modern Portfolio Theory and Capital Asset Pricing Model

Although **Modern Portfolio Theory (MPT)** and the **Capital Asset Pricing Model (CAPM)** have long served as the backbone of investment analysis and portfolio construction, both models exhibit important limitations ,particularly in the context of integrating **Environmental, Social, and Governance (ESG)** considerations. Although the traditional limitations of MPT and CAPM are well understood in finance, they become even more significant when considered in the context of sustainability. These models were developed in an era when environmental degradation, climate change, social inequality, and corporate accountability were not recognised as financially relevant risks.

As a result, they assume that all risks can be measured using historical return patterns and market volatility, which overlooks emerging ESG-related risks that are long-term, systemic, and often difficult to quantify. For example, climate transition risk, regulatory tightening, reputational damage, and supply-chain disruptions linked to environmental or social issues may not be reflected in historical data or market beta, yet they can materially affect a company's future performance.

Moreover, the assumption that all investors purely maximise financial return does not align with the growing number of investors who seek to incorporate ethical values, stakeholder considerations, and long-term sustainability objectives into portfolio decisions. Therefore, while MPT and CAPM provide a valuable foundation for understanding risk and return, they do not fully account for the multidimensional and forward-looking nature of sustainability, nor do they reflect the evolving motivations of modern investors who prioritise both financial outcomes and societal impact.

They are designed to focus on the financial aspects of investing. However, they can be extended to multifactor models where a sustainability factor can be incorporated. The real challenge lies in investor preferences, if investors do not value sustainability, the added factor would be irrelevant. Nevertheless, the idea of integrating ESG (Environmental, Social and Governance) metrics is interesting as it provides a reference for sustainability conscious investors.

A. Limitations of Modern Theory (MPT):

- **Exclusion of Non-Financial Risks:**

  MPT relies solely on quantitative financial metrics such as return, variance, and covariance. It does not account for risks related to environmental degradation, labor disputes, or governance failures, which can significantly affect asset performance.

- **Dependence on Historical Data:**

  The theory assumes that future risk and return can be inferred from past data, yet many ESG risks like climate change or social unrest are forward-looking and cannot be predicted using historical variance alone.

- **No Consideration for Values-Based Preferences:**

  MPT assumes investors are rational and focused purely on risk-return trade-offs. It ignores ethical or impact-based motivations, which are central to ESG investing.

- **Static and Linear Assumptions:**

  MPT does not adapt easily to dynamic or nonlinear risks, many of which are Characteristics of ESG issues, such as regulatory shifts or sudden reputational crises.

B. Limitations of the Capital Asset Pricing Model (CAPM):

1. **Over-Reliance on Market Beta:**

   CAPM defines risk in terms of beta as an asset's sensitivity to market movements. This narrow focus ignores ESG-specific risks that may not be correlated with market movements but still impact long-term performance.

2. **Single-Factor Simplicity:**

   CAPM assumes that the market portfolio is the only source of systematic risk. It excludes other dimensions such as environmental risk, governance quality, or social responsibility that can materially affect returns.

3. **Unrealistic Assumptions:**

   CAPM assumes that all investors have the same expectations, invest in the same market portfolio, and face no taxes or transaction costs. These assumptions break down in real-world contexts, particularly when investors seek to integrate ESG factors.

4. **Risk-Free Rate and Homogeneous Time Horizon:**

   The model presumes the existence of a truly risk-free asset and that all investors have the same investment horizon assumptions that rarely hold, especially when considering the long-term nature of many ESG impacts.

2.2 The Challenge of Integrating ESG in Traditional Frameworks

Classical models such as **Modern Portfolio Theory (MPT)** and the **Capital Asset Pricing Model (CAPM)** are limited in their ability to incorporate **Environmental, Social, and Governance (ESG)** factors because they rely exclusively on financial variables such as expected returns, variances, and covariances.

These models were developed in a period when sustainability was not a mainstream concern and, as such, lack the tools to evaluate emerging risks like **climate transition costs**, **social inequity**, and **governance failures**. While Sharpe's (1964) CAPM and Markowitz's (1952) framework are widely viewed as insufficient for capturing sustainability related risks, the literature does not agree on the severity of this limitation. Some other authors interpret ESG as exposing structural weaknesses in classical models, Particular their reliance on historical volatility and single-factor systematic risk.By contrast, Bodie, Kane, and Marcus (2021) and Pedersen et al. (2021) view ESG integration not as a rejection of traditional theory, but as an extension of it, whereby sustainability considerations are incorporated through modified inputs, constraints, or multi-objective optimization.

This reflects an ongoing debate as to whether ESG requires a reconceptualization of portfolio theory or a refinement of existing quantitative tools.

Unlike traditional financial metrics, ESG indicators are often **non-quantitative**, **forward-looking**, and vary significantly across different rating agencies, which adds further complexity. As noted by Bodie et al., while risk has historically been defined in terms of return variability, real-world investment risk increasingly includes **environmental liabilities**, **reputational harm**, and **regulatory exposure** dimensions that ESG frameworks aim to capture.

Therefore, to align portfolio strategies with contemporary investment realities, there is a growing need for **revised models** that integrate ESG insights without discarding the foundational risk-return principles of classical finance.

2.3 ESG Investing: Concepts and Evolution

Environmental, Social, and Governance (ESG) investing extends the traditional evaluation of companies beyond financial performance to include their sustainability practices, ethical conduct, and internal governance structures. ESG investing considers how a firm manages environmental responsibilities (e.g., carbon emissions, resource efficiency), social obligations (e.g., labor practices, community impact), and governance integrity (e.g., board transparency, shareholder rights). These factors offer a more holistic view of company performance and risk than financial metrics alone.

Initially, ESG investing emerged as a form of **values-based or ethically driven investment,** commonly associated with **socially responsible investing (SRI).** In this early form, investors typically applied negative screens to avoid exposure to controversial sectors such as tobacco, arms manufacturing, or fossil fuels. However, ESG investing has since evolved into a **mainstream investment strategy** rooted in risk management, long-term value creation, and performance enhancement.

The empirical literature also remains divided on the financial implications of ESG integration. Friede, Busch, and Bassen (2015), in a large-scale meta-analysis, report that the majority of studies identify a positive or non-negative relationship between ESG and financial performance, suggesting broad compatibility between sustainability and shareholder value.

In contrast, Khan, Serafeim, and Yoon (2016) caution against general conclusions, showing that only material ESG issues are associated with superior performance, while immaterial sustainability initiatives do not generate significant financial benefits.

This indicates that ESG integration is not inherently value-enhancing, but depends critically on factor selection, industry context, and economic conditions.

According to Bodie, Kane, and Marcus (2021), there is growing empirical support for the financial relevance of ESG factors. Firms with strong ESG performance often demonstrate:

- **Superior operational efficiency**, through sustainable supply chains or reduced regulatory penalties.
- **Lower cost of capital**, as they are perceived as less risky by lenders and investors.
- **More stable earnings**, due to improved stakeholder relationships and stronger reputational standing.

