Facultad de Ciencias Económicas y Empresariales

"ESG Performance, Corporate Financial Outcomes, and Idiosyncratic Risk: A Critical Review and Empirical Assessment within the S&P 500 Index"

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MADRID | Junio 2026

Dedication

To my parents Teo and Kornilia, my wife Beatriz and my son Paris.

Acknowledgements

I would like to express my deep gratitude to my supervisors, Isabel Figuerola-Ferretti and Sara Lumbreras, for their invaluable guidance and support during this thesis.

Thanks to the Universidad Pontificia Comillas (ICADE) and especially to Maria Carmen Valor for her support. I also extend my sincere appreciation to any other individuals who helped me in whatsoever capacity throughout the elaboration of this work.

Lastly, my heartfelt regards to my fellow Ph.D. students. Thank you all for your friendship, support, and boundless flow.

Credit Author Statement.

I have contributed to the development of each chapter in conceptualization of different concepts and theories; investigation; formal analysis; resources; Methodology; Writing, review and editing;

Use of GenAI Statement

During the preparation of this dissertation, I used CHATGPT in order to ensure that ideas flow logically and clearly. AI tools identify inconsistencies, suggest better transitions, and maintain a consistent tone and structure throughout the text. This support allows me to communicate more effectively and produce polished content. After using CHATGPT, I reviewed and edited the content as needed and take full responsibility for the content of the publication.

THESIS SUMMARY

This thesis investigates the relationship between ESG performance, corporate financial outcomes, and idiosyncratic risk. It integrates both return and risk dimension and introduces the Idiosyncratic Equity Premium (IEP) to assess whether firm-specific risk is priced. A thorough literature review is conducted to define and examine current explicit and implicit valuation channels under the lens of the discounted cash-flow (DCF) model. Firm value changes only through risk-adjusted discounting in the DCF model. ESG affects valuation by altering, firm specific (idiosyncratic) risk, and market wide (systematic) risk, which affects firm valuation, according to the DCF model through cash flow risk and the cost of capital, respectively.

We do not treat ESG metrics as a standalone factor, but we jointly analyze the relation among ESG, financial performance, idiosyncratic risk and risk with respect to asset pricing. In this way, the thesis fully integrates ESG-Risk-Return framework. The IEP is introduced as an idiosyncratic quantifiable factor which measures directly compensation for fir-specific risk. This factor goes beyond standard idiosyncratic volatilities measures as it decomposes return shock into firm-specific shocks, market risk and microstructure components especially important for price discovery in equity markets. Based on SP 500 firms, large–scale panel data is examined (2004–2023), using Refinitiv, Bloomberg, and FactSet data. This provides robust inference across market regimes, as the data set sample is divided into three different economically meaningful sub-samples. In this manner, ESG relevance is explicitly treated within the pre-2015 and post-2016 period. Methodology includes panel regressions and asset pricing models (CAPM, Fama-French, Carhart). Idiosyncratic risk is measured via residual returns and volatility.

Empirical results demonstrate that ESG performance is a financially material driver of both risk and asset pricing. It reduces firm-specific volatility, improves financial stability, and crucially affects expected returns through the pricing of idiosyncratic risk, especially in the post-Paris regulatory environment. Including ESG pillars as explicit explanatory variables augments granularity with respect to regime shifts and relevant economic context. Provides integrated ESG-risk-performance analysis, introduces IEP, and delivers robust long-term empirical evidence.

ESG improves risk-adjusted returns and hence can be used as a risk-management overlay. The case supports ESG disclosure standardization. It is a financially material driver that reduces firm-specific risk and influences expected returns through the pricing of idiosyncratic risk.

RESUMEN DE TESIS

Esta tesis investiga la relación entre el desempeño ESG, los resultados financieros corporativos y el riesgo idiosincrático. Integra las dimensiones de rentabilidad y riesgo, introduciendo la Prima Idiosincrática de Capital (IEP) como medida directa de la compensación por riesgo específico de la empresa. Bajo el marco del modelo DCF, el ESG influye en la valoración al modificar el riesgo idiosincrático y sistemático, afectando tanto el riesgo de los flujos de caja como el coste del capital. La tesis adopta un enfoque integrado en un perfil de ESG–Riesgo–Rentabilidad, evitando tratar ESG como un factor aislado.

El análisis empírico se basa en datos de empresas del SP 500 (2004–2023), utilizando Refinitiv, Bloomberg y FactSet. Se aplican regresiones de panel y modelos de valoración de activos (CAPM, Fama-French, Carhart), donde el riesgo idiosincrático se mide mediante rendimientos residuales y volatilidad utilizando retornos diarios.

Los resultados muestran que el desempeño ESG es financieramente relevante: reduce la volatilidad específica de la empresa, mejora la estabilidad financiera e influye en los rendimientos esperados mediante la valoración del riesgo idiosincrático, especialmente tras el Acuerdo de París.

Finalmente, la tesis aporta evidencia robusta a largo plazo, introduce el riesgo idiosyncratico, (IEP), como innovación clave y demuestra que el ESG mejora los retornos ajustados al riesgo, respaldando además la estandarización de la divulgación ESG.

Abstract

Over the past two decades, growing interest in sustainable business practices has led researchers to investigate the financial implications of Environmental, Social, and Governance (ESG) metrics on corporate performance. This study synthesizes theoretical and empirical insights to explore the ESG–Corporate Financial Performance (CFP) nexus through a discounted cash-flow framework, focusing on three transmission channels: future cash-flow generation, risk mitigation, and valuation enhancement. Building on this foundation, we introduce the Idiosyncratic Equity Premium (IEP) as a novel measure of excess return compensation for firm-specific risk, using cross-sectional data from SP 500 firms between 2004 and 2023. Our findings reveal that the IEP significantly contributes to explaining excess returns, even after accounting for traditional risk factors. Further, we examine how ESG engagement and disclosure influence idiosyncratic volatility and long-term financial returns, showing that ESG scores, particularly when disaggregated into their environmental, social, and governance dimensions, serve as valuable indicators of uncompensated risk. The results suggest that while ESG initiatives may incur short-term costs, they offer moderate upside potential and reduce portfolio volatility over time. Ultimately, this research demonstrates that ESG practices not only support global sustainability goals but also function as strategic financial tools that enhance firm value through improved risk management and return predictability.

Keywords— ESG Investment, Sustainability, SDGs, Corporate Financial Performance, Idiosyncratic Risk, CSR, Tail-Risk.

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Chapter 1 Motivation

1.1 Central Research Question

This thesis investigates the extent to which Environmental, Social, and Governance (ESG) practices and disclosures mitigate firm-specific (idiosyncratic) risk in U.S. companies, how such risks are priced in equity markets, and how the distinct ESG pillars differentially influence long-term financial performance and asset pricing beyond traditional models. At its core, the study seeks to understand whether ESG engagement represents a source of economic value creation through risk reduction and improved valuation, or whether it constitutes a strategic cost that is not fully compensated in financial markets.

Sustainability, encompassing environmental stewardship, social responsibility, and sound governance, has become an increasingly central principle in corporate strategy and financial decision-making. As firms integrate ESG and corporate social responsibility (CSR) considerations into their operations, a growing body of literature examines the implications of these practices for corporate financial performance (CFP), including profitability, risk exposure, and market valuation. However, despite substantial empirical progress, the mechanisms through which ESG performance affects firm-specific risk and its pricing in equity markets remain insufficiently understood.

From a theoretical perspective, legitimacy theory and signaling theory provide compelling foundations for understanding why disclosure of ESG can influence firm risk and valuation. Legitimacy theory, (see also [1]), posits that companies engage in ESG activities and disclosures to align with societal norms and stakeholder expectations, thus reducing reputational, regulatory, and operational risks. This mechanism is particularly relevant in contexts such as initial public offerings (IPOs), where companies face elevated information asymmetry and uncertainty. Complementing this view, signaling theory (see also, [2]), suggests that ESG disclosure serves as a credible signal of firm quality, governance strength, and long-term orientation, helping to reduce information asymmetry between firms and investors. In capital markets where firm-specific uncertainty is pronounced, such disclosures may lower perceived idiosyncratic risk and, consequently, the risk premium demanded by investors.

Empirical evidence supports this theoretical integration. Academic work from [3], shows that voluntary disclosure of ESG in IPOs significantly reduces idiosyncratic volatility and downside tail risk in the first year of trading, compared to firms with limited ESG information. Their findings suggest that ESG disclosure can replace traditional uncertainty proxies, such as firm age or underwriter reputation, by enhancing investor confidence and reducing firm-specific risk premia. This aligns directly with [4] argument that lower idiosyncratic risk improves valuation accuracy and reduces the equity risk premium. This insight underscores the importance of ESG transparency not only as a corporate governance practice, but also as a risk management mechanism with quantifiable market consequences.

These theoretical and empirical insights naturally connect ESG engagement with firm valuation through a discounted cash flow (DCF) framework. In the DCF model adjusted for ESG proposed by [4], the characteristics of ESG influence the valuation of the firm through both the cash flow and discount rate channels. On the cash flow side, superior ESG performance can improve operational efficiency, reduce downside risk, and improve long-term growth prospects, thus stabilizing and potentially increasing future cash flows. On the discount rate side, the reduced idiosyncratic and systematic risk associated with strong ESG performance may lower the equity risk premium, thereby reducing the cost of capital. By adjusting both projected cash flows and discount rates for ESG performance, this framework provides a quantitative mechanism that links ESG engagement to firm valuation beyond traditional financial indicators.

To deepen the analysis, the thesis is structured into two interconnected empirical chapters that reflect these channels. Chapter 3, investigates the role of idiosyncratic and systematic risk in shaping equity returns and the equity premium. It highlights how investors often demand a premium for bearing idiosyncratic risk, particularly in environments characterized by high uncertainty. By decomposing return innovations into orthogonal components, the chapter isolates firm-specific risk that is not captured by traditional asset pricing models such as the Capital Asset Pricing Model (CAPM) or Fama–French factor frameworks. This analysis examines whether a persistent idiosyncratic equity premium exists, how it interacts with market microstructure frictions such as liquidity constraints, and whether idiosyncratic risk represents a priced and economically meaningful component of equity returns.

Building on this foundation, chapter 4 examines how ESG engagement and disclosure influence firm-specific volatility and excess returns in the U.S. equity market. Drawing on legitimacy and signaling arguments and informed by the evidence in [3], this chapter evaluates whether ESG performance reduces idiosyncratic risk and whether such reductions are reflected in asset prices. It provides empirical evidence that strong ESG performance is associated with reduced idiosyncratic volatility, suggesting that ESG metrics serve as a form of risk mitigation. Special attention is given to the distinct contributions of the Environmental, Social, and Governance pillars, as well as to the evolution of ESG–risk relationships across regulatory milestones such as the Paris Agreement. By integrating ESG metrics into extended asset pricing frameworks, the chapter assesses whether traditional models are incomplete without accounting for ESG-related risk and valuation effects.

Overall, this thesis offers a unified theoretical and empirical framework that links ESG performance, firm-specific risk, and asset pricing. By clarifying whether ESG initiatives mitigate uncompensated idiosyncratic risk and enhance firm value through both risk reduction and improved discounted cash flow valuation, the study provides insights of relevance to investors, policymakers, and corporate managers, while advancing the broader debate on the financial and strategic implications of sustainability in modern capital markets.

1.2 Objectives and Contributions

Growing investor and regulatory interest in sustainability has led to the widespread adoption of ESG metrics as proxies for a firm's social and environmental impact. These metrics not only inform portfolio allocation decision-making but also shape market perceptions and influence corporate financial performance (CFP). For instance, global sustainable assets under management rose from \$639 billion in 1995 to over \$52 trillion by 2024, according to US-SIF reports. Yet, the extent to which ESG/CSR contributes to financial value remains contested in both academic and investment circles.

The central debate revolves around whether ESG/CSR enhances shareholder value or imposes additional costs. On one hand, proponents argue that responsible practices improve stakeholder trust, reduce operational and reputational risks, and attract long-term capital. On the other, critics view ESG as a cost burden or managerial tool for promoting personal agendas, citing agency theory. Furthermore, the ESG–CFP relationship is complicated by inconsistent ESG data, reverse causality, and firm heterogeneity.

To address these challenges, we review current academic literature and adopt the Discounted Cash Flow (DCF) framework as a unified model to analyze the financial impact of ESG factors. The DCF model enables us to decompose the ESG–CFP nexus into three distinct transmission mechanisms: The cash-flow channel, ESG/CSR improves operational efficiency and stakeholder engagement, leading to stronger and more stable future cash flows. The systematic risk channel, firms with high ESG ratings tend to exhibit lower cost-of-capital due to reduced exposure to market-wide risks. The downside risk channel, ESG strategies enhance resilience to shocks (e.g., climate, regulatory, reputational), reducing extreme loss potential.