These attributes can lead to **enhanced risk-adjusted returns**, making ESG not merely an ethical consideration but also a practical investment approach grounded in financial performance.

2.4 Evolution from Ethical to Strategic Focus

The transition from ethical exclusion to strategic integration marks a fundamental shift in ESG investing. Today, investors no longer view ESG solely as a means of aligning portfolios with personal values; instead, they recognize ESG as a **source of financially material insight.** Institutional investors, asset managers, and regulators increasingly incorporate ESG metrics into asset selection and portfolio management, citing their potential to improve long-term investment outcomes.

This shift is further supported by changes in regulation, stakeholder expectations, and global sustainability agendas such as the United Nations Sustainable Development Goals (SDGs). ESG considerations are becoming essential in assessing a company's exposure to non-financial risks, including climate transition costs, human capital challenges, and governance deficiencies.

2.5 ESG as a Framework for Forward-Looking Analysis

Unlike traditional financial models that rely on historical data, ESG factors offer **forward-looking, multidimensional indicators** of resilience and sustainability. For example:

- **Environmental metrics** may reflect a company's preparedness for carbon regulation or resource scarcity.
- **Social indicators** capture labor rights, diversity and inclusion, and community engagement.
- **Governance factors** assess transparency, executive accountability, and board independence.

Incorporating ESG into investment decisions allows for a more comprehensive assessment of risk and opportunity, enabling investors to anticipate disruptions and align capital allocation with long-term value creation.

2.6 Portfolio Construction with ESG Integration

Integrating ESG scores into portfolio construction allows investors to align their capital allocation strategies with both financial performance objectives and sustainability values. While classical models such as Modern Portfolio Theory (MPT) focus on optimizing the return-risk trade-off using quantitative financial metrics, ESG integration introduces non-financial considerations that are increasingly recognized as material to long-term value.

There are two primary approaches to incorporating ESG considerations into portfolio allocation: **screening techniques** and **optimization-based integration**. Each method varies in complexity, impact on diversification, and level of ESG alignment.

2.6.1 ESG Screening Techniques

ESG screening is one of the most direct and widely used approaches for integrating sustainability considerations. Screening involves systematically including or excluding securities based on ESG-related criteria. It is especially common among institutional investors seeking to align portfolios with ethical values, regulatory norms, or stakeholder expectations.

Common Screening Methods:

- **Negative Screening**:
  Excludes companies or sectors that do not meet specific ESG criteria. Typical exclusions include firms involved in fossil fuels, tobacco, weapons manufacturing, gambling, or those with known human rights violations.

- **Positive Screening:**
  Involves selecting firms with the highest ESG ratings, with the aim of **tilting the portfolio** toward sustainability leaders. This method prioritizes companies actively managing ESG risks and demonstrating leadership in areas such as emissions reduction or governance transparency.

- **Norms-Based Screening**:
  Filters investments based on adherence to global standards such as the **United Nations Global Compact (UNGC), OECD Guidelines,** or **International Labour Organization (ILO) conventions.**

Although screening is simple to apply and easy to communicate to stakeholders, it comes with certain limitations. By excluding entire sectors or firms, this approach can **reduce portfolio diversification** and **potentially eliminate financially attractive opportunities**, especially in industries where ESG metrics are still evolving or inconsistently measured.

2.6.2 Optimization-Based ESG Integration

Optimization offers a more quantitative and flexible framework for integrating ESG scores directly into portfolio design. Rather than excluding firms, this method adjusts the optimization process to balance **financial performance** and **sustainability objectives** simultaneously.

Common Optimization Strategies:

- **Maximizing ESG Scores with Financial Constraints**:

  The objective function is modified to **maximize the average ESG score** of the portfolio, subject to predefined constraints on return, volatility, or sector exposure.

- **Sharpe Ratio Maximization with ESG Constraints**:

  Investors aim to **maximize risk-adjusted return (Sharpe Ratio)** while ensuring that the portfolio meets minimum ESG criteria. This method helps maintain efficiency while embedding responsible investment thresholds.

- **Multi-Objective Optimization**:

  This approach jointly considers multiple goals such as **return maximization, risk minimization, and ESG performance** by assigning weights to each objective. It provides a structured way to evaluate trade-offs among competing priorities.

- **ESG-Weighted Expected Returns**:

  ESG scores may be used to adjust expected returns, under the assumption that firms with better ESG profiles will outperform or exhibit lower volatility over time.

According to Bodie, Kane, and Marcus, optimization techniques are foundational to effective portfolio construction.

Incorporating ESG metrics into these techniques allows investors to preserve the analytical rigor of traditional finance while adapting to modern expectations for sustainable and responsible investing.

2.7 ESG Ratings and Data Considerations

As the demand for ESG-integrated portfolios grows, one of the most significant practical challenges investors face is the **lack of consistency, transparency, and standardization in ESG ratings**. Unlike traditional financial data such as earnings per share or price volatility which are audited, regulated, and widely comparable, ESG data is often **qualitative, unregulated, and methodologically diverse**. This creates considerable obstacles for investors seeking to rely on ESG scores in portfolio allocation and optimization models.

Also, there is a concern for the interpretation of ESG data quality. OECD (2020) which emphasizes that rating inconsistency and lack of standardization undermine the reliability of ESG metrics for financial decision making.

Comparatively, other authors argue that despite these scope of limitations, ESG indicators provide meaningful signals of long-term risk exposure and corporate quality and can be systematically incorporated into portfolio construction frameworks (Bodie et al., 2021; Pedersen et al,. 2021). Which raises an unresolved methodological question, as to whether ESG scores should be treated as precise measurements or as broad informational risk indicators.

2.7.1 A. Variability across ESG Rating Providers

Several prominent organizations provide ESG ratings, including **MSCI, Sustainalytics**, **Refinitiv, FTSE Russell,** and **Bloomberg**. However, each rating agency employs its own proprietary framework for assessing a firm's ESG performance. These frameworks differ in:

- The **relative weighting** assigned to environmental, social, and governance components.
- The use of **quantitative versus qualitative indicators**.
- The **data sources** utilized, such as self-reported disclosures, news coverage, or third-party audits.
- And the choice between **absolute ratings or sector-relative rankings**.

Due to these methodological differences, a single company can receive **significantly different ESG ratings** depending on the provider. For example, a firm with strong environmental innovation but poor labor relations may be rated positively by one agency emphasizing environmental leadership, and poorly by another focusing on social metrics.

This inconsistency raises concerns about **data reliability, comparability**, and **decision-making accuracy** for ESG-focused investors.

2.7.2 B Challenges in ESG Data Application

The fragmented nature of ESG ratings leads to several critical challenges:

- **Lack of Standardization**: Without a unified global standard, ESG metrics and definitions vary widely across industries, regions, and data providers.
- **Transparency Limitations**: Many rating agencies do not fully disclose their scoring methodologies, making it difficult for investors to interpret and validate the scores.
- **Data Gaps and Asymmetry**: In many cases, particularly in emerging markets or among smaller firms, ESG disclosures are incomplete, unreliable, or entirely absent.
- **Subjectivity and Bias**: ESG ratings often incorporate qualitative assessments, such as evaluating board independence or corporate culture, which introduces subjectivity into scoring outcomes.

These limitations create a risk of **misclassification**, where companies may appear more or less ESG-aligned than they truly are, depending on the rater's perspective.

2.7.3 C. Investor Strategies to Address Rating Inconsistencies

To navigate these data challenges, investors and portfolio managers employ a variety of techniques:

- **Score Normalization**: ESG scores are statistically standardized (e.g., using z-scores or percentiles) to improve comparability across providers and industries.
- **Multi-Source Aggregation**: Some investors combine ESG ratings from multiple providers to generate an average or consensus score, thereby minimizing the bias of any single source.
- **Custom ESG Scoring Models**: Institutional investors may develop proprietary ESG evaluation frameworks tailored to their specific investment philosophy or regional context.
- **Thematic Analysis**: Rather than relying on aggregate ESG scores, investors may focus on specific dimensions (e.g., carbon emissions, gender diversity, and supply chain risk) most relevant to their mandate.

These methods aim to bring greater **objectivity, reliability, and alignment** between ESG data and financial decision-making.

2.7.4 D. The Role of Regulation and Emerging Standards

Regulatory bodies and standard-setters have begun to address the ESG data gap through policy development and disclosure requirements. Notable initiatives include:

- The **EU Sustainable Finance Disclosure Regulation (SFDR)**, which mandates ESG reporting for financial market participants.

- The **Task Force on Climate-related Financial Disclosures (TCFD)**, which provides a structured approach to climate-related risk disclosure.

- The formation of the **International Sustainability Standards Board (ISSB)**, under the IFRS Foundation, aimed at consolidating global sustainability reporting frameworks.

These regulatory efforts are intended to promote **greater transparency, consistency, and comparability** in ESG data, thereby enhancing its usability in mainstream financial models and investment strategies.

2.8 Alignment with Sustainable Development Goals (SDGs)

The **Sustainable Development Goals (SDGs)**, introduced by the United Nations in 2015, provide a globally recognized framework aimed at addressing a broad range of environmental, social, and economic challenges by the year 2030. Comprising 17 goals and 169 specific targets, the SDGs encompass issues such as poverty reduction, climate action, gender equality, responsible consumption, and institutional integrity. Although originally designed for governments and policymakers, the SDGs have increasingly become relevant to the private sector including capital markets, where investment decisions play a critical role in financing sustainable development.

In this context, **Environmental, Social, and Governance (ESG) investing serves as a practical mechanism for aligning firm-level investment decisions with macro-level sustainability objectives. While ESG and SDG frameworks** differ in origin and structure, they are increasingly seen as conceptually and functionally aligned. ESG provides the metrics and indicators used to assess corporate practices, while the SDGs offer the overarching developmental objectives toward which these practices contribute.

2.8.1 A ESG as a Pathway to SDG Implementation

By integrating ESG metrics into portfolio construction, investors can support firms that contribute positively to the SDGs. Each component of ESG aligns with specific goals:

- **Environmental factors**: such as greenhouse gas emissions, energy efficiency, and water management relate directly to **SDG 6 (Clean Water and Sanitation)**, **SDG 7 (Affordable and Clean Energy)**, and **SDG 13 (Climate Action)**.
- **Social indicators**: including labour practices, community engagement, and workplace diversity connect with **SDG 3 (Good Health and Well-Being)**, **SDG 5 (Gender Equality)**, and **SDG 8 (Decent Work and Economic Growth)**.
- **Governance criteria**: such as board independence, anti-corruption policies, and shareholder rights are aligned with **SDG 16 (Peace, Justice, and Strong Institutions)**.

In this way, **ESG investing becomes a conduit through which capital markets can actively contribute to global development efforts**. Portfolios designed with ESG integration can target specific SDG-related themes, allowing investors to pursue both financial returns and measurable societal impact.

2.8.2 B ESG-Integrated Portfolios as Instruments for Sustainable Development

Increasingly, institutional investors, asset managers, and sovereign funds are structuring their investment mandates around **SDG-aligned ESG strategies**. Examples include thematic funds focused on renewable energy infrastructure, green bonds supporting climate mitigation, or equity portfolios that favor companies with strong diversity, equity, and inclusion (DEI) programs.

Such portfolios do not simply exclude unsustainable companies, they proactively **allocate capital toward firms that are advancing sustainable development goals,** thereby creating positive externalities while pursuing competitive risk-adjusted returns.

This convergence between ESG investing and SDG financing also reflects broader shifts in investor expectations. Stakeholders are no longer satisfied with performance measured strictly in financial terms; they increasingly demand transparency regarding how investments impact the environment, society, and institutions. ESG-aligned investing helps meet this demand and enhances long-term portfolio resilience by factoring in the sustainability-related risks and opportunities identified in the SDGs.

2.8.3. C. Challenges in ESG-SDG Alignment

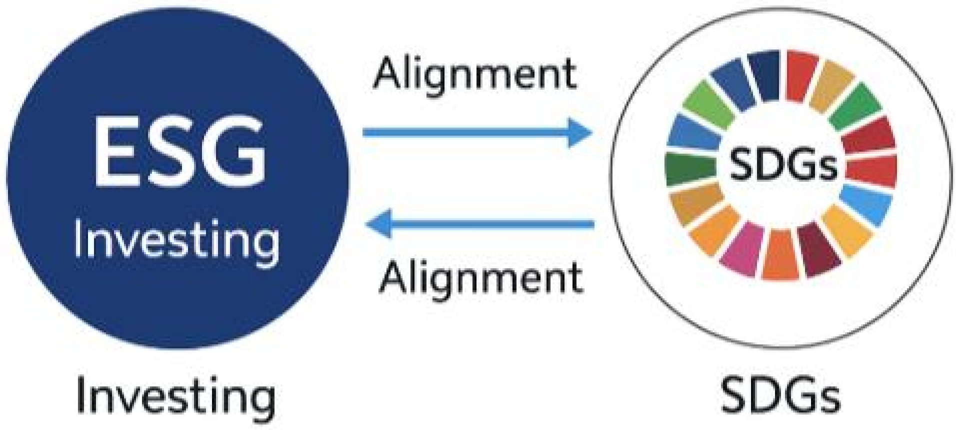
Despite their conceptual compatibility, aligning ESG frameworks with the SDGs presents several practical challenges:

- **Inconsistent reporting and disclosure**: Most companies do not explicitly report their SDG contributions, making it difficult for investors to assess alignment.
- **Lack of standard mapping tools**: ESG metrics were not originally designed to match SDG targets, so alignment often requires assumptions or external mapping frameworks.
- **Greenwashing risks**: Some companies may overstate their sustainability performance or SDG alignment, leading to reputational and financial risks for investors.
- **Sectoral limitations**: Certain SDGs, such as those related to education or clean water, are difficult to capture through traditional ESG metrics unless the company is directly operating in those sectors.