The literature review makes five key contributions to the ESG/corporate financial performance (CFP) literature. First, it offers a unified theoretical foundation by embedding ESG considerations within the Discounted Cash Flow (DCF) framework, thereby linking sustainability practices directly to corporate valuation. Second, it identifies three core transmission mechanisms, cash-flow improvements, systematic risk reduction, and downside risk mitigation, that connect ESG performance to both financial outcomes and relevant Sustainable Development Goals (SDGs). Third, it clarifies the role of risk by distinguishing between idiosyncratic and systematic components, demonstrating how ESG initiatives can influence firm value through different channels of the DCF model. Fourth, the review addresses persistent challenges to ESG measurement by proposing the use of financial market proxies, such as volatility, beta, and skewness, to quantify the intangible value of ESG efforts. Finally, it emphasizes the practical relevance of these insights by mapping the

ESG-DCF linkages to specific SDGs, highlighting the dual financial and social impact of responsible corporate behavior for both investors and policymakers.

The third chapter advances the asset pricing literature by developing a new theoretical and empirical framework to examine the link between idiosyncratic risk and expected excess returns. It addresses long-standing debates on whether firm-specific risk is priced, challenging traditional views that idiosyncratic risk is diversifiable, and thus irrelevant for expected returns. A central innovation of the chapter is the introduction of the Idiosyncratic Equity Premium (IEP), a real-time observable measure that captures the excess return investors demand to hold idiosyncratic risk. Unlike traditional models that exclude idiosyncratic risk from pricing, this approach treats it as a meaningful source of return variation.

The proposed Idiosyncratic Equity Premium (IEP) framework makes three key contributions. First, it challenges the traditional assumption that idiosyncratic risk is entirely diversifiable and thus unpriced, arguing instead that under certain market conditions, it carries meaningful return implications. Second, it offers a more refined perspective on the equity premium puzzle by demonstrating how firm-specific risk contributes to excess returns, particularly in the presence of investor constraints, as theorized by Merton. Third, the IEP framework has practical relevance for investors and portfolio managers, providing a measurable and responsive risk premium that captures firm-level events, enhancing both asset pricing accuracy and portfolio decision-making.

Chapter 4, introduces ESG pillars and overall scores to the equation along with IEP. It investigates how firm-specific ESG/CSR practices and sustainability risk serve as key drivers of long-run financial performance. We develop a theoretical two-asset pricing model to explain how idiosyncratic risk, calculated directly from observable daily returns, is influenced by ESG performance.

A related body of literature identifies a positive relationship between idiosyncratic risk and portfolio returns ([5], [6]. These long-run value drivers are often mis-priced by the market. High sustainability scores are increasingly seen as proxies for intangible value components such as reputation, employee satisfaction, and community engagement ([7]). Our study builds upon these insights by linking idiosyncratic risk to ESG metrics, both globally and across individual ESG pillars (Environmental, Social, Governance), using U.S. equity data across multiple sample periods.

This study offers a multifaceted contribution to the literature on asset pricing by integrating both ESG factors and idiosyncratic risk into a conditional empirical framework. The model builds upon traditional multi-factor approaches, such as the Carhart four-factor model, by introducing sustainability metrics and firm-specific volatility as jointly influential components in the determination of expected returns. Overall, the following contributions highlight the theoretical and empirical significance of this approach.

Firstly, we integrate ESG into conditional asset pricing models. Our framework extends the scope of asset pricing models by incorporating ESG scores as explanatory variables within a conditional setting. Unlike static factor models, which treat risk exposures as constant over time, our model allows for dynamic interactions between ESG performance and firm-level risk sensitivities. This aligns with recent developments in sustainable finance, where ESG characteristics are increasingly viewed as priced risk factors due to their material impact on firm valuation, regulatory exposure, and investor preferences, see also, [8]. This aligns with the findings of [3], who demonstrate that voluntary ESG disclosure during IPOs (Initial Public Offerings) significantly reduces idiosyncratic volatility and downside tail risk in the aftermarket.

Secondly, we link ESG to risk sensitivity via the Γ coefficient. By modeling the sensitivity coefficient as a function of global ESG scores, we provide a novel mechanism for assessing how sustainability practices influence a firm's exposure to risk. The empirical specification in chapter 4, enables direct testing of the hypothesis that ESG performance modulates the transmission of shocks through the idiosyncratic channel. A significant δ coefficient would imply that ESG factors not only affect expected returns but also alter the structure of risk exposures at the firm level.

Thirdly, empirical identification of the ESG-volatility channel. The model contributes to the literature by empirically identifying the ESG-volatility channel, wherein firms with higher ESG ratings exhibit lower idiosyncratic volatility. This finding supports the view that ESG-aligned firms are more resilient to firm-specific shocks due to stronger governance, environmental risk management, and stakeholder engagement [9], [3]. By capturing this relationship, the model enhances our understanding of how sustainability practices influence asset price formation beyond traditional systematic factors.

Fourthly, the thesis extends the use of idiosyncratic risk pricing. Traditionally considered diversifiable and thus unpriced, idiosyncratic risk has gained empirical relevance in the presence of market frictions, limited diversification, and behavioral biases. Our framework treats idiosyncratic risk as conditionally priced, particularly when linked to ESG performance. This challenges the assumptions of the Capital Asset Pricing Model (CAPM) and aligns with findings that idiosyncratic volatility may carry a premium under specific market conditions [10].

Fifth, we use ESG as a risk mitigator in portfolio construction. The model provides evidence that ESG performance may reduce both total and idiosyncratic risk, thereby enhancing portfolio stability and risk-adjusted returns. This contribution is particularly relevant for institutional investors and asset managers seeking to integrate ESG criteria into portfolio construction and risk management frameworks. It supports the growing consensus that ESG factors are not merely ethical considerations but financially material inputs into investment decision-making [11].

Sixth, we make novel Use of the $\Gamma_{s,t}$ coefficient in risk analysis. Introducing the sensitivity coefficient as a dependent variable linked to ESG scores offers a new lens for analyzing firm-level risk dynamics. This approach captures how sustainability practices influence the responsiveness of asset returns to both systematic and idiosyncratic shocks, providing a more granular understanding of risk transmission mechanisms.

The model has direct implications for regulatory policy and sustainable investment strategies. By quantifying the financial relevance of ESG performance through its impact on risk sensitivity and volatility, the framework supports the development of ESG-integrated asset pricing models that reflect both investor preferences and long-term value creation. This is particularly pertinent in the context of evolving disclosure standards and the increasing demand for ESG transparency among market participants [12].

Traditional asset pricing models generally assume only systematic risks are priced, while firm-specific risks are diversifiable. However, firm-specific risk reduction can stem from improved employee satisfaction ([13]), reduced environmental/litigation exposure ([14]), or reputational gains ([15]). Poor ESG performance and weak disclosure can elevate firm-specific risks, even in competitive ESG environments. The work of [16], for example, show that companies with superior Corporate Social Performance (CSP) demonstrate significantly lower idiosyncratic risk.

Finally, this study contributes to the literature by introducing a theoretically grounded, market-based approach to defining idiosyncratic volatility, offering a clearer lens through which to assess firm-specific risk. It quantifies the direct effect of ESG risk on both idiosyncratic risk and excess returns, demonstrating how transparency in sustainability practices translates into financial performance. The study further shows that ESG involvement mitigates uncompensated risk, lowers a firm's cost of capital, and strengthens credit profiles. Empirical findings reveal a robust negative relationship between ESG performance and idiosyncratic volatility, validating ESG as a credible signal of long-term value. Collectively, these insights highlight the need to revise traditional asset pricing models to incorporate sustainability metrics and their influence on firm-specific risk dynamics.

1.3 Methodology

In order to fulfill the objectives of the study, we followed a structured, multi-step literature review protocol to gather a comprehensive body of evidence on how environmental, social, and governance (ESG) factors affect corporate financial performance (CFP).

First, we conducted keyword searches on Google Scholar using terms such as ESG, corporate social responsibility (CSR), discount rate, idiosyncratic risk, volatility, tail-risk, and financial performance. We restricted results to peer-reviewed, English-language articles published in academic journals.

Second, we screened titles, abstracts, and, where necessary, full texts. We retained only empirical studies that explicitly tested relationships between ESG or CSR metrics and at least one dimension of financial performance (e.g., accounting returns or market-based measures). Conceptual or purely descriptive papers were excluded.

Third, we expanded the corpus by examining the reference lists of eligible studies and including additional cited articles that met our empirical inclusion criteria. We initially retrieved 85 articles. Additional selection was based on primary criteria such as the time frame, market context (e.g., U.S., EU, and emerging markets), and geographic diversity. We considered the temporal dimension crucial for understanding both the evolution and impact of ESG factors, particularly given the sharp rise in sustainable and responsible investment over the past two decades.

We categorized studies into two periods: those conducted prior to the 2008 global financial crisis and those from 2008 through the post-COVID-19 era. We also paid special attention to the issue of reverse causality in the ESG-CFP relationship, with the aim of evaluating the effects of ESG from a holistic perspective. Each selected article was reviewed in full.

In addition, we supplemented our search using two large-language model-powered academic discovery tools, Consensus and Elicit, which surfaced recent or less traditionally indexed studies. All articles retrieved through these platforms were subjected to the same screening and inclusion criteria. This rigorous process yielded a focused yet representative set of studies that form the foundation of the analysis presented in this chapter.

Our study aims to deepen the understanding of how ESG performance, particularly through disclosure and firm-level commitment, affects idiosyncratic risk and excess stock returns in the U.S. equity market. Using a theoretical two-asset model and panel data of 8,176 firm-year observations from 2004–2022, we examine the interplay between ESG metrics (both aggregate and by pillar) and firm-specific risk. Our novel contribution lies in defining idiosyncratic volatility directly from observable market returns rather than residuals from traditional models like CAPM or Fama-French. We analyze three distinct sub-periods, 2004–2022, 2004–2016, and 2016–2022 (the latter motivated by post-Paris Agreement ESG regulation), to assess how ESG's impact on risk and return evolves over time.

In chapter 3, we develop a theoretical framework that goes beyond traditional models like CAPM by decomposing return shocks into, systematic risk (Ut) due to common macroeconomic factors. Idiosyncratic risk (Vi,t) that represents firm-specific shocks, and market microstructure noise (Qt), which is attributable to trading frictions, liquidity, and institutional effects. This decomposition allows for a more granular understanding of what drives asset returns, which is essential if your analysis involves cross-sectional return behavior, volatility modeling, or risk premia estimation. We incorporate both persistent and stochastic components, which enables us to reflects non-diversifiable risks that persist over time, which are crucial for explaining long-term expected returns and volatility premiums. The introduction of the Idiosyncratic Equity Volatility Premium (IEP) quantifies how firm-specific uncertainty contributes to excess returns, which is especially relevant to quantify non-financial performance metrics.

We employ daily price data for all SP 500 constituents from January 30, 2004, to June 1, 2023, sourced from FactSet. The data set accounts for dividends, capital gains, and corporate actions, including stock splits and scrip dividends. To control for systematic risk and firm-specific characteristics, we incorporate [17] and [18] factor data, specifically the SMB (size), HML (value), and MOM (momentum) factors. Market volatility is estimated using a 30-day rolling standard deviation of daily SP 500 returns, consistent with its role as a proxy for the U.S. market portfolio, see also [19]. Stock-level volatility is computed on a daily basis and the idiosyncratic equity premium (IEP) is defined as the difference between the total volatility of each stock and the volatility of the market. To address potential biases from liquidity and ensure accurate volatility estimation, the analysis relies on daily price data. Panel regression models are estimated using cluster-robust standard errors, following [20], to correct for potential cross-sectional and temporal dependencies.

Chapter 4, employs a correlation-based innovation decomposition, where stock returns are modeled as a linear combination of market and firm-specific shocks via a correlation parameter. This structure facilitates direct sensitivity analysis of expected returns with respect to correlation and investor risk aversion, integrating the Carhart four-factor model and ESG dimensions. It offers a compact and empirically tractable framework for analyzing excess returns and pricing idiosyncratic volatility. Recent literature supports this approach; see, for instance, [21] and [22]. is built around a Carhart four-factor framework, which is widely used and empirically validated. It integrates market excess return, size (SMB), value (HML), and momentum (MOM). This makes it directly compatible with standard regression techniques and datasets commonly used in empirical finance. Therefore, it offers granularity as it is compact and has a correlation-driven structure, suitable for empirical testing with factor models and investor behavior.

During the second phase, the quantitative analysis is complemented by additional methodological input, which contributes to a more holistic understanding of the research problem. We analyze daily price data for all SP 500 components from April 2000 to April 2021, sourced from Bloomberg. The data set includes dividends, capital gains, and adjustments for capital changes such as stock splits and scrip dividends. The sample period spans major market events, including the 2007–2008 Global Financial Crisis and the signing of the Paris Agreement in December 2015, both of which contributed to the growing emphasis on ESG investing.

To assess risk, we compute the distribution of stock-level returns that are not attributable to market-wide factors. Specifically, we employ three measures: (1) market volatility, calculated as the standard deviation of daily S&P500 returns; (2) total firm-level volatility, calculated as the standard deviation of each stock's daily returns; and (3) idiosyncratic volatility, defined as the difference between firm-specific and market volatility, based on a rolling standard deviation window of one month.

ESG data are sourced from Thomson Reuters and are available annually over the same period. These ratings offer a widely recognized benchmark for ESG performance, covering over 6,500 firms, including all S&P500 constituents since 2002. ESG scores are constructed from more than 400 raw indicators, of which 178 are standardized and aggregated into 10 thematic categories in the dimensions of environmental (E), social (S) and governance (G).