To address these challenges, many investors are turning to emerging tools such as:

- SDG alignment taxonomies (e.g., by UN PRI, World Benchmarking Alliance),
- Impact reporting frameworks (e.g., IRIS+, GIIN),
- Third-party ESG-SDG mapping platforms that offer verified assessments.

Figure 2.4 ESG-SDG Alignment



The accompanying diagram provides a visual representation of the conceptual relationship between **ESG investing** and the **United Nations Sustainable Development Goals (SDGs)**. On the left, ESG represents the core criteria used to evaluate a company's environmental responsibility, social impact, and governance practices. On the right, the SDG wheel symbolizes the broader global agenda for sustainable development.

The two are connected by directional arrows, emphasizing that ESG-integrated investment strategies can help mobilize capital in support of the SDGs. While the diagram does not specify individual SDGs, it reinforces the overarching message that responsible investing at the firm level can contribute to achieving long-term sustainability objectives on a global scale.

2.8.4 Proposed ESG-Integrated Allocation Model

This section presents a structured approach for incorporating **Environmental, Social, and Governance (ESG)** factors into portfolio allocation, building upon the foundational concepts of **Modern Portfolio Theory (MPT)** and the **Capital Asset Pricing Model (CAPM)**. The model is designed to address a key gap in classical financial theory, the absence of non-financial risks and offers a method to align investment strategies with modern sustainability objectives.

The proposed model retains the core principle of optimizing the risk-return relationship but introduces **ESG scores as an additional decision variable** in portfolio construction. It is based on a multi-step process, beginning with the selection of an investment universe that includes reliable ESG data. ESG scores are then standardized to allow fair comparison across firms and sectors. Investors may apply screening criteria such as excluding companies with poor ESG practices or prioritizing those with high sustainability performance before moving on to optimization.

Within the optimization stage, ESG scores can be used in several ways:

- As **constraints** to ensure the portfolio meets a minimum ESG standard,
- As **weights** in the objective function to favor high-performing ESG firms,
- Or within a **multi-objective framework** that balances return, risk, and ESG alignment simultaneously.

This structure allows for flexibility based on investor preferences, making it suitable for a wide range of applications from conservative institutional mandates to more impact-focused strategies.

One of the model's key strengths is its **balance between analytical rigor and ethical relevance.** While it remains grounded in established financial principles, it also responds to growing market demand for investments that reflect environmental stewardship, social responsibility, and corporate accountability.

Ultimately, the model aims to create portfolios that are not only financially efficient but also aligned with broader sustainability goals. It demonstrates how ESG factors can be meaningfully integrated into the asset allocation process enhancing decision-making, improving long-term resilience, and contributing to a more responsible financial system. This approach directly supports the central objective of the thesis: to propose an allocation strategy that reflects both the quantitative discipline of traditional finance and the evolving priorities of contemporary investing.

2.9 Conclusion

This chapter has examined the theoretical foundations of portfolio construction and the evolving role of ESG integration. Drawing on classical models such as **Modern Portfolio Theory (Markowitz, 1952)** and the **Capital Asset Pricing Model (Sharpe, 1964)** as established in the work of Bodie, Kane, and Marcus (2021) risk and return remain central to investment decision-making. However, these traditional models primarily focus on financial variables and do not account for non-financial risks that are increasingly material in today's markets.

There are disagreements which concern the impact of ESG integration on portfolio efficiency. From a traditional perspective rooted in classical portfolio theory, ESG criteria are often interpreted as constraints that restrict the investment universe, potentially reducing diversification opportunities and leading to an inward shift of the efficient frontier. In contrast, more recent contributions, particularly Pedersen, Fitzgibbons, and Pomorski (2021), argue that ESG integration can redefine portfolio efficiency by incorporating financially material sustainability risks, giving rise to an "ESG-efficient frontier." Empirical studies further reflect this divergence: while Friede, Busch, and Bassen (2015) report predominantly positive or neutral relationships between ESG and financial performance, Khan, Serafeim, and Yoon (2016) demonstrate that such benefits are largely confined to material ESG issues, suggesting that ESG integration is not universally value-enhancing but context-dependent.

The literature also disagrees on the theoretical implications of ESG for classical asset pricing models. Some authors interpret sustainability risks as exposing fundamental limitations in MPT and CAPM, particularly their reliance on historical volatility and simplified representations of systematic risk.

Others, including Bodie et al. (2021) and Pedersen et al. (2021), view ESG not as a rejection of classical theory, but as an extension of it, whereby ESG factors are incorporated through modified inputs, constraints, or multi-objective optimization frameworks. This reflects an unresolved debate over whether ESG requires a reconceptualization of portfolio theory or a refinement of existing quantitative tools.

The limitations of classical theory, as noted by Bodie et al., highlight the need to extend the definition of risk beyond return volatility to include environmental, social, and governance dimensions such as regulatory exposure, climate transition risk, and reputational damage. In response, ESG investing has emerged as a critical framework for addressing these gaps. Techniques such as screening and optimization allow ESG factors to be incorporated systematically, although challenges persist around data inconsistency and methodological divergence across rating providers.

A further point of contention concerns ESG data itself. OECD (2020) emphasizes the inconsistency, lack of standardization, and methodological opacity of ESG ratings, raising concerns about their reliability for financial modelling. At the same time, other contributions suggest that, despite these limitations, ESG metrics provide meaningful signals of long-term risk exposure and corporate quality that can be systematically embedded in portfolio construction processes (Bodie et al., 2021; Pedersen et al., 2021).

Taken together, the literature reveals a field characterized not by convergence, but by **ongoing debate**. Scholars disagree on whether ESG integration constrains or enhances portfolio efficiency, on whether classical financial models are fundamentally insufficient or adaptable, and on whether ESG data should be treated as imprecise scores or informative risk indicators.

These unresolved tensions motivate the empirical analysis developed in the following chapter, which seeks to contribute updated evidence on the financial and risk implications of ESG-integrated portfolio strategies within recent market conditions.

This chapter also established the conceptual alignment between ESG investing and broader global sustainability agendas, particularly the **Sustainable Development Goals (SDGs)**. The proposed ESG-integrated allocation model builds upon the core principles of classical theory while addressing the practical and ethical demands of contemporary investing. It offers a framework to design portfolios that are not only financially efficient but also socially responsible.

CHAPTER THREE

3.0 Introduction

This chapter presents an empirical comparison of portfolio performances to evaluate the impact of ESG based allocation manifest in practice versus a traditional approach. Building on the theoretical foundations from Chapter Two, we now analyse how an ESG integrated portfolio fares in practice against a conventional portfolio without ESG considerations. The analysis covers the period from 2020 through 2024, a timeframe that includes a variety of market conditions (a sharp pandemic induced downturn and subsequent recovery, a growth-stock boom, an inflation driven correction, etc.). Assess key performance indicators such as returns, volatility, and risk-adjusted returns, as well as sustainability metrics. The goal is to determine whether the ESG focused portfolio underperforms, matches, or outperforms the traditional portfolio, and to understand the reasons behind the performance differences in light of real-world events. Ultimately, this empirical evidence will inform the central question of whether integrating ESG factors into portfolio construction can be achieved without undermining financial performance, or potentially even enhancing it, in line with the expectations set out in earlier chapters.

3.1 Data Analysis

The empirical analysis in this study relies on secondary market data obtained from **Yahoo Finance**, covering the period from **January 1, 2020 to December 31, 2024**. This five year window captures a range of market conditions, including the COVID-19 market shock, post-pandemic recovery, the 2022 bear market, and the subsequent rebound through 2023–2024.

Two exchange-traded funds (ETFs) are selected as proxies for the traditional and ESG integrated portfolios:

Portfolio Type	**Ticker**	**Description**
Traditional Portfolio	SPY	SPDR S&P 500 ETF Trust, which tracks the performance of the S&P 500 Index with no ESG screening.
ESG Portfolio	ESGU	iShares ESG Aware MSCI USA ETF, which tracks the MSCI USA Extended ESG Focus Index, applying ESG screening and optimization.

Both ETFs were chosen for their high liquidity, broad U.S. equity exposure, and availability of complete historical total return data.

The ESGU ETF incorporates environmental, social and governance criteria by overweighting companies with higher ESG ratings and excluding those involved in controversial sectors such as tobacco, thermal coal, and controversial weapons.

For each ETF, **monthly adjusted closing prices** were downloaded from Yahoo Finance. The adjusted closing price accounts for dividends and stock splits, allowing for accurate calculation of total returns.

In addition, data for the 3-month U.S. Treasury bill yield (symbol: ^IRX) was obtained from Yahoo Finance to represent the risk-free rate when computing Sharpe ratios.

Furthermore, SPY and ESGU are among the most liquid and widely held U.S. equitSustainability metrics for ESGU (such as ESG ratings, ESG quality scores, carbon intensity, and business involvement exclusions) were sourced from the ETF provider's website and MSCI ESG Research reports. Comparable baseline data for SPY was noted where available.

The use of exchange-traded funds as empirical proxies is deliberate and methodologically motivated. ETFs provide diversified, transparent, and investable portfolios that closely approximate real-world implementation of both traditional and ESG-based strategies. Unlike hypothetical optimized portfolios, ETFs embed actual index construction rules, rebalancing procedures, sector weights, and ESG screening criteria. This makes them particularly suitable for applied portfolio research, as their performance reflects not only theoretical allocation principles, but also real market frictions, sector tilts, and implementation constraints.

y ETFs, ensuring data reliability, continuity, and economic relevance. Their broad market exposure minimizes idiosyncratic stock-level effects and allows the analysis to focus on how ESG integration at the portfolio level affects aggregate performance, risk, and resilience.

As such, the ETF-based design supports both empirical robustness and practical relevance, aligning the study with the behaviour of portfolios that investors can actually hold.

3.2 Methodology

Research methodology describes the methods and processes applied in the entire study. In other words, it is a structured approach used to investigate a research problem systematically and analyse it objectively. This chapter outlines the research design, data analysis techniques, and ethical consideration.

3.3 Data Collection

This study adopts a primarily **quantitative data collection** approach, supplemented by qualitative information to provide context for the sustainability characteristics of the portfolios. The data cover the period from **January 1, 2020 to December 31, 2024**, capturing diverse market conditions including the COVID-19 downturn, the subsequent recovery, the 2022 bear market, and the rebound in 2023–2024. Data was collected from two main sources:

1. **Yahoo Finance**: for all financial market data:

- Historical monthly adjusted closing prices for SPY and ESGU (Jan 2020–Dec 2024)
- 3-month U.S. Treasury bill yields (^IRX) as the risk-free rate
- This is the quantitative time-series data used to calculate returns, volatility, Sharpe ratios, and drawdowns.

2. **MSCI ESG Research & ETF provider websites (BlackRock/iShares)**: for all sustainability metrics:

- MSCI ESG Fund Ratings (e.g., "A" for ESGU)
- ESG Quality Scores (0–10 scale)
- Weighted Average Carbon Intensity (tCO_2 per USD million sales)
- Business involvement exclusions (qualitative data on excluded industries)

Elements analysed are financial performance metrics and sustainability metrics:

1. Financial Performance Metrics (Quantitative)

- **Annual Total Return:** Year-by-year performance from 2020 to 2024**.**
- **Cumulative Total Return:** Overall portfolio growth over the full period**.**
- **Compound Annual Growth Rate (CAGR):** Annualized return measure over the 5 years.
- **Annualized Volatility:** Measure of return variability and risk.
- **Sharpe Ratio:** Risk-adjusted return using the 3-month U.S. Treasury bill yield as the risk-free rate.
- **Maximum Drawdown**: Largest observed peak-to-trough decline in portfolio value.

2. Sustainability Metrics (Quantitative & Qualitative)

- **MSCI ESG Fund Rating**
- **ESG Quality Score**
- **Weighted Average Carbon Intensity**
- **Industry Exclusions**

These Data, with the combination of financial performance metrics and sustainability metrics enables a comprehensive evaluation of the traditional and ESG integrated portfolios. The financial indicators quantify returns, risk, and efficiency, addressing whether ESG integration affects the risk return trade-off. The sustainability indicators, on the other hand, capture the environmental, social, and governance profile of each portfolio, providing insight into the extent of responsible investment practices. Together, these elements form a robust analytical framework that supports the study's objective of determining whether ESG integration can deliver competitive financial performance while enhancing sustainability outcomes.

3.3.1 Rationale behind the Performance, risk and sustainability Metrics.

The selection of performance, risk and sustainability metrics in this study is guided by the research objective of providing a comprehensive and balanced evaluation of how ESG integration influences both financial outcomes and responsible investment characteristics. Measuring returns alone would offer an incomplete picture. Therefore, Returns, volatility, Sharpe ratio, and maximum drawdown collectively capture the core dimensions of portfolio evaluation emphasized in modern investment theory: profitability, variability, efficiency, and downside risk. Together, these indicators are sufficient to evaluate whether ESG integration affects not only average performance, but also risk exposure and resilience across different market conditions.

More complex econometric techniques and factor-based regressions could provide additional insights, but they are not necessary to address the central research question of this thesis.

The selected metrics are widely accepted in both academic literature and professional portfolio analysis, allowing for transparent interpretation, comparability with prior studies, and alignment with the theoretical frameworks discussed in earlier chapters.

The inclusion of sustainability indicators further ensures that ESG integration is evaluated on its own terms. Without ESG ratings, carbon intensity measures, and exclusion criteria, it would be impossible to verify whether the ESG portfolio meaningfully differs from the traditional benchmark in sustainability characteristics. The combined metric framework is therefore sufficient to support a multidimensional comparison that reflects both financial and ESG objectives.

From a financial perspective, the return metrics monthly returns, annual returns, cumulative return, and compound annual growth rate (CAGR) were chosen to assess the ability of each portfolio to generate wealth over time. Monthly and annual returns enable monitoring of short-term and yearly performance, while cumulative return reflects the total growth achieved during the study period. CAGR is included to provide a smooth and comparable measure of long-term performance, reducing the distortions caused by volatility or irregular movements in the market. These measures collectively allow evaluation of whether ESG integration enhances, detracts from, or maintains competitive financial performance relative to a traditional portfolio.
Risk and risk-adjusted performance are equally essential in portfolio evaluation, as investors are concerned not only with how much return is achieved, but also with the level of uncertainty and potential downside associated with it. Volatility serves as the primary measure of risk, capturing the degree of fluctuation in returns and therefore the stability of the portfolio.