Environmental scores capture corporate behavior in areas such as resource use, emissions, and innovation. Social scores assess aspects including human rights, labor relations, community involvement, and product responsibility. Governance scores address corporate structure, executive compensation, shareholder rights, and transparency. Each category is weighted proportionally based on the number of underlying indicators, with greater disclosure contributing to higher weights.

Category scores are derived using a percentile rank methodology that mitigates sensitivity to outliers. The ranking accounts for the relative position of each firm compared to peers, and polarity adjustments ensure consistent interpretation across all indicators. The overall ESG score is the weighted sum of the ten category scores, reflecting both the breadth and depth of a firm's sustainability practices.

Having established the fact that ESG matters through the theoretical foundation through which ESG metrics influence corporate financial performance, we now turn to a comprehensive review of the existing literature. This chapter critically examines empirical studies, develops existing theories and outlines the transmission mechanisms. By synthesizing key findings and identifying prevailing patterns, contradictions, and gaps, the review provides a bridge between the theoretical and empirical insights from both chapters 3 and 4, showing how ESG performance can directly influence the pricing of risk in capital markets. We provide a broader understanding of how sustainability practices are evaluated and interpreted within financial economics. This sets the stage for a more nuanced discussion of ESG's evolving role in shaping corporate strategy and investor behavior.

Chapter 2 ESG, Corporate Financial Performance and Idiosyncratic Risk: A critical Review

Abstract

In the last twenty years, researchers and professionals have aimed to assess the financial payoff of sustainable business practices by investigating the relationship between environmental, social, and governance (ESG) metrics and corporate financial performance (CFP). Using a discounted-cash-flow approach, this review synthesizes evidence from financial-economics research and maps the impact of ESG on three transmission channels: (i) future cash-flow generation, (ii) idiosyncratic and downside risk, and (iii) systematic risk. We assess whether a durable, positive ESG-CFP link holds in respect of profitability, dividend policy, volatility, and tail-risk measures. The cumulative evidence indicates that robust ESG performance generally enhances operating profits, improves overall financial results, and facilitates higher dividend distributions, although these benefits are contingent on market conditions, investment horizons, and geographic settings. Understanding these contingencies elucidates the core channels by which ESG affects valuation. Beyond its financial significance, ESG acts as a conduit for advancing the Sustainable Development Goals of the United Nations: it bolsters SDG 8 (Decent Work and Economic Growth) by fostering resilient long-term business models, advances SDG 12 (Responsible Consumption and Production) through improved corporate accountability, and drives SDG 13 (Climate Action) through the reduction of environmental risks. Consequently, ESG acts as a financial indicator and a strategic tool for sustainability, providing practical guidance to policymakers, investors, and diverse partnerships aiming for SDG 17 (Partnerships for the Goals).

Keywords— ESG Investment, Sustainability, SDGs, Corporate Financial Performance, Idiosyncratic Risk, CSR, Tail-Risk.

2.1 Introduction

Sustainability is a multidimensional principle that encompasses environmental stewardship, social responsibility, and long-term economic viability. It aims to meet present needs without compromising the ability of future generations to meet their needs. Within this framework, corporate social responsibility (CSR) and environmental, social and governance (ESG) practices have emerged as strategic priorities for firms seeking competitive advantage and long-term resilience. ESG metrics serve as measurable proxy for sustainability performance, enabling companies to align with global initiatives such as the Sustainable Development Goals (SDGs) of the United Nations and to communicate their responsible practices to investors and stakeholders.

Corporate Social Responsibility (CSR) is increasingly emerging as a strategic priority for firms seeking competitive advantage. The reputation of a company and the perception of the market of its CSR efforts have become key factors in assessing both the market value and the corporate financial performance (CFP), (see also [23]). Recognizing the importance of CSR, major global initiatives such as the Principles for sustainable investment[1] have called on businesses to adopt responsible practices aimed at advancing environmental sustainability and social well-being. As a result of this process, environmental, social, and governance (ESG) factors have allowed companies to disseminate their responsible practices throughout the wider market.

A substantial body of empirical research has examined the relationship between ESG practices and firm-level financial outcomes. Meta-analyses such as [24], have shown that approximately 90% of studies report a non-negative relationship between ESG and financial performance, with many indicating a positive correlation. In the work of [25], they found that firms with high sustainability profiles outperform their peers in both the stock market and accounting metrics over the long term. These findings suggest that ESG integration can enhance firm value through improved operational efficiency, innovation, and stakeholder trust.

It is also widely argued that the results reported in the literature are highly dependent on the measurement of the ESG/CSR dimensions and firm performance metrics (see [26]). ESG/CSR captures hard-to-observe firm characteristics that translate into tangible financial outcomes. The analysis of the (ESG/CSR-CFP) nexus is highly challenged by divergence in ESG metrics and CSR considerations. Differences in ESG scores among data providers underscore the complexity of aligning sustainability measures with specific firm characteristics. Developing a unified framework to evaluate the impact of ESG/CSR on corporate performance is critical for advancing both theory and practice. Several studies, including [27], [28], and [29], address the divergence of ESG scores, highlighting the difficulty in optimally representing the value of intangible ESG to reflect the specific characteristics of the firm. The dissimilar nature of each pillar (Environmental, Social, and Governance) among data providers makes it unlikely to achieve uniform ESG-CFP effects within a company. Understanding the nature of each sustainability pillar and the various ESG/CSR issues is essential to build theoretical foundations that connect sustainability to the characteristics of firms with hard-to-observe short and long-term financial value.

The analysis of the ESG/CSR link is also challenged by the size factor. This arises from the possibility that inherently competitive and profitable firms are more likely to adopt these practices. The issue of reverse causality holds great importance in the discussion of ESG and financial performance, see [30]. The work of [28] shows that large corporations exhibit higher ESG ratings as companies with higher profitability are expected to have more discretionary funds to allocate to ESG initiatives. They also demonstrate in a portfolio analysis that firms with high ESG scores are less exposed to size risk.

Beyond performance, ESG practices have also been linked to risk mitigation. The research conducted by [12] and others have shown that firms with strong environmental performance tend to experience lower idiosyncratic risk, as measured by stock return volatility. ESG-aligned firms are often better positioned to anticipate and manage regulatory, reputational, and operational risks, which can reduce the variability of their cash-flows and improve their risk-adjusted returns.

In the discounted cash-flow (DCF) framework, firm performance is shaped by three risk channels. Idiosyncratic risk, specific to the firm and not correlated with market movements, is commonly represented by residual volatility from return regressions or firm-specific stock price volatility. Systematic risk, transmitted through the cost of capital, is captured by CAPM betas; higher betas

[1] https://www.unpri.org/about-us/about-the-pri

increase the discount rate and lower firm value. The downside risk, which reflects potential losses from extreme events, combines idiosyncratic and systematic elements, influencing both cash flows and discount rates. Measures such as conditional skewness and tail risk capture this dimension.

This chapter reviews the literature on the ESG/CSR-CFP nexus using the benchmark discounted cash-flow model (DCF). The main objective is to answer the following research question: "To what extent does a firm's ESG/CSR performance influence its corporate financial performance, risk profile, systematic risk, and tail risk, and are these effects consistently positive in different market conditions, time horizons, and geographic regions?".

We contribute to existing academic research by structuring the literature on the ESG/CSR–CFP relationship in the DCF framework. This approach enables us to identify the primary transmission channels: (i) the cash-flow transmission channel, (ii) the discount rate or systematic risk channel, and (iii) the downside risk transmission channel, which emerges as a combination of the first two. These channels guide the specification of our dependent variables. This framework helps to pinpoint the key factors that influence the relationship between ESG/CSR and corporate performance. Consequently, we assess the degree to which the ESG-CFP nexus holds true in different regions, time frames, and economic contexts.

Since cash-flows are defined in terms of EBIT, ESG/CSR characteristics can enhance firm value by boosting revenues. Key variables of interest in this context include revenue growth and performance metrics such as Return on Assets (ROA) and Return on Equity (ROE). Increased cash-flows may also result from cost reductions. Either or both of these mechanisms can contribute to higher firm value, reflected in higher stock prices, improved returns, and stronger expectations of future performance as indicated by Tobin's Q.

Table 2.1: Mapping ESG–DCF Mechanisms to UN Sustainable Development Goals

ESG–DCF Mechanism	Explanation	Linked SDG(s)	Relevant SDG Target(s)
Cash-flow Channel (Profitability via ESG) 8.2 – Promote higher levels of productivity through diversification and innovation 9.4 – Upgrade infrastructure for sustainability and efficiency	ESG practices improve operational efficiency, stakeholder trust, and long-term value creation.	**SDG 8** – Decent Work and Economic Growth **SDG 9** – Industry, Innovation	Infrastructure
Idiosyncratic Risk Reduction Strong Institutions	Strong governance and ethical practices lower firm-specific risks, such as reputational and legal risks. 12.6 – Encourage companies to adopt sustainable practices 16.6 – Develop effective, accountable, and transparent institutions	**SDG 12** – Responsible Consumption	Production **SDG 16** – Peace, Justice
Downside Risk Mitigation 12.4 – Environmentally sound management of chemicals and waste 13.1 – Strengthen resilience and adaptive capacity to climate-related hazards	ESG helps firms prepare for and absorb environmental, social, and regulatory shocks.	**SDG 12** – Responsible Consumption	Production **SDG 13** – Climate Action
Cost of Capital Reduction (Systematic Risk Channel)	High ESG scores attract long-term investors and reduce perceived investment risk.	**SDG 8** – Decent Work and Economic Growth **SDG 17** – Partnerships for the Goals	8.10 – Strengthen the capacity of domestic financial institutions 17.3 – Mobilize financial resources for sustainable development

The table above illustrates how the financial mechanisms identified in this review contribute directly to the achievement of specific UN Sustainable Development Goals (SDGs), highlighting the importance of ESG metrics not only in improving corporate financial performance but also in advancing global sustainability agendas.

Specifically, the table outlines how various ESG–DCF (Environmental, Social, and Governance – Discounted Cash-Flow) mechanisms align with specific UN Sustainable Development Goals (SDGs) and their targets. It highlights four key mechanisms: cash-flow channel, which links ESG-driven profitability to SDGs 8 and 9 through innovation and infrastructure; Idiosyncratic Risk Reduction, which emphasizes ethical governance to reduce firm-specific risks, aligning with SDGs 12 and 16; Downside Risk Mitigation, which prepares firms for environmental and regulatory shocks, supporting SDGs 12 and 13; and Cost of Capital Reduction, where strong ESG performance attracts investors and lowers risk, contributing to SDGs 8 and 17. Every mechanism links to particular SDG goals, illustrating how financial and sustainability aims can support each other.

This review is organized as follows. Section 2.2 describes the ESG investment pillars and compares them with the CSR and SRI criteria. Section 2.3 outlines the cash-flow (CF) transmission channel in connection with CFP and idiosyncratic risk. Section 2.4 explores the link between ESG/CSR and systematic risk. Section 2.5 reviews the relationship of the ESG/CSR performance and downside risk under a combination of the cash-flow and discount rate channels. Section 2.6 discusses the remaining gaps in the literature. Finally, section 2.7 offers some concluding remarks.

2.2 ESG characteristics versus CSR and SRI criteria, and research methodology

Before delving into the research, it is essential to clarify the terminology used in the academic literature. Environmental (E), Social (S), and Governance (G), investment refers to a strategy that integrates these three key factors into investment decisions, along with traditional financial metrics. The goal of investing in ESG is to support sustainable and ethical business practices while aiming at competitive financial returns. ESG, was first introduced as an acronym in a 2004 report by the "Who Cares Wins" initiative. This has produced several reports focusing on integrating ESG factors into financial markets.[2]

2.2.1 ESG characteristics versus CSR and SRI criteria

Corporate Social Responsibility (CSR) is increasingly regarded as a key component of competitive strategies of companies. The perceived commitment of a company to CSR has become a significant factor in how the market assesses both its overall reputation and its Corporate Financial Performance (CFP).

ESG investment, as a general concept, implies considering long-term factors when valuing a company. Various investors implement ESG ratings to quantify in the long-run the intangible risks of ESG reflected in stock prices over the long-term. Therefore, ESG metrics provide a public tool for transparency and information on sustainability policies adopted by a company. Rating providers collect data from many publicly available sources (e.g., firm sustainability reports, media sources, company websites, NGOs etc.). This approach serves as an analytical framework for evaluating long-term financial performance along with social and environmental impacts. It is data-driven and centers on three key dimensions, environmental sustainability, social responsibility, and corporate governance.[3] Investors primarily use this framework to identify and assess both financial and non-financial risks and opportunities that can affect firm value over time (see [31]).

It is important to briefly inform the reader about the various ESG rating systems. Each ESG provider applies its own criteria and methodology regarding weighting, which can lead to biased assessments of a company's ESG performance. Portfolio construction using ratings from different providers can result in significant performance dispersion and low correlation of returns, (see for example [32]). Their work highlights discrepancies in ESG ratings for companies like Wells Fargo and Facebook, illustrating how varying assessments can lead to different investment conclusions. In summary, the choice of an ESG rating provider plays a crucial role in shaping investment decisions, and investors must exercise discernment in selecting and interpreting ESG ratings to align with their specific goals and values.