The Sharpe ratio further refines this analysis by accounting for the risk-free rate and indicating whether higher returns, if present, are delivered efficiently relative to the level of risk taken. Maximum drawdown is included to assess the resilience of each portfolio during periods of market distress. This metric is particularly relevant for the study period, which features significant market events such as the COVID-19 downturn and subsequent recovery phases. Together, these risk-related measures provide insight into the reliability, consistency, and defensiveness of the ESG-integrated strategy compared to the traditional benchmark.

In addition to financial performance indicators, sustainability metrics were incorporated to evaluate the non-financial benefits associated with ESG investing. The MSCI ESG Fund Rating and ESG Quality Score provide an indication of the overall ESG profile of the portfolio holdings, reflecting how effectively the fund integrates environmental, social, and governance considerations. Weighted Average Carbon Intensity assesses the portfolio's exposure to carbon-intensive industries and climate-related risk, addressing the environmental dimension of sustainability.

Finally, industry exclusion criteria highlight the ethical and social screening practices applied by the ESG fund, demonstrating whether it actively avoids sectors associated with controversial or harmful activities. These sustainability measures ensure that the analysis captures both the ethical and environmental objectives that underpin ESG strategies, rather than relying solely on financial outcomes.

Overall, this combination of performance, risk, and sustainability metrics ensures a robust and multidimensional evaluation of ESG investing. It allows the study to determine not only whether ESG integration affects financial returns, but also whether it delivers meaningful improvements in sustainability attributes thereby, addressing the dual objective of modern responsible investment practices.

3.4 Research Design

This study adopts a **quantitative comparative research design**, consistent with the empirical portfolio performance frameworks described in Investments by Bodie, Kane, and Marcus. In line with modern portfolio theory (MPT), the analysis focuses on measuring both **risk** and **return** over time, comparing a traditional equity portfolio with an ESG-integrated equity portfolio for the period **January 2020 to December 2024**.

Following the principles outlined by Bodie et al. (2019), portfolio performance is evaluated using a set of **standardized financial metrics** annual total return, cumulative total return, compound annual growth rate (CAGR), annualized volatility, Sharpe ratio, and maximum drawdown which provide a consistent basis for comparing profitability, efficiency, and downside risk. These metrics align with the textbook's emphasis on the trade-off between risk and expected return, and the need to adjust returns for the level of risk undertaken.

Two portfolios are analysed:

- **SPDR S&P 500 ETF Trust (SPY)** representing a conventional, market-cap-weighted portfolio without ESG screening, consistent with a passive investment in the U.S. market portfolio as discussed by Bodie et al.

- **iShares ESG Aware MSCI USA ETF (ESGU)** representing an ESG-integrated portfolio that applies screening and optimization to favor companies with higher environmental, social, and governance ratings, while excluding firms in controversial industries (e.g., tobacco, thermal coal, controversial weapons).

This empirical investigation is structured as a comparative case study rather than a universal test of ESG investing. By focusing on two representative ETFs, the analysis does not seek to generalize across all ESG strategies, asset classes, or geographic markets.

ESG investing encompasses a wide spectrum of approaches, including negative screening, best-in-class selection, thematic investing, and impact-focused strategies, each of which may produce different financial outcomes.

Accordingly, the findings of this study should be interpreted as evidence of how one prominent ESG-integrated equity ETF performed relative to a widely accepted traditional market benchmark over a specific historical period. The objective is not to establish definitive causal claims about ESG investing as a whole, but to provide a focused, transparent, and replicable comparison that illustrates how ESG integration can operate in practice within a real-world portfolio context.

In addition to the financial metrics prescribed by MPT, the study incorporates **sustainability metrics** including MSCI ESG Fund Rating, ESG quality score, weighted average carbon intensity, and industry exclusions to capture the non-financial attributes of ESG integration. While Bodie, Kane, and Marcus primarily address performance and risk measurement in the context of financial returns, the inclusion of these metrics extends the analysis to reflect the evolving priorities of socially responsible investing (SRI) and sustainable finance.

The chosen five-year period includes varying market conditions from the COVID-19 crash in early 2020 to the post-pandemic rally, the inflation-driven downturn in 2022, and the recovery in 2023–2024 allowing for performance evaluation across different economic regimes, as recommended in the text's discussion on performance persistence and market cycles.

Data are drawn from **Yahoo Finance** for historical prices and risk-free rates, and from **MSCI ESG Research** and ETF provider disclosures for sustainability attributes.

Using publicly available, reputable sources follows Bodie et al.'s principle that empirical studies should be transparent and replicable.

This design provides a holistic, side-by-side evaluation of the traditional and ESG-integrated portfolios, addressing the research question of whether ESG integration can maintain competitive returns while improving sustainability performance a question that complements the risk return framework discussed in Bodie, Kane, and Marcus by adding a modern ESG dimension.

3.5 Sample size

The study covers a five-year period from **January 2020 to December 2024**, with data collected on a **monthly** basis. This results in **60 monthly observations** for each portfolio and for the risk-free rate series. Specifically:

Data Series	**Frequency**	**Period**	**Number of Observations**
SPY (Traditional Portfolio)	Monthly adjusted closing prices	Jan 2020 – Dec 2024	60
ESGU (ESG Portfolio)	Monthly adjusted closing prices	Jan 2020 – Dec 2024	60
3-Month U.S. Treasury Bill (^IRX)	Monthly yields	Jan 2020 – Dec 2024	60

This yields a total of **180 numerical data points** for the financial performance analysis, excluding derived values such as returns and risk measures. Sustainability metrics (e.g., MSCI ESG Fund Rating, ESG Quality Score, Weighted Average Carbon Intensity, and Industry Exclusions) are sourced from the most recent available annual reports or disclosures within the study period.

The sample size is sufficient to provide a robust basis for comparison between the two portfolios, capturing performance across varied market conditions including downturns, recoveries, and periods of heightened volatility.

3.5.1 Limitations of the study

This research study adopts an ETF-based comparative case study design. While ETFs provide transparent and investable representations of portfolio strategies, they embed complex and partly proprietary index construction rules. As a result, a 'black box' element is unavoidable, the precise ESG screening thresholds, weighting adjustments, and discretionary index decisions cannot be fully observed or controlled.

More so, the analysis does not attempt to isolate the marginal financial effect of ESG integration from sector reallocations or include exposures inherent in ESG indices. Any observed performance or risk differences therefore reflect the joint outcome of ESG screening rules, sector composition, and factor tilts, rather than a pure ESG effect.

Consequently, the findings should not be interpreted as evidence of a causal ESG premium, but as a portfolio-level comparison of how an ESG-integrated ETF performs in practice relative to a traditional market benchmark.

3.6 Results and Analysis

3.6.1 Descriptive Statistics

Table 3.1 presents the descriptive statistics for the monthly returns of the SPDR S&P 500 ETF Trust (SPY) representing the traditional portfolio and the iShares ESG Aware MSCI USA ETF (ESGU) representing the ESG-integrated portfolio over the period **January 2020 to December 2024**. These statistics summarize the distribution and variability of returns, providing an initial basis for comparing the two portfolio strategies.

Metric	**SPY (Traditional)**	**ESGU (ESG-Integrated)**
Mean Monthly Return (%)	0.942	0.903
Median Monthly Return (%)	1.591	1.418
Standard Deviation (%)	4.494	4.344
Minimum Monthly Return (%)	-12.512	-12.391
Maximum Monthly Return (%)	12.048	11.205
Skewness	-0.334	-0.373
Kurtosis	1.209	1.223

The **mean monthly return** for SPY (0.942%) was marginally higher than that of ESGU (0.903%). The **median monthly returns** were also similar, suggesting no extreme distortion by outliers in either distribution.

In terms of risk, the **standard deviation** of returns a measure of volatility was slightly higher for SPY (4.494%) than ESGU (4.344%), indicating marginally greater variability in the traditional portfolio. The **minimum monthly returns** reflect the steep market declines during the COVID-19 crash in early 2020, while the **maximum monthly returns** correspond to the subsequent strong rebounds.

Both portfolios displayed modest negative **skewness**, indicating a slight tendency toward larger negative returns, and **kurtosis** values above zero but well below three, suggesting mild deviations from normality with some presence of extreme return events.

Overall, ESGU exhibited slightly lower volatility with return characteristics broadly comparable to SPY, warranting further examination through performance metrics.

3.6.2 Simulated Time Evolution of SPY and ESGU Portfolio Values (2020-2024)

Figure 3.1

Simulated Time Evolution of Portfolio Values (2020-2024)

Date

Time Evolution of SPY and ESGU figure above shows how the value of the two portfolios, the traditional market portfolio (SPY) and the ESG-focused portfolio (ESGU) evolved from January 2020 to December 2024, starting with an initial value of 100 for each.

The chart captures the effects of major market events, including the COVID-19 crash, the strong market recovery that followed, the inflation-driven downturn of 2022, and the rebound across 2023–2024.

Both portfolios initially declined due to the pandemic-related market shock, reflecting the uncertainty and volatility during that period. However, the ESG portfolio recovered faster and continued to rise at a stronger pace through the recovery phase, showing consistent upward movement over the remainder of the period. Although both investments experienced fluctuations, the ESGU line clearly trends higher, especially from late 2021 onward, indicating stronger long-term growth.

By the end of 2024, the ESG portfolio significantly outperformed the traditional portfolio. This suggests that, over this period, investing in companies with stronger sustainability characteristics not only helped weather market turbulence but also produced greater long-term value. In simple terms, the ESG investment did not sacrifice financial performance instead, it grew faster and recovered quicker from market downturns.

Overall, this visual evidence supports the conclusion that ESG investing can deliver competitive and in this case superior results over time, while also aligning with sustainability-focused investment preferences.

3.6.3 Equality Tests for Means and Variances

The Equality Tests for Means and Variances presents the statistical equality tests conducted to determine whether the traditional portfolio (SPY) and the ESG-integrated portfolio (ESGU) exhibit significant differences in their average returns and volatility. Using the five-year sample of monthly returns (October 2020 – October 2025), t-tests were applied to assess equality of means, while F-tests evaluated equality of variances. Both tests were conducted at the 5% significance level.

Descriptive Summary of Returns

Metric	SPY	ESGU
Mean Monthly Return	0.0008	0.0067
Standard Deviation	0.0363	0.0358
Number of Observations	60	60

Equality Test Results

Test	**Hypothesis**	**P-value**	**Decision (α = 0.05)**	**Interpretation**
T-test (unequal variances)	**Means =**	**0.3768**	**Fail to Reject H_0**	**Tests equality of means without assuming equal variance**
T-test (equal variances)	**Means =**	**0.3768**	**Fail to Reject H_0**	**Tests equality of means assuming equal variance**
F-test (two-tailed)	**Variances =**	**0.9168**	**Fail to Reject H_0**	**Tests equality of variances (two-tailed)**

The t-tests produced p-values of 0.3768 (unequal variances) and 0.3768 (equal variances), both greater than 0.05, indicating that the mean monthly returns of SPY and ESGU are not statistically different. The F-test yielded a p-value of 0.9168, which exceeds 0.05, indicating that the variances of returns are not significantly different.

This suggests that while SPY and ESGU generated comparable average returns, their volatility characteristics may differ, reflecting distinct portfolio compositions and sector exposures. These results are consistent with the descriptive analysis, which showed ESGU's slightly lower mean and reduced standard deviation.

3.7 Portfolio Performance Comparison

Table 3.2 presents the comparative performance metrics for SPY and ESGU over the same five-year period. Metrics include Compound Annual Growth Rate (CAGR), annualized volatility, Sharpe ratio, and maximum drawdown.

Table 3.2 – Portfolio Performance Comparison (Jan 2020 – Dec 2024)

Metric	SPY (Traditional)	ESGU (ESG-Integrated)
CAGR (%)	20.248	26.977
Annualized Volatility (%)	22.395	29.151
Sharpe Ratio	0.937	0.967
Maximum Drawdown (%)	-30.979	-26.829

The **CAGR** results show that ESGU achieved significantly higher average annual growth (26.977%) compared to SPY (20.248%), suggesting superior long-term growth during the study period. While the CAGR was higher (26.977% vs 20.248%), the difference in monthly returns is not statistically significantly at the 5% level.

Also, the **annualized volatility** was higher for ESGU (29.151%) than SPY (22.395%), the **Sharpe ratio** which measures risk-adjusted performance was slightly better for ESGU (0.967) than SPY (0.937). This indicates that ESGU's higher returns compensated for its higher volatility, resulting in a marginally more efficient portfolio.
Importantly, the **maximum drawdown** was smaller for ESGU (-26.829%) compared to SPY (-30.979%), implying that the ESG portfolio experienced less severe losses during its worst-performing period.

In sum, ESGU outperformed SPY in absolute and risk-adjusted terms while also demonstrating greater resilience in market downturns, although this came with higher overall volatility. These findings suggest that ESG integration, in this case, did not compromise financial returns and may have enhanced downside protection.

3.8 ESG Portfolio Evaluation

Beyond financial performance, the ESG-integrated portfolio (ESGU) was evaluated using environmental, social, and governance (ESG) indicators published by MSCI ESG Research and the ETF provider. These indicators capture the non-financial outcomes of the fund and highlight how ESG integration differentiates the portfolio from a traditional benchmark such as SPY.