Although ESG and corporate social responsibility (CSR) are often used interchangeably, they differ in several ways. The World Bank defines Corporate Social Responsibility (CSR) as a commitment of businesses to ethical behavior and sustainable economic development through collaboration with stakeholders to improve lives in ways that benefit both business and society. CSR has gained increasing importance in both academic research and business practice globally. Many business leaders now view CSR as a driver of success, growth, innovation, and competitive advantage, (see also [33]). CSR is voluntary, broader in scope than ESG, and focused on corporate contributions to society, emphasizing ethical responsibility and goodwill.[4]

A key difference between ESG and CSR is that ESG directly incorporates governance as a fundamental element, whereas CSR usually addresses governance indirectly through its environmental and social dimensions. As a result, ESG provides a more organized and measurable framework to assess corporate responsibility than CSR (see also [25]).

ESG and CSR practices can also be related to Socially Responsible Investment (SRI), see also [34]. This initiative integrates investment criteria aligned with ESG considerations. SRI encompasses a range of investment products with varying social objectives, from minimizing social harm to actively generating measurable social benefits. SRI can also be defined as an investment process that integrates ethical values, environmental protection, improved social conditions, and

[2]For more information, see the International Finance Corporation's (IFC) website at [https://www.ifc.org)

[3]https://www.sasb.org/

[4]see:https://www.hec.edu/en/institutes-and-centers-expertise/sustainability-organizations/think/executive-factsheets/what-corporate-social-responsability-csr: :text=Corporate

good governance into traditional investment decision making (see also [35]). Unlike ESG, which provides a framework for assessing corporate sustainability, SRI goes a step further by offering specific guidelines for including or excluding investments based on ethical considerations. For instance, an investor may choose to exclude tobacco companies from their portfolio or, conversely, prioritize firms that allocate a significant portion of their profits to charitable causes. The table below identifies the main risks associated with each ESG pillar.

A closer look at the table below shows how ESG factors translate CSR concerns into specific risk categories that influence financial performance and valuation.

With regard to environmental issues, companies face risks from climate change, pollution, resource depletion, and unsustainable land use. These lead to higher costs, regulatory challenges, operational disruptions, reputational damage, legal liabilities, and limited market access. Social issues involve human rights violations, poor labor practices, and conflicts that impact supply chains and workforce productivity. This results in lost innovation opportunities, reduced market access, increased political and financial risks, brand damage, and potential legal actions. Finally, corporate governance issues include poor governance, such as tax avoidance, corruption, lack of transparency, and weak leadership processes, which undermine investor confidence. The consequences include difficulty in financing, increased costs, reputational harm, accounting fraud, loss of business opportunities, and diminished shareholder value.

CSR denotes a company's voluntary commitment to ethical and responsible conduct, emphasizing social and environmental effects, whereas ESG offers a structured, data-centric approach mainly utilized by investors to assess a company's risk and sustainability performance. They have similar objectives, but as explained, they vary in methods, evaluation, and utilization.

Table 2.2: Green Risk Categories and Company Exposure: Own Elaboration

Environmental Issues and Company Risks	
Climate change - industrial pollution - greenhouse effect - extreme weather conditions - natural disasters - Increased atmospheric CO2 gas.	1.1 Higher production costs 1.2 Policy and regulatory risks 1.3 Risks in social license to operate at an industry level
Fracking policies - depletion of water usage - over exploitation - methane emissions.	1.4 Operational and physical risks 1.5 Reputational risks 1.6 Community controversies, bans 1.7 Additional costs of the adverse climatic effect, low economic innovation
Sustainable land use - inefficient supply chains - tropical deforestation and degradation.	1.8 Direct or indirect costs: high reputational risks 1.9 Legal risk 1.1 Market access risks
Social Issues and Company Risks	
Human rights and labor, employee relations, conflict zones.	2.1 Loss of potential benefits from innovative suppliers, low access to market contracts, low motivation and productivity rates and commitment from employees. 2.2 Lack of responsible business, high political, economic and financial risks. 2.3 Lack of human rights in supply chains and increased risks in the production process. Lack of trace ability and market driven changes, supply chain disruption, reduced market share, brand damage, loss of sales, potential lawsuits and fines.
Corporate Governance Issues and Company Risks	
Tax avoidance - executive pay - unethical contracts design - corruption - conflict of interest and creation value for director nominations - cyber security.	3.1 Lack of awareness within companies of investors concerns, low transparency of clear business goals and hence inability of promoting long term value creation. 3.2 Difficulty in ensuring favorable financing, increased operating costs, bad reputation, loss of clients loyalty, deterioration of the social and economic conditions in which the company operates. 3.3 Accounting frauds, large profit losses, exclusion from beneficial business opportunities, damage to brand and share price. 3.3 Direct loss of value for investors, lack of processes to review managerial performance, poor financial planning, lack of a robust process to place and select candidates that can best serve the company.

2.2.2 Research Methodology

We followed a structured multi-step literature review protocol to gather a comprehensive body of evidence on how environmental, social, and governance (ESG) factors affect corporate financial performance. First, we conducted keyword searches on Google Scholar using the terms 'ESG', 'corporate social responsibility (CSR)', 'discount rate', 'idiosyncratic risk', 'volatility', 'tail-risk' and 'financial performance', restricting results to peer-reviewed articles and academic journal articles published in English. Second, we screened titles, abstracts, and, when necessary, full texts. We retained only studies that contained explicit empirical tests linking ESG/CSR metrics with at least one dimension of financial performance (e.g. accounting returns or market-based measures); conceptual or purely descriptive papers were excluded. Third, we expanded our corpus by examining the reference lists of eligible studies and adding any additional articles cited that had an empirical component that met our inclusion criteria.

A total of 85 articles were initially retrieved. The primary inclusion criteria for further selection included the time frame, market conditions (comparing the U.S., EU, and emerging markets), and geographic diversity. We view the time frame as a crucial element for comprehending both the effects of ESG and its development, especially in light of the significant increase in sustainable and responsible investments.

We categorized studies into those conducted before the 2008 global financial crisis and those from 2008 through the recent post-COVID-19 period. We also sought to tackle the problem of reverse causality in the ESG–corporate financial performance (CFP) relationship to evaluate the effects of ESG initiatives from a holistic viewpoint. Every selected article was later reviewed in full.

In addition, the search was enriched by the use of two large-language-model-based academic discovery tools, Consensus and Elicit, which surfaced recent or less traditionally indexed work. All candidate papers retrieved through these platforms were subjected to the same screening and inclusion filters. This process yielded a focused, yet representative set of studies that underpins the analysis reported in this chapter.

2.3 The cash-flow transmission channel, corporate financial performance and idiosyncratic risk

We employ the work of [4] and use the discounted cash-flow (DCF) model to decompose and review the financial and economic impact of ESG factors focusing on their effects on performance through the lens of cash-flow, idiosyncratic and systematic risk transmission. The framework is used to address the following issues, a) the channels through which ESG characteristics deliver financial performance, b) the key variables shaping corporate performance that should be examined to quantify the ESG impact.

We define the DCF model as:

$$\text{Firm Value} = \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t} \tag{1}$$

CF_t is the predicted cash flow. r is the discount rate (e.g., required rate of return or cost of capital, which can be proxies for the Weighted Average Cost of Capital or WAcc) t is the time period (from 1 to n) n is the total number of periods in the projection.

The DCF framework, which defines a company's value as the sum of its future cash flows discounted by the cost of capital, is used to decompose the impact of a firm's ESG/CSR profile on equity valuation. It identifies three key mechanisms through which ESG/CSR characteristics influence corporate financial performance (CFP). These are structured around the two main components of the DCF model, the numerator (cash-flows) and the denominator (discount rate or cost of capital).

The cash-flow channel of ESG practices refers to how a firm's ESG initiatives impact its financial performance through changes in the firm's cash-flow (CF). The existing literature investigates multiple channels through which Environmental, Social, and Governance practices influence firm-level financial performance, particularly in terms of revenues, costs, and overall cash-flow generation.

A key mechanism by which ESG practices affect corporate cash-flows is through revenue enhancement, facilitated by market differentiation and the strengthening of brand equity. ESG initiatives can boost a company's revenue by attracting consumers who prioritize sustainable and ethical products (see [36]). Companies with strong ESG commitments often achieve higher customer loyalty and brand value, leading to stable or increasing revenues (see [13]). In addition, companies investing in ESG can access new markets and benefit from premium pricing on sustainable products. The positive impact of ESG practices on future cash-flows can also manifest through cost reductions and efficiency gains. Specifically, ESG initiatives contribute to improved operational efficiency by lowering energy consumption and minimizing waste management expenses (see [4]). In addition, the adoption of sustainable supply chain practices has been shown to reduce procurement expenditures and optimize resource utilization. Lastly, companies with strong ESG policies tend to experience higher employee productivity and retention, reducing recruitment and training expenses (see [37]). The different mechanisms through which ESG practices improve revenues contribute to a firm's competitive advantage, resulting in improved abnormal returns, higher profitability, and higher dividends (see [38]). What follows is a summary of the literature that examines the relationship between ESG performance and firm outcomes through the cash-flow channel.

2.3.1 The link between performance, value and ESG practices

In this subsection, we review the relevant literature on the relationship between financial performance, value, ESG, CSR, and SRI. There are increasing numbers of studies from both academia and institutional asset management that have examined the potential financial benefits of investing in ESG. The analysis in the work of [24] provides an extensive review, reporting that over 90% of the literature reveals a non-negative relationship between ESG and financial performance, with the majority indicating positive results (see also [39].) The study reviews over 2,000 empirical papers spanning the fields of management, accounting, finance, and economics. Within the finance literature, various methodological approaches are employed to examine the relationship between ESG commitment and firm performance. Performance and firm value are typically evaluated using metrics such as short- and long-term stock returns or Tobin's Q.

The work of [40] concludes that ESG can enhance CSR, highlighting that further standardizing efforts are needed given the differences between regions and sectors. ESG investment emerges as a strategy that companies use to differentiate. Thus, the cost of ESG investment represents an act of assuming social responsibility in pursuit of future economic benefits and higher long-term profitability. They argue that ESG and CSR are integral to the global financial system. However, they highlight the lack of adequate financial metrics to evaluate their impact and enforce sanctions for non-compliance. Therefore, their arguments are consistent with the use of the DCF model to disentangle the different transmission channels. This consequently creates economic pressure on firms to fulfill their ESG responsibilities. Finally, they emphasize the need for further research on ESG investment from a CSR perspective to deepen the understanding of its contribution to firm value.

The effect of ESG/CSR policies can increase income as well as enhance operational efficiency. Higher CSR-rated companies leverage their competitive advantage to generate higher levels of profitability, which is reflected in the numerator of the DCF model, the cash-flow channel. The impact of higher ESG or CSR compliance enhances profitability through increased revenues or lower costs, hence increasing firm value. The relationship between ESG/CSR policies and firm value has been studied with mixed conclusions. Some theoretical studies, such as [29] and [23], suggest that higher ESG performance can increase firm value but also argue that sometimes CSR activities can create managerial agency problems. Corporate managers may pursue CSR-friendly activities that maximize personal utility at the expense of shareholder welfare, as analyzed in [29]. Academic research identifies various ways sustainability commitments can create firm-specific value. First, CSR activities can enhance shareholder wealth by increasing future profitability and, hence, cash flows (e.g., attracting investors, improving employee satisfaction and productivity).[5] Second, ESG activities may create value by maximizing shareholder utility. Beyond higher cash flows, shareholders might value the environmental and social benefits of ESG practices, deriving greater

[5]This literature also discusses the role of lower discount rates (e.g. lowering the cost of capital) in increasing firm value.

utility from responsible firms even if cash flows remain unchanged compared to irresponsible firms. In a seminal contribution, [41] examines both the financial and real-world impacts of sustainable investment within a highly manageable equilibrium framework. In doing this, they discuss how agents obtain higher utility from holdings of green firms and inutility from investing in a brown firm.

Furthermore, [42] uses panel data from Chinese listed companies from 2017 to 2021, with Reuters as the source for stock prices and ESG scores. They find that ESG scores negatively correlate with Tobin's Q, indicating that Chinese stocks tend to be undervalued as their ESG ratings increase. While the social and governance pillars are insignificant, only the environmental score explains this correlation. Their results remain robust with fixed effects. When ROA is used as a dependent variable, none of the ESG factors is significant, implying that investment in ESG does not substantially improve ROA. Similar results are observed with ROE. They conclude that ESG practices are not fully reflected in financial performance as ESG remains a relatively new concept not yet integrated as a core corporate strategy in China.

The relationship between ESG and CFP can also work in the reverse direction: higher-value firms with strong financial performance may exhibit higher ESG scores, as larger companies are better equipped to allocate resources to ESG activities. The evidence supports this association, with higher CSR performance often observed in firms with greater resources and in developed countries. It is important to understand the complex reverse causality relationship in order to assess the true impact of ESG metrics on financial performance.