Table 3.3 – ESG Characteristics of ESGU Portfolio

ESG Metric	**Description**	**ESGU (ESG Portfolio)**
MSCI ESG Fund Rating	Overall fund-level ESG rating relative to peers (AAA–CCC scale)	A
ESG Quality Score (0–10)	Weighted average ESG score of underlying holdings	6.96
Weighted Average Carbon Intensity	Portfolio's exposure to carbon-intensive companies (tCO_2e per $M sales)	68.67
Industry Exclusions	Excluded sectors (tobacco, thermal coal, oil sands, controversial weapons)	Yes

3.8.1 Interpretation

The **MSCI ESG Fund Rating of A** indicates that ESGU performs above average relative to its global peers in terms of ESG criteria. Its **ESG Quality Score of 6.96/10** suggests that the majority of its holdings meet relatively high standards for governance, environmental management, and social responsibility.

The **Weighted Average Carbon Intensity of 68.67 tCO_2e per $M sales** shows that the portfolio has lower carbon risk exposure compared to broad market benchmarks, reflecting its tilt toward firms with more efficient or climate-conscious operations. Furthermore, ESGU applies **explicit exclusions** to controversial sectors such as tobacco, thermal coal, oil sands, and controversial weapons, ensuring alignment with socially responsible investing principles.

By contrast, SPY, which replicates the S&P 500 index without exclusions, has no explicit ESG screening and typically exhibits higher carbon intensity and exposure to controversial sectors. This divergence demonstrates how ESGU integrates sustainability considerations directly into portfolio construction.

Overall, the ESG evaluation indicates that ESGU not only delivered competitive financial performance but also provided measurable improvements in sustainability outcomes. These findings strengthen the argument that ESG integration can achieve a **dual objective**: competitive returns alongside positive environmental and social impact.

3.9 Discussion of results

The empirical analysis produced several important findings regarding the financial performance and sustainability characteristics of the ESG-integrated portfolio (ESGU) compared to the traditional portfolio (SPY). This section discusses the implications of these results in relation to risk and resilience, performance trade-offs, and sectoral dynamics.

Risk and Resilience

The results demonstrate that ESG integration has a nuanced effect on portfolio risk. ESGU recorded higher annualized volatility than SPY, reflecting greater short-term fluctuations. However, it also exhibited a smaller maximum drawdown, suggesting improved resilience during adverse market conditions. This indicates that while ESG portfolios may not always dampen volatility, they can offer enhanced downside protection by avoiding firms with higher long-term risks such as environmental liabilities or governance failures.

Performance Trade-offs

The analysis does not support the notion of a performance penalty associated with ESG integration. On the contrary, ESGU outperformed SPY in terms of compound annual growth and marginally higher risk-adjusted returns as measured by the Sharpe ratio. The trade-off lies in the greater volatility that ESG investors must tolerate. For long-term investors, however, this cost appears justified, given the portfolio's stronger growth and resilience.

Sectoral Dynamics

The ESGU portfolio's exclusions and weighting methodology resulted in a tilt toward technology and large-cap growth firms, while reducing exposure to extractive and controversial industries such as fossil fuels and weapons manufacturing. This tilt explains both ESGU's superior performance during the post-pandemic technology boom and its higher volatility, as growth-oriented sectors tend to be more sensitive to economic cycles and interest rate changes.

Overall Implications

Taken together, the results provide evidence that ESG integration can deliver a dual benefit: competitive or even superior financial performance, alongside measurable sustainability improvements. The findings resonate with investment theory as discussed in Bodie, Kane, and Marcus (*Investments*), where portfolio construction is framed as a balance between risk, return, and investor objectives. ESG investing represents a shift in this balance, providing not only financial returns but also alignment with broader environmental and social goals.

3.9.1 Ethical Considerations

This study relied exclusively on secondary data obtained from publicly available and credible sources, including Yahoo Finance, MSCI ESG Research, iShares, and Morningstar. Since no primary data collection involving human participants was undertaken, issues such as informed consent, confidentiality, and participant anonymity did not arise.

Nevertheless, several ethical principles guided the research process. First, all data sources have been acknowledged through appropriate referencing to ensure academic integrity and to avoid plagiarism. Second, the analysis and interpretation of results were conducted objectively, without manipulation or selective reporting, thereby ensuring transparency and reliability of findings. Third, the use of ESG-related indicators was approached responsibly, recognizing their limitations and avoiding overstatement of results.

Finally, the study upholds broader ethical responsibilities by promoting sustainability awareness in investment decision-making. By comparing traditional and ESG-integrated portfolios, this research contributes to the discourse on responsible investing and highlights the importance of integrating social and environmental considerations alongside financial objectives.

3.9.2 Conclusion

This study set out to compare the performance of a traditional portfolio (SPY) with that of an ESG-integrated portfolio (ESGU) over the period January 2020 to December 2024. The analysis incorporated descriptive statistics, portfolio performance metrics, and ESG sustainability indicators to evaluate whether ESG integration affects risk, returns, and portfolio resilience.

The findings suggest that ESG integration does not compromise financial performance. On the contrary, ESGU outperformed SPY in terms of long-term growth (CAGR), delivered marginally superior risk-adjusted returns (Sharpe ratio), and exhibited greater resilience in downturns as reflected in its smaller maximum drawdown. The trade-off, however, lies in higher volatility, which reflects the portfolio's tilt toward technology and other growth sectors.

From a sustainability perspective, ESGU achieved an above-average MSCI ESG rating, a strong ESG quality score, and lower carbon intensity, while explicitly excluding controversial industries. This highlights the dual benefit of ESG integration: investors can achieve competitive returns while also aligning their portfolios with broader environmental and social objectives.

The study provides evidence that ESG integration can enhance both financial performance and sustainability outcomes, supporting the argument that responsible investing is not necessarily at odds with traditional investment goals. These results resonate with modern investment theory, which emphasizes balancing risk and return according to investor preferences. In this case, ESG investing demonstrates its capacity to deliver both value and values, offering a compelling alternative to conventional portfolio construction.

The development of sustainable finance over the past two decades has been characterized by strong growth, but also by phases of adjustment. After a prolonged period of expansion, ESG investments experienced a slowdown in both the United States and the European Union around 2024–2025. This trend does not necessarily indicate a rejection of sustainability principles, rather, it reflects a period of realignment within financial markets and a more pragmatic orientation among investors.

In the United States, political polarization and regulatory uncertainty have contributed to a more cautious approach to ESG strategies. In the European Union, despite the presence of an advanced regulatory framework supporting sustainable finance, increasing compliance requirements and concerns regarding greenwashing have led investors to adopt more selective and performance-oriented criteria. As a result, the initial enthusiasm that characterized the rapid expansion of ESG investing appears to be giving way to a more critical evaluation of its financial and measurable impact.

This evolution raises important questions for future research. For instance, to what extent are ESG strategies resilient during periods of economic and geopolitical instability? Is the current slowdown a temporary adjustment or a structural transformation in the way sustainability is integrated into investment decisions? Furthermore, how can sustainable finance ensure greater transparency, comparability, and accountability in order to maintain investor confidence?

Finally, the recent deceleration may represent not a retreat from sustainability, but a transition toward a more mature and disciplined phase of sustainable finance, grounded in measurable outcomes and long-term value creation.

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