Several studies suggest that firms with high profitability or large market share are more likely to engage in ESG practices, for reasons like reputation management and resource availability. Profitable firms have more capital to allocate to long-term ESG initiatives, such as sustainability commitment programs, social work and community engagement, or employee welfare schemes, (see [43]). In their work they do not address the reverse causality explicitly, but they include control variables such as size, profitability, leverage, and growth opportunities, which helps mitigate the possibility that financially healthier firms are simply more likely to engage in CSR activities.

In addition, financially successful firms often face greater public and social scrutiny. Hence, they use ESG adoption as a tool for managing their reputation and reducing social and regulatory risks, (see also [30]). In their work, they emphasize a holistic view of CSR, where both external and internal actions related to CSR, influence the financial conditions of the fim. External actions refer to public-driven (e.g. implementing green technology, reducing carbon emissions, philanthropic actions, or public commitments). Internal actions involve employee satisfaction, corporate culture, and the integration of CSR principles to management decisions. They measure financial performance by assessing the ROA and Tobin's Q. They utilize both the stakeholder theory, focusing on both external and internal aspects to achieve long-term value, and the resource-based view, which suggests that firms with unique and valuable resources (employee engagement, strong reputation, strong ESG commitment) can gain an effective competitive advantage. Their key finding is that internal CSR, when along with aligned corporate culture, becomes a stronger predictor of long-term financial returns. The greater the gap between internal and external action is associated to 26.5 percent lower market value than the average. On the other hand, when the gap is equal to zero, the market value is 36.5 percent higher than the average. Synergistic effects can be key, as firms aligning their internal and external CSR efforts can build a more consistent and authentic CSR brand, potentially leading to higher stock market performance and improved financial returns, which in turn could foster higher levels of commitment.

This result is compatible with the bidirectional relationship ESG-CFP, meaning that strong financial performance leads to better ESG adoption, and strong ESG practices further improve financial outcomes. Finally, companies with strong financial performance and stability are adopting long-term strategic goals and hence ESG initiatives. They usually face greater pressure from their stakeholders, such as customers, investors, and regulators, and thus they focus on sustainability as a strategic issue rather than a short-term goal. Related contributions that address the reverse causality issue in the ESG literature include [24], [44], [45], [46].

The work of [47] examines the relationship between corporate social responsibility (CSR) and firm performance, considering firm size as a key factor. It finds that larger firms tend to have more structured CSR activities and greater capacity to engage in socially responsible practices. Although this chapter focuses primarily on CSR, the findings are relevant for ESG, as CSR is an essential component of the "S" (Social) factor in ESG. Similarly, the analysis of [25] examine how companies that adopt sustainability practices (including ESG factors) perform over time, focusing on large versus small companies. The authors find that firms with robust sustainability practices tend to perform better financially in the long run, and this effect is particularly strong for large companies due to their ability to invest more in sustainability.

Likewise, the study by [48] investigates the relationship between company size, ESG performance, and financial performance. They find that larger firms tend to perform better in terms of ESG scores because they have more resources, governance structures, and transparency. However, the relationship between ESG performance and financial returns is more pronounced in larger companies. Higher-value firms and better financial performance can lead to higher ESG performance, as larger firms are better equipped to allocate resources to ESG activities. Both directions of causality predict a positive association between ESG performance and shareholder wealth. There is enough evidence to support this association, with higher CSR performance often seen in firms with greater resources and in developed countries. Identifying the direction of causality remains an important issue.

In contrast, some argue that CSR activities can create problems for the management agencies. Corporate managers may pursue activities that maximize personal utility at the expense of shareholder welfare, as analyzed in [29].

A related strand of research suggests that companies that offer high-quality environmental and social disclosures can reduce informational asymmetry. Effective corporate ESG reporting is recognized as a key tool for enhancing corporate reputation, (see [49]). The overall conclusion is that there are two directions of causality within the ESG-CFP link and that both effects relationships predict a positive association between ESG performance and shareholder wealth.

Table 2.3, presents performance metrics and their relationship with environmental, social and governance (ESG) scores or corporate social responsibility (CSR) data in various countries and time periods. Reported results show that there is a significant variation in terms of geographical scope and sample periods, as well as performance measures used in the analysis. Most importantly, the sign of the ESG/CSR-CFP nexus varies.

Regional trends show that in the Chinese economy, there are mostly positive results for the ESG/CSR link, ([42]). In the US, studies generally support a positive long-term impact of ESG ([13], [25]), while some studies with a short-run focus find neutral or negative effects on ROA. In Europe, we find more mixed findings, likely due to stricter ESG norms and variation across countries. Cross-continental studies ([50], [30]) generally show a positive long-run performance effect.

In many cases, a positive relationship is observed between ESG/CSR performance and financial performance metrics, particularly for firms in the USA, China, and Europe. This positive association is especially evident in metrics such as equity returns and firm valuation indicators (e.g., Tobin's Q). However, a negative relationship has been reported in a few instances, such as for Tobin's Q in the USA during 2007 ([51]), possibly reflecting market reactions to ESG in crisis periods or perceived inefficiencies.

The overall body of evidence supports the view that ESG/CSR is value-enhancing, particularly over the long term. This is most consistently demonstrated in studies using market-based measures such as stock returns or long-run performance.

In contrast, short-term results and accounting-based indicators (e.g., ROA, ROE) may understate this relationship, likely due to implementation lags, reporting inconsistencies, or the delayed realization of ESG benefits.

When short-run returns or limited time frames are analyzed, as in event studies or single-year snapshots, the findings tend to be mixed or negative, highlighting the time-dependent nature of ESG impact. This aligns with the understanding that ESG initiatives are typically long-term strategic programs, often embedded within a broader corporate governance framework.

Several studies reported mixed results, with both positive and negative effects observed depending on the metric or time horizon (e.g., excess returns in Europe, short-term returns in the USA). Additionally, a null relationship was found in some contexts, such as revenue growth in the USA between 2003 and 2009 ([52]), further emphasizing the complexity and multi-dimensionality of ESG-financial performance linkages.

Table 2.3: Performance Metrics, Value, and ESG

Sample	Sample Period	Performance Metric	Ind/Dependent	Sign	Citation
CHINA	2009-2021	Value Added of Assets	Independent	+	Yuer et al. 2024
CHINA	2017-2021	ROA, ROE, Tobin´s Q	Dependent	+/-	Zhao et al. 2023
EUROPE	2005-2019	Excess returns	Independent	+/-	Bermejo et al. 2021
USA	1991-2011	Stock returns	Dependent	+	Chang et al. 2019
USA	2003-2015	Tobin´s Q	Dependent	+	Alburquerque et al. 2019
USA	1991-2013	Firm Value	Independent	+	Meng 2019
USA	2007	Tobin´s Q	Dependent	-	Buchanan et al. 2018
USA/Europe	2007-2015	Long-run returns	Dependent	+	Glosner 2017
USA/Europe	2002-2008	ROA, ROE, Tobin´s Q	Dependent	+	Hawn et al 2016
USA	2001-2007	Short run returns	Dependent	+/-	Kruger 2015
USA	2002-2011	Portfolio returns	Dependent	+/-	Halbritter 2015
USA	1993-2010	Stock portfolio returns	Dependent	+	Eccles 2014
USA	2003-2009	Revenue Growth	Dependent	0	Di Giuli and Kostovetsky 2014
USA	2003-2009	ROA	Dependent	-	Di Giuli and Kostovetsky 2014
USA	1991-1995/1996-2000/2001-2008	Financial Constraints	Independent	-	Hong et al 2012
USA	1984-2009	Long-run returns	Dependent	+	Edmans 2011
USA	1998-2002	DJSI	Dependent	+	Lee Faff 2009

This table summarizes the results proposed to relate to ESG/CSR in the academic literature on firm-specific value and performance. For each paper cited, we report the variable of interest, whether it is an independent or dependent variable. The sign indicates the direction of the relationship between the ESG / CSR and the performance metric. 0 indicates that no significant relation was found. Both +/- means relationships in both directions have been found among different ESG metrics.

Studies such as [28] use three different sources of ESG ratings. Bloomberg, Asset4, Reuters, and KLD. They highlight that results can be biased depending on the underlying rating approach. In addition, they emphasize the limitations arising from the use of short periods in other studies, arguing that cross-sectional regressions provide better insight into ESG levels and their effect on stock returns. Using a sample period from 1990 to 2011, they combine and normalize ESG metrics from the three providers. They employ a time-series portfolio approaches to evaluate the performance of the ESG ratings, applying the Carhart four-factor model [17]. To gain further insight, they conducted a cross-sectional regression analysis, following the panel-based strategy of [53], to analyze the direct impact of ESG values on returns. Their findings show no significant return differences between firms with high and low ESG ratings. Cross-sectional regressions reveal an ambiguous influence of ESG variables depending on the rating provider.

Interestingly, [52] utilize KLD ratings at the firm level and find no evidence of companies recovering ESG expenditures through sales. They report a negative relationship between increases in ESG ratings and future stock returns, along with declines in firm ROA. This implies that the benefits of the commitment to sustainability are achieved at the expense of firm value. Their sample includes a panel of the Russell 3000 index from 2003 to 2009. They calculate KLD scores by summing up 56 categories for each firm-year observation and regressing stock returns on the prior year's levels of KLD strengths, concerns, and overall ratings. Their results indicate that KLD scores have no effect on stock returns. Firms with Democratic-leaning insiders that increase CSR scores experience a drop in future stock returns of about 1.8 percent per year. The effect is statistically significant, particularly for firms that already had high CSR scores. They conclude that expanding sustainability commitments leads to long-term declines in financial performance and ROA, interpreting stock declines as delayed market reactions to ESG policies due to the investors' learning processes.

Conversely, studies such as [23] report a significantly positive relationship between ESG ratings and financial performance. They find that firms with high product differentiation benefit from favorable sustainability policies. They find that firms with higher CSR scores exhibit higher Tobin´s Q values as a result of greater market valuation. A one standard deviation rise in CSR leads to a 0.087 increase in Tobin's Q, which is approximately a 5 percent increase relative to the average Tobin´s Q of 1.885. These results are even more significant in firms with higher levels of product differentiation, they use advertising levels as a proxy of product differentiation. The rise in Tobin´s Q is 0.356 higher due to CSR than companies without advertising expenditure.

On the other hand, [54] takes an alternative approach by examining the relationship between firm cash holdings and CSR performance. Using KLD ratings for US corporations from 1991 to 2011, they regress firm cash holdings on CSR performance and estimate the effect on cash value. The positive link between CSR and cash holdings is solid and statistically significant at 1% level in firms whose sustainability commitments is related to internal actions as in [30]. They control for firm-specific factors such as size, profitability, and leverage. A one standard deviation increase in the CSR score is associated with a 0.7 to 1.3 percentage point increase in the cash-to-assets ratio. Their findings indicate that an additional dollar increase in cash has a more significant impact on firm value for higher ESG-rated companies, suggesting that sustainability commitments enhance firm value.

Additional studies support the positive effects of CSR/ESG on financial performance. [13] uses a 14-year period from 1984 to 2009 and demonstrates a positive correlation between employee satisfaction and long-run returns, indicating that sustainability policies create firm value. More analytically, they report that companies listed in the "100 Best Companies to Work For in America" gain an annual alpha of 3.5 percent from 1984 up to 2009, outperforming industry benchmarks by 2.1 percentage points. Similarly, [55] analyzes US banks and concludes that poor performance is positively related to the overall ESG index (using KLD ratings), suggesting that CSR activities are rewarded with improved financial performance.

Several studies focus on short-term market reactions to ESG events. [12] analyzes stock market reactions to more than 2,000 positive and negative sustainability events for US companies using the KLD Socrates database. They find significant differences in market responses: investors respond strongly and negatively to adverse events and weakly and negatively to positive events. Adverse reactions are particularly pronounced for information about communities and the environment. The authors estimate a median cost of $76 million for adverse events, indicating substantial expenses associated with corporate irresponsibility. Their results also show that adverse events provide information about legal risks and economic contexts, aligning with the view that unsustainable behavior is costly to shareholders.

A different approach used by [51] contributes to the ESG literature by showing that the effect of the CSR value varies with institutional ownership levels. Using Bloomberg ESG ratings as a proxy for CSR quality, they examine the impact of CSR on firm value changes during the financial crisis. They find that CSR participation can negatively affect the value of the firm, particularly during severe agency conflicts. High ESG/CSR investment costs are cited as the reason for more significant value declines among firms with strong sustainability commitments during the crisis. In normal market conditions before the 2008 financial crisis, more responsible firms show a Tobin´s Q 5 or 7 percent higher than non-CSR firms, on average. In general, they find that CSR contributes to firm value in normal market conditions and decreases firm value during a crisis unless there is strong institutional oversight.

2.3.2 ESG as a Risk Mitigator

In the framework proposed by [4], ESG performance may also affect future cash flows and hence valuations through two channels. The systematic risk channel, as ESG reduces exposures to market-wide risks, lowering the firm's cost-of-capital. The idiosyncratic risk channel, ESG performance improves stability and predictability of future cash-flows, reducing the volatility premium investors demand and hence variations in idiosyncratic (as well as tail-downside-risk) risk exposures. Various studies have argued that ESG can influence a company's risk profile through several channels. These include idiosyncratic risks and, more specifically, reputational, product development and litigation risk.

Table 2.4, documents studies that use idiosyncratic risk as the main research variable. Data reported in column 1 show that the literature addressing the ESG/CSR nexus covers different geographic areas and time periods. Column 2 highlights the heterogeneity of sample periods used while column 3 reports the different measures of idiosyncratic risk applied. A large number of idiosyncratic risk measures are used, including Z-scores, implied volatility, residuals from asset pricing models (e.g., FF3, FF4, FF5, Carhart 4-factor), among others. Idiosyncratic risk refers to the pure firm specific measures that the academic literature analyzes when examining the ESG performance nexus.[6] The third column explains how the variable of idiosyncratic risk is measured and defined in relation to ESG. The reported results indicate that companies with high ESG ratings have historically shown lower idiosyncratic volatility and better management of company-specific risks.

A substantial number of studies identify a negative relationship between ESG performance and idiosyncratic risk, suggesting that firms with stronger ESG profiles tend to experience lower firm-

[6] Note that there are some instances in which the ESG measures have been used as a proxy for idiosyncratic risk

specific risk or volatility. This negative association has been documented across various markets, including the US, China, Europe, and Australia, and is particularly robust in studies employing residual-based risk measures derived from models such as Fama-French (FF3, FF4, FF5) or the Carhart 4-factor model.

This evidence supports the hypothesis that ESG/CSR engagement functions as a risk mitigation mechanism, especially over longer time horizons. ESG-oriented firms may benefit from reduced exposure to operational disruptions, regulatory penalties, and reputational shocks, thereby lowering their idiosyncratic risk. These benefits appear to accrue over time, which aligns with the notion that ESG is a long-term strategic investment rather than a short-term performance lever.

Similar to the financial performance literature, findings based on short-term or event-based measures of risk (e.g., implied volatility or portfolio-based proxies) are more likely to produce mixed or inconsistent results. For example, studies using options data or short-term Z-score models occasionally report ambiguous or even positive relationships, potentially reflecting investor uncertainty or ESG over-investment concerns in the short term.

Some studies observed no significant relationship, especially when risk was treated as an independent variable or when measurement frameworks lacked consistency across firms and time (e.g., [56], [57]). Nonetheless, the dominant trend through the literature is that ESG engagement is associated with reduced idiosyncratic risk, reinforcing the view that such practices contribute to corporate resilience and long-term stability.

Table 2.4: The link between Idiosyncratic Risk and ESG

Sample	Sample Period	Idiosyncratic Risk	Ind/Dependent	Sign	Citation
Taiwan	2007-2022	Z-score elaboration	Dependent	+/-	Liu 2024
USA	2005-2020	Options Implied Volatility	Dependent	+/-	Sautner 2023
USA	1991-2018	Residuals of 4-factor Carhart model	Dependent	-	Horn 2023
China	2012-2022	FF3, FF4, FF5 residuals	Independent	-	D Liu, et al. 2023
USA	2006-2018	Vine-Risk measures	Independent	+	Bax et al. 2023
Europe	2002-2015	Excess Returns	Independent	+	Jarjir et al. 2022
World	2011-2020	ESG Indices	Independent	-	Jin 2022
China	2006-2019	CSR	Dependent	-	He et al. 2022
USA	2002-2018	FF3 residuals	Dependent	-	Reber 2022
Australia(ASX)	2007-2017	Cost of capital/FF3 residuals	Dependent	-	Gholami 2022
USA IPOS	2002-2018	FF3 residuals	Dependent	-	Gold 2021
Malaysia	2005-2018	Cost of capital/FF3 residuals	Dependent	-	Wong 2021
China	2011-2017	FF3 residuals	Dependent	-	Xiaoran Kong, et al. 2020
USA	2003-2015	Tobin´s Q	Dependent	+	Alburquerque et al 2019
Spain	2006-2011	Corporate reputation	Dependent	+	Odriozola 2017
Europe	2002-2014	Residuals 4-factor Carhart Model	Dependent	-	Sassen 2016
Poland	2012-2013	Portfolio approach	Dependent		Cherwinska 2015
USA	2003-2015	Tobins Q/Firm Value	Dependent	+	Albuquerque et al. 2018
USA	1992-2005/2006-2010	Deterministic estimation	Dependent	-	Becchetti 2015
USA	2007-2012	Portfolio approach	Portfolio approach	-	Clayman 2014
UK	2002-2011	Residuals of 4-factor Carhart model	Independent	0	Humphrey 2012
World	1998-2002	CAPM/Residuals of 6- factor model	Dependent	-	Lee, Faff 2009
Canada	1995-1999	Market Model/Campbell 2001	Portfolio approach	-	Savaria 2004

This table summarizes the results proposed to relate to ESGR in the academic literature on firm-specific downside risk. For each paper cited, we report the variable of interest, whether it is an independent or dependent variable. The sign indicates the direction of the relationship between the ESG and the performance metric. 0 indicates that no significant relation was found. Both +/- means relationships in both directions have been found among different ESG metrics.

Recent studies (post-2020) lean more strongly towards a negative ESG-risk link, likely due to better ESG data quality, higher investor sensitivity to sustainability (post-covid period), or improved econometric modeling. The type of idiosyncratic measure that matters, that is, residual-based models (FF3, Carhart, etc.), are more consistent in showing negative relationships with ESG, indicating that ESG helps to reduce firm-specific noise or volatility. Market-based measures (e.g., Tobin's Q, options implied volatility) produce mixed results, probably because they capture market expectations or strategic ESG signaling. Portfolio approaches also produce mixed results, often lacking statistical detail or consistency over time.

This positive correlation is seen in regions such as the USA (e.g., for Tobin's Q and firm value), Europe (excess returns), and Australia (cost-of-capital). In many cases, studies find a negative relationship between ESG/CSR and idiosyncratic risk. For example, residuals from asset pricing models (FF3, FF4, FF5) show negative correlations, particularly in regions such as China, the USA, and the rest of the world. Other research finds a mixed relationship (both positive and negative results depending on the specific ESG metric), such as in Taiwan (Z-score) and the USA (options-implied volatility). The study regarding the UK (2002-2011) finds no significant relationship between ESG and idiosyncratic risk using the Carhart model residuals. The table also indicates that while most research considers idiosyncratic risk as the dependent variable, examining its relationship with ESG/CSR factors, some analyses use ESG/CSR metrics as independent variables, assessing their impact on idiosyncratic risk.

The work of [58] particularly focuses on the impact stemming from the additional costs and risks resulting from ESG investment. They investigate Taiwan's financial industry from 2007 to 2022 in order to shed light on the link between CSR, capital costs, and business risk. They construct a z-score to represent risk as the degree of bankruptcy and financial distress of the companies. They use accounting variables such as earnings, revenue, working capital, earnings before interest, and the market value of the company to construct the z-score, assigning multipliers that are firm-specific (that is, idiosyncratic). ESG scores for 2017 to 2022 period are used as reference data. They find that for the full sample and for financial holding companies, the overall ESG score has a significant positive effect on the z-score at the 5% significance level with a low impact coefficient of -0.005, meaning that banks that have implemented ESG strategies exhibit a lower financial risk. The environmental sustainability and corporate commitment scores in CSR have a negative impact on the z-score at a 10% significance level, with negative coefficient of -0.575 and -0.498 respectively. The social pillar is not significant, and the environmental score is negatively significant at 5% level with a coefficient of -0.017. They interpret that an indirect risk banks face arises from clients who do not respond rapidly to changes in environmental policies, hence causing increased costs for banks and further risk. Additionally, they show that corporate governance has a significant impact at the 1% level and a positive 0.033 correlation with the z-score, which means that good corporate governance can improve business performance and reduce risks in the case of financial holdings.

Moreover, the research conducted by [59] analyzes risk premiums in 18 European countries using ESG ratings as a proxy for CSR. The monthly returns for European stocks from June 2002 to May 2015 are extracted from Thomson Reuters. Stocks are classified into three ESG groups (good, bad, neutral), and then linked to financial ratings which is used as the dependent variable. Risk premiums are determined by the excess return of lower-rated firms compared to higher-rated ones. This risk class is labeled as "footprint risk." Reported results reflect that poor ESG practices lead to lower ratings in the medium to long-term. They further conclude that companies with low ESG ratings yield higher expected returns to compensate for higher risks. This is consistent with the work of [60], [61], and [62], which report similar results in a multi-sector panel analysis of us equity based on carbon emissions and stock returns. This related literature also supports the existence of a carbon premium using carbon emissions firm-level data. It should be noted that this conjecture is challenged by the work of [63], which shows that green firms offer risk-hedging statistical properties and therefore lower returns. [41] discusses how the increased perception of climate risk is reflected in green expected and realized returns.

In particular, [64] **i**nvestigate the relationship between ESG criteria and idiosyncratic risk in Australian companies from 2007 to 2017 using Bloomberg data. Their panel regression analysis shows that higher ESG ratings correlate with lower financing costs and reduced idiosyncratic risk.[7] They emphasize that corporate ESG disclosures mitigate firm-specific risks, providing better access to financing. They suggest that future research should focus on non-listed small and medium-sized companies while controlling for diverse economic conditions and cultural environments.

Similarly, [57] report comparable results using USA sample of SP 500 companies for the period from 2007 to 2012. They provide an in-depth analysis of the documented negative nexus between ESG and volatility. They conducted Chi-square frequency tests and demonstrated that higher CSR-rated companies tend to be in the low-volatility groups, while low ESG-rated firms tended to be in high-volatility groups in a statistically significant manner for all the time periods considered. Both high CSR companies and low volatility resulted in higher stock returns, but the ESG effect is documented to be an independent driver of greater returns. Hence, they argue that there was value creation in using sustainability criteria in investment decisions.

As explored by [16], it is found that firms with high corporate social performance (CSP) exhibit lower idiosyncratic risk. They calculate idiosyncratic risk using the CAPM and the six-factor market model, showing that CSP differences explain return variations. High CSP firms achieve lower volatility, and their portfolios yield higher returns. They also emphasize the importance

[7] Note that the effect on the cost of capital will be analyzed in section 4.

of using the Dow Jones Sustainability Index (DJSI) as a multidimensional sustainability measure. They calculate idiosyncratic risk in two ways. Firstly, they follow [65] and [66] and use the CAPM to estimate the firm's idiosyncratic risk. They also use the six-factor market model. The idiosyncratic risk is then computed using annual time series regressions, repeating the same process on a five-year basis. Similar methods of computing idiosyncratic risk are also used in [64], [67], [68], [16], and [65]. In their paper, the firm's idiosyncratic risk is taken as the square root of the residual variance captured in each of the models considered. They report that a significant part of the difference in returns between leading CSP and lagging CSP firms or portfolios is explained by differences in idiosyncratic risk.

Earlier studies on idiosyncratic risk and CSR performance include [66]. They analyze a relatively small sample of Canadian firms over the 1995-1999 period. They report evidence of significantly lower idiosyncratic risk for higher socially responsible firms when compared to lower socially responsible companies. In a related paper, [69] we find evidence of lower risk in leading CSP firms. [70] argue the relevance of idiosyncratic risk for equity prices. They believe that the size effect found by [71] could be a proxy for the varying idiosyncratic risks of small and large firms. Secondly, they imply that portfolio managers and investors may reasonably seek an additional risk premium for individual company issues perceived to have exceptionally high specific risk. The latter is consistent with the notion of market friction and imperfect capital market assumptions.

In a later study, [27], it is argued that ESG information is perceived to provide insights about risk rather than the competitive position of the firm (see also [38]). They use a survey approach to first pose the question of what motivates investors to use ESG data. They find that eighty-two percent of the respondents believe that ESG information is important for investment performance. A smaller percentage of the respondents state that such information is considered in the decision-making process because it allows accounting for ethical responsibility, with European investors being more likely to regard this as an ethical obligation. First, their findings strongly suggest that investors mainly utilize CSP information for financial performance rather than ethical considerations. Secondly, they explore why ESG information is relevant to investment decisions. The respondents suggested that this information is highly relevant for assessing the company's reputational, legal, and regulatory risks. The third reason is that better CSR performance serves as a proxy for management quality. In essence, sustainability reporting offers insight into a company's risks and serves as a corporate accountability tool. Finally, they pinpoint specific ESG issues that are financially significant for investment decisions. Respondents identify anti-corruption policies, board and leadership practices, climate change, and energy and fuel management as the most material ESG factors.

ESG awareness issues in estimating the risk premium for firm-specific climate change are analyzed in [72] among SP 500 stocks from 2005 to 2020. They find positive risk premiums before the global financial crisis of 2008 and an increase afterward. The risk premium is calculated using the expected return proxy (MW) introduced by [73] and a different approach (GLB) by [74], which incorporates higher-order moments of stock returns. All estimated parameters include the six-factor [53] model and various firm characteristics. Before 2008, they report a positive risk premium for climate change risk exposures of 1% annually. During the financial crisis, the risk premium decreased sharply and became negative. From 2011 to 2014, both premiums increased, ranging between 0.5% and 1% annually. Since 2015, the premiums have been reduced to zero. Since 2015, it has reverted to zero again. In addition, they find that the flows of ESG funds decrease the risk premium for exposure to climate change. This suggests that additional flow information raises stock prices, reducing the conditional risk premium. These findings align with the idiosyncratic risk channel mechanism described by [4], highlighting how better risk management reduces severe incidents and tail risks.

In the region of China, [7] examines the effect of ESG performance on stock idiosyncratic volatility using data from listed firms (2012–2022). They find that ESG reduces idiosyncratic volatility by enhancing transparency and enabling better risk management, establishing a causal link between ESG performance and reduced firm-specific risks.

In contrast, [75] notes that firm-specific factors influence idiosyncratic risk and can increase with ESG efforts due to additional restrictions on profit maximization. Although ESG initiatives can raise idiosyncratic volatility, they also help mitigate stakeholder conflicts, indicating that firms with high ESG performance are not inherently riskier.

In the literature, the relationship between ESG and idiosyncratic risk remains complex. Positive ESG performance is frequently associated with lower volatility and financing costs, but methodologies and data interpretation variations introduce nuances that warrant further investigation. The key takeaways of this section is that the idiosyncratic risk dimension of the cash-flow channel documents economically meaningful drivers of the ESG-CFP channel. Specifically, ESG disclosures are linked to lower capital constraints, (see [43]) and decreased stock price variation due to enhanced ESG transparency. Moreover, industry-specific classifications of the financial materiality of ESG disclosures highlight their direct relationship with firm value and their predictive ability for future financial performance (see also [76]). ESG information is also associated with lower price synchronicity, as prices reflect more firm-specific information, thereby capturing idiosyncratic risks as in [77].

In general, a strong commitment to ESG generally reduces the risk of idiosyncratic events in various regions and sectors. This effect is particularly pronounced during periods of economic uncertainty, such as the COVID-19 pandemic and the 2008 global financial crisis. It is influenced by firm-specific factors such as CEO power and rating consistency. These findings emphasize the importance of integrating ESG principles into corporate strategies to enhance financial stability and resilience. In the following section, we conduct a brief analysis of two companies, each representative of their respective economies and operating within the same sector, with a focus on their cash-flows and ESG practices.

2.3.3 Case Study: Apple vs Xiaomi

We chose Apple and Xiaomi as two representative companies from the U.S. and Chinese economies, respectively. They reflect the broader economic structures, strengths, and strategic priorities of their home countries. Also, they are comparable, as they belong to the same sector.

Apple is a leading institution in terms of the implementation of sustainability-related targets. It topped the 2024 Drucker Institute "Best Managed Companies"[8] list, scoring highly on social responsibility and employee engagement, core ESG metrics, in addition to financial strength.[9]

Apple's early adoption of ESG reporting in 2010, along with its emphasis on transparency, reflects the broader U.S. focus on corporate responsibility, regulatory compliance, and investor disclosure. Apple aims to achieve carbon neutrality across its entire footprint (Scope 1, 2 & 3) by 2030, starting with an ambitious 75% reduction from a 2015 baseline, with high-quality carbon removal offset the remainder.[10]

Xiaomi shows China's core strengths in hardware production, electronics, and efficient manufacturing. Its strategy focuses on affordable innovation, aligning with China's focus on serving a vast domestic market and price-sensitive consumers in emerging markets. Like many Chinese companies, Xiaomi has experienced rapid growth through lean operations, e-commerce, and ecosystem expansion, exemplifying China's entrepreneurial dynamism and the rise of its digital economy. Although Xiaomi is still maturing in its ESG practices, this reflects the broader trend among Chinese companies, many of which are early in their ESG transitions but face increasing regulatory and investor pressure.

Apple exemplifies the innovation-driven nature of the U.S. economy by focusing on research and development, product design, software, and ecosystem integration, while outsourcing manufacturing globally while aiming for climate neutrality. The company consistently sets global trends in both technology and industrial design. Through substantial stock buybacks and dividends, Apple improves the return on assets (ROA) and the return on equity (ROE), forcing a more disciplined capital allocation. This leads to better use of resources and signaling financial, improved future earnings and supporting cash flow while remaining very committed to concrete environmental with verified emissions reductions, renewable supply-chain investments, and use of recycled materials.

Returning capital to shareholders through dividends and buybacks is a very typical U.S. investment strategy, especially for mature, cash-generating companies. The approach in Asia is, however, more conservative. Firms often retain cash or reinvest, especially in Japan or South Korea.

[8]https://unitesi.unive.it/handle/20.500.14247/1343

[9]see Apple Tops the List of Best-Managed Companies of 2024, 8th Dec 2024

[10]see Apple.com

The following table presents key aspects of each company, along with their ESG initiatives across each pillar. Apple's operating cash flow is $118.3 billion. Its carbon neutrality status has been achieved, and its ESG reporting began in 2010. The company also participates in heavy stock buybacks and dividends totaling $110 billion. In contrast, Xiaomi has an operating cash flow of $4.5 billion, a deteriorating state of carbon neutrality, and a moderate dividend policy.

Category	**Company A (Apple)**	**Company B (Xiaomi)**
IPO Year	1980 (NASDAQ)	2018 (Hong Kong Exchange)
Global Market Position	World's largest tech company by revenue	Top 5 smartphone maker globally, strong in China & India
Product Focus	Premium smartphones, computers, wearables, services	Smartphones, IoT devices, smart home products, budget to mid-range smartphones
ESG Reporting	Since early 2010s, detailed annual ESG and Sustainability Reports	Started formal ESG reporting post-2018 IPO, increasingly comprehensive
Environmental Initiatives	Carbon neutrality for corporate operations since 2020; 100% recycled aluminum in some devices	Growing renewable energy use; carbon footprint reduction plans; focus on sustainable packaging
Social Initiatives	Strong data privacy stance, diversity & inclusion, supplier responsibility programs	Supply chain labor standards improvements, workforce diversity efforts, expanding data privacy policies
Governance Practices	Diverse and independent board; rigorous ethics and transparency	Governance reforms underway; increased transparency since IPO
Capital Allocation (2024)	Heavy stock buybacks and dividends supported by strong cash flow	Reinvesting cash flow in R&D and ESG initiatives, moderate dividends/buybacks
R&D Investment	$\tilde{\$}$30+ billion annually, leading in innovation	Increasing investment, but significantly smaller scale compared to Apple
Brand & Market Strategy	Premium brand, ecosystem lock-in, high margin	Competitive pricing, broad product portfolio, rapid expansion in emerging markets

Table 2.5 reports the evolution of CSR policies and ESG development with the cash-flow for each company.

Given the information of the table[11] above, we can assess various aspects of both companies. In terms of financial scale, Apple's cash flows significantly exceed those of Xiaomi, reflecting Apple's larger market share, premium pricing, and mature global ecosystem. Xiaomi has shown rapid growth since its IPO and remains a major player, especially in the budget and mid-tier segments. Regarding ESG development, Apple leads with long-established ESG programs and ambitious carbon neutrality goals. Xiaomi while newer to formal ESG, is making solid progress, particularly in environmental initiatives and social responsibility. The environmental impact shows that Apple is fully committed to carbon neutrality in corporate operations and a more circular product life cycle. Xiaomi is advancing renewable energy usage and sustainable practices, but lags behind Apple in scale and scope. Social responsibility (CSR policies) indicates that both companies focus on supply chain labor standards and diversity, but Apple's initiatives are broader and more mature. Xiaomi is improving rapidly, partly driven by investor expectations and regulatory environments. In terms of governance issues, Apple has a well-established governance structure with high transparency. Xiaomi is evolving governance to meet international standards as it expands globally.

From the above example, we see how the moment of ESG adherence affects the cash-flow channel. Although Xiaomi's ESG efforts have matured significantly post-IPO, transitioning from basic CSR to comprehensive sustainability reporting and action plans aligned with global standards,

[11] Sources for gathering the information on both companies: https://investor.apple.com/investor-relations/default.aspx, https://www.apple.com/environment/, https://www.hkexnews.hk/index.htm, Reuters.

Apple is still ahead due to its detailed sustainability reporting since early 2010. This has contributed to the achievement of a more efficient capital allocation for Apple through heavy stock buybacks. However, Xiaomi's dividend policy has been moderate reinvesting cash flow in RD and ESG initiatives.

Apple and Xiaomi present contrasting ESG profiles reflecting their maturity, market positioning, and strategic priorities. Apple has a well-established and comprehensive ESG framework, with early adoption of sustainability reporting, carbon neutrality in operations, strong governance practices, and a robust focus on data privacy and supplier responsibility. Its high R&D spending and consistent shareholder returns further underscore its leadership in ESG integration. In contrast, Xiaomi is in an earlier stage of ESG development, having initiated formal reporting after its 2018 IPO. Although it shows a growing commitment through the adoption of renewable energy, sustainable packaging, and supply chain improvements, its efforts to promote and sustain sustainability remain less advanced in scope and execution. In general, Apple leads the maturity and implementation of ESG,on of ESG, while Xiaomi is progressing steadily as it scales its operations and responds to increasing stakeholder expectations.

However, it must be noted that Apple and Xiaomi are not comparable in terms of market size, which implies that Apple's higher performance may be driven by a reverse causality effect. Apple is a global leader with enormous brand power and financial scale implying that its advance sustainability performance may be driven partly driven increases access to financial resources. This is important given that ESG investment is capital intensive. Xiaomi is nevertheless a large-cap challenger, strong in emerging markets, still scaling its ecosystem and ESG credentials.

Both companies are nevertheless comparable in terms of ESG disclosure trajectories, as well as consumer electronics innovation, ESG disclosure trajectories and strategic use of supply chains and platform ecosystems. In the next section, we analyze the valuation channel through which systematic risk affects the company's cost-of-capital and hence increase its valuation.

2.4 The Valuation Channel, the link between ESG and Systematic Risk

The characteristics of ESG influence the systematic risk by affecting the discount factor. Systematic risk is the primary risk incorporated into the required cost-of-capital of an investor. Firms with strong ESG performance are often perceived as lower-risk investments due to improved governance, regulatory compliance, and stakeholder trust. This can lead to lower equity and debt risk premiums, reducing the firm's cost of capital, as analyzed in the work of [68], [43].

To build a fundamental understanding of how ESG characteristics influence corporate financial profiles, it is important to perceive systematic risk as a risk associated with macroeconomic or market factors, changes in the regulatory framework, and technological expertise. Furthermore, companies focused on environmental sustainability may experience lower exposure to macroeconomic shocks, climate risks, and social instability, thus, reducing their cost of capital. As a result, investors can apply a lower discount rate to future earnings, ultimately increasing firm valuation and long-term shareholder value. Thus, we explore relevant and recent academic literature to gain insights, and rationale on the link between sustainability efforts and systemic risk.

For instance, the work of [29] we observe that firms with higher ESG ratings may have different exposures to systematic risk due to their resilience during crises and/or the presence of a specific ESG/CSR risk factor. Consistent with this argument, [78] finds that during the global financial crisis of 2008-2009, companies with higher ESG ratings performed better than less socially responsible firms.

In their paper, [38] investigate the value derived from CSR, focusing on stock market measures that reflect future cash-flow expectations rather than accounting measures. They highlight that the "stickiness" of CSR measures small or often non-existent changes can lead to incorrect conclusions about CSR's impact on risk or financial performance. To estimate the impact on systematic risk, they assess the cost of equity capital. They use this parameter as a proxy for risk that determines the required rate of return. Higher systematic risk calls for higher expected returns to compensate investors. To explore this, they compare the cost of capital between "Green" and "Toxic" firms by forming portfolios of these stocks. Using the FF-3 model [18], they provide a richer analysis of systematic risk through size (SMB) and value (HML) factors compared to CAPM. Their key findings indicate that CSR strengths ("Greenness") are positively valued across all stakeholders, while CSR concerns ("Toxicity") negatively impact firm value. Notably, only the environmental dimension directly contributes to sustainability performance. They also demonstrate that "Green" firms exhibit greater long-term growth in abnormal earnings across most CSR dimensions, except the employee dimension. Their research concludes that high CSR commitment delivers a competitive advantage, allowing firms to achieve long-term abnormal earnings growth. While the reduction in the cost of equity is statistically significant, the authors note that its economic magnitude is relatively modest compared to the impact of CSR on long-term growth prospects.

The analysis of [23] confirms empirically the link between CSR, systematic risk, and firm values. Their main message is that higher CSR leads to lower beta and higher Tobin´s Q. In their analysis they estimate individual betas using the CAPM and regress these betas on CSR scores, controlling for industry and size effects, time effects, and leverage. Specifically, the authors find that a one-standard-deviation increase in a firm´s CSR score is associated with a 1 percent reduction in its beta, the measure of systematic risk. This implies that firms with greater sustainability engagement tend on average to have less exposure to market risk.

Table 2.6: Systematic Risk and ESG

Sample	Sample Period	Performance Metric	Ind/Dependent	Sign	Citation
USA	2005-2021	CAPM Beta	Dependent	+/-	Pistolesi et al. 2024
CHINA	2015-2021	CAPM Beta	Dependent	-	Saci et al. 2023
World	2002-2021	Ebitda	Dependent	-	Egorova et al. 2023
World	2010-2021	Probability of default	Dependent	+/-	Anwer et al. 2023
Indonesia	2018-2020	Market Beta	Dependent	+/-	Ekaputra et al. 2023
World	2007-2020	Value At Risk	Dependent	-	Aevoae et al. 2022
USA	2016-2020	PCA	Dependent	-	Eratalay et al. 2022
Europe	2016-2018	Market Value Model	Dependent	+/-	Cerqueti et al. 2021
USA	2003-2015	Tobin´s Q	Dependent	+	Alburquerque et al 2019
World	2007-2017	DCF Model	Dependent	-	Giese et al. 2019
USA	2007	Tobin´s Q	Dependent	-	Buchanan et al. 2018
USA	2001-2007	Short run returns	Dependent	+/-	Kruger 2015
USA	1992-2009	Firm Value	Dependent	+	Gregory 2014
USA	1993-2010	Stock portfolio returns	Dependent	+	Eccles 2014
USA	1991-1995/1996-2000/2001-2008	Financial Constraints	Independent	-	Hong et al. 2012
USA	1980-2003	Stock portfolio returns	Dependent	+	Hong et al. 2009

This table summarizes the results proposed to relate to ESG in the academic literature on firm-specific downside risk. For each paper cited, we report the variable of interest, whether it is an independent or dependent variable. The sign indicates the direction of the relationship between the ESG and the performance metric. 0 indicates that no significant relation was found. Both +/- means relationships in both directions have been found among different ESG metrics.

The results reported in table 2.6 show that numerous studies indicate a correlation between better ESG/CSR performance and lower systematic risk. This includes various measures of systematic risk, such as the CAPM beta, value at risk (VaR) or the probability of default. However, several studies find a positive relationship, primarily using CAPM betas and stock returns.

The impact of ESG integration in a DCF model is detailed in the work of [4], which understands ESG as a tool for improving portfolio risk-return profiles. They attribute inconclusive results to differences in underlying ESG data and the lack of standardized methodologies for controlling common factors. Their analysis focuses on three transmission channels: the idiosyncratic risk channel, the discounted cash-flow (DCF) channel, and the valuation channel. As is the case in the current analysis, systematic risk is captured by the cost of capital, while firm-specific risks are reflected in the present value of future cash flows. A strong ESG profile contributes to competitive advantages and profitability, resulting in higher future cash-flows and dividends. Lower idiosyncratic risk arises from better risk management, which reduces severe incidents and tail risks. Systematic risk is minimized through lower capital costs, leading to higher valuations. For instance, energy-efficient companies are less vulnerable to shocks, translating to lower beta and required returns under a CAPM framework. The study of [15] highlights two additional factors: socially responsible investors who avoid low-ESG companies and reduced information asymmetry in high-ESG firms due to greater transparency.

Analyzing US-data, [79] analyzes the relationship between systematic risk and ESG factors for 791 NYSE-listed companies over 17 years (2005–2021). They find a non-linear, inverted U-shaped relationship between ESG expenditure and systematic risk. Low ESG spending provides flexibility and reduces risk, but higher ESG investments lead to lower systematic risk beyond a certain threshold. When they consider the quadratic term in their regression model, a statistical significance at the 1% level is confirmed. They calculate the level of each independent variable that maximizes systematic risk. For example, in the case of the overall ESG score the maximum point is 0.477. Shifting from zero up to this point increases systematic risk due to the relevant risks associated to sustainability commitments of the firms. Investing resources in ESG efforts means they have fewer resources to allocate to other, more profitable activities. As a result, companies become more rigid and, consequently, more perilous. Conversely, surpassing the upper limit, systematic risk diminishes as ESG-focused investors support ESG-dedicated companies not due to their financial results but for their CSR achievements.

This dynamic reflects investor preferences and persistent demand for ESG stocks, as identified by [80] and [41]. Their analysis demonstrates that, similar to the DCF model, companies with strong ESG profiles are less susceptible to market shocks, as indicated by a lower market beta factor. They help quantify a specific threshold beyond which companies can gain competitive advantage over peers by lowering their cost of capital and leading to higher valuations.

Overall, strong ESG performance generally leads to a reduction in systematic risk, especially during periods of economic uncertainty such as the COVID-19 pandemic. These mitigating effects are particularly significant in the environmental and governance pillars, underscoring the role of ESG metrics in promoting financial stability within the global economy. ESG practices are especially pronounced under conditions of economic uncertainty, such as the COVID-19 period and the financial crisis of 2008, see [79], [4], [38] and are influenced by specific firm conditions, such as CEO power and rating consistency. These findings highlight the importance of integrating ESG principles into corporate strategic plans as tools to enhance financial stability and resilience.

2.5 ESG/CSR performance and Downside Risk

The cash-flow channel that identifies the ESG-CFP link also addresses the effect of downside risk as a firm-specific idiosyncratic mechanism when ESG (Environmental, Social, and Governance) factors play a crucial role in mitigating downside risk, which refers to the potential for significant financial losses due to adverse events. Firms with strong ESG performance tend to exhibit lower downside risk through several mechanisms that can be embedded under the cash-flow channel as well as the discount rate or systematic channel. These include i) reputational resilience: strong ESG practices enhance brand reputation and stakeholder trust, making firms less vulnerable to consumer backlash, boycotts, or social controversies that could harm financial performance. ii) Operational stability: Sustainable supply chain management, ethical labor practices, and environmental risk mitigation enable companies to prevent disruptions that could result in expensive operational setbacks. iii) market perception and investor confidence: firms with strong ESG credentials are often viewed as lower-risk investments by institutional investors, which can reduce stock price volatility and downside risk during market downturns. iv) regulatory and legal protection, companies that proactively address ESG concerns are less likely to face fines, lawsuits, or regulatory penalties, reducing unexpected financial shocks. v) crisis resilience: ESG-focused firms tend to demonstrate stronger financial and strategic resilience during economic crises, as they are better prepared to manage long-term risks related to climate change, social unrest, and governance failures.

The literature that specifically investigates the relationship between ESG/CSR performance and downside risk is noteworthy. Important contributions include [81], [78], [23], [82], [83].

The study of [84] introduces an innovative approach to studying tail risk by examining downside, extreme systemic, and spillover risks in ESG factors within the health and financial sectors in the USA, China, Europe, and the UK using ETFs. They use global daily data spanning from 1999 up to 2022, and from 2007 to June 2022 for the ESG metrics. Motivated by the climate change crisis, they focus on the health and financial sectors due to their unique role during the COVID-19 pandemic and their interconnection with ESG investments. Using daily ESG-ETF data from Bloomberg, they identify the top 10 ESG healthcare and financial ETFs by net asset value. Applying extreme value theory, they assess equity tail risk, finding that ESG sectors exhibit high tail risk during shocks of ETFs drops of 25% or 50%. The ESG sector remains the riskiest for extreme systemic risk, especially during shocks originating in China. The financial sector shows the highest risk, while the healthcare sector demonstrates the lowest tail quartile risk. The study also shows that the healthcare and ESG sectors have lower spillover risks than the financial sector. As an example of the spillover risk, if one ESG ETF goes into financial distress, there is a 17.71% probability that all 10 ESG ETFs will also go into distress. The equivalent effect is 16.40% for the healthcare sector and 20.57% for the financial sector.

A similar analysis is conducted by [85]. They analyze ESG indices' risk-adjusted performance in developed and emerging markets, such as India, Brazil, and China, using data from the MSCI database for 2017–2022. ARCH and GARCH models are applied to model conditional variance, and the Sortino ratio is calculated to measure downside risk. Findings reveal that ESG returns are highest in the USA (13.69%) and India (13.04%), with lower volatility than diversified markets in most regions, except China. ESG indices generally yield positive rolling returns, with India achieving the highest alpha (4.82%) and China the second highest (1.49%). The sortino ratio exceeds the sharpe ratio for all ESG indices, indicating limited downside risk relative to overall volatility. This is attractive for risk-averse rational investors seeking minimal downside exposure.

Furthermore, [78] found that firms with high environmental and social ratings achieved significantly higher returns during the 2008–2009 financial crisis. Using MSCI ESG statistics, they observe that socially responsible firms had returns 4–7 percentage points higher than less responsible firms, attributing this to more outstanding social capital. Regression analyses reveal that social capital is at least half as important as liquidity and leverage. Idiosyncratic risk is defined as residual variance from a market model, included as a control variable and the results show a significant negative relationship to returns when a positive relationship is present between crisis-period returns and CSR. Their research suggests that CSR activities, and social capital in general, yield higher returns, particularly during periods when trust becomes more crucial, especially due to significant downside risks, as seen during the 2008-2009 global financial crisis.

They also find that excess returns are higher for companies based in regions where people have higher levels of trust. They do not find noticeable differences in stock return performance between high- and low-CSR firms during the recovery period after the crisis. In general, these findings imply that, in periods of greater lack of transparency and information asymmetry, the social capital gained through CSR activities is particularly valuable during times when trust in corporations has diminished. In contrast, during more stable periods, the benefits of social capital are already reflected in the stock price of a company. The absence of a reversal in returns after the crisis suggests that trustworthiness has remained important, which aligns with the cash-flow mechanism, reputational resilience, and operational stability.

Accordingly, [82] indicates that the involvement of ESG contributes to a reduction in downside risks, although the extent of this impact varies depending on the nature of the involvement. In particular, the most substantial risk mitigation is observed in environmental areas such as climate change, whereas engagements deemed unsuccessful exhibit no statistically significant effects. Using the FTSE All-World Index, they find that downside risk decreases significantly after successful ESG engagements, providing evidence that ESG initiatives can create long-term value.

The work of [86] investigates the risk reduction and window dressing hypotheses using a sample of US firms in controversial industries from 1991 to 2010. They find that CSR commitment inversely relates to firm risk, with higher CSR scores associated with lower long-term risk. The study emphasizes that CSR involvement can improve a company's image and corporate reputation while reducing downside risk.

Table 2.7, reports a summary of recent specific studies that address ESG performance and downside risks. The studies cover diverse geographical regions, including the USA, Europe, China, Korea, and heterogeneous samples and measures of downside risk.

Table 2.7: ESG/CSR Perfomance and downside risk

Sample	Sample Period	Downside Risk Metric	Ind/dependent	Sign	citation
USA, UK, China, Europe	1999-2022	EVA Tail-Risk	Dependent	+	Chaudhry 2023
USA, Germany, Japan, India, Brasil China	2017-2022	Sortino Ratio	Independent	-	Gupta 2023
USA, Canada, Mexico	2011-2020	Ohlson O-score	Dependent	-	Lisin 2022
China	2010-2020	Lower order returns	Dependent	-	Feng 2022
World	2018-2020	VaR	Dependent	+	Loof 2022
Korea	2011-2019	Credit Risk	Dependent	+/-	Kim et al 2021
USA	2009-2020	ESG risk rating	Dependent	-	Xiong, J. X. 2021
USA	2009-2016	Climate Risk Tail	Dependent	-	Emirhan Ilhan et al 2020
China	2015-2020	Stock-return volatility	Dependent	-	Broadstock et al 2020
Korea	2010-2015	Credit Ratings/Bond Returns	Independent	+/-	Jang et al 2020
World	2005-2018	Negative Returns	Dependent	-	Hoepner et al 2018
USA	2008-2009	Idiosyncratic downside risk	Independent	-	Lins et al 2017
USA	1995-2009	Conditional skewness	Dependent	-	Kim et al 2014

This table summarizes the results proposed to relate to ESG/CSR in the academic literature on firm-specific downside risk. For each paper cited, we report the variable of interest, whether it is an independent or dependent variable. The sign indicates the direction of the relationship between the ESG/CSR and the performance metric. 0 indicates that no significant relation was found. Both +/- means relationships in both directions have been found among different ESG metrics.

We compile key findings from various academic studies that examine the relationship between Environmental, Social, and Governance (ESG) or Corporate Social Responsibility (CSR) performance and downside risk. Most studies indicate a negative relationship between ESG/CSR and downside risk. This suggests that firms with stronger ESG/CSR performance generally experience a lower downside risk.

For example, in the USA (2008-2009), idiosyncratic downside risk decreases with better ESG performance, according to [78]. In the USA (2009-2020), the ESG risk rating has a negative impact on downside risk ([87]. In China (2015-2020), companies with strong ESG/CSR practices experience lower volatility in stock returns, as reported by [88].

In some cases, ESG/CSR improvements are associated with lower downside risk. For example, a global study (2018-2020) found that the impact of ESG scores was more evident in the year 2020 during the pandemic crisis. In particular, they report that ESG is more significant as a long-term variable than a short-term effect. A one unit improvement in ESG metrics results in a 2.5 basic points reduction in downside risk as a short-term effect and 7 basis points as a long-term effect significant at 1% level. Hence, the Value at Risk (VaR) decreases with the involvement of ESG / CSR, as reported by [89].

However, a study covering the USA, the UK, China, and Europe (1999-2022) shows that EVA tail risk is positively associated with ESG, according to [84]. These findings suggest that, while ESG may offer benefits, certain aspects of ESG engagement could expose firms to additional risks, potentially due to higher costs or market perceptions.

Several studies report mixed effects, where ESG/CSR may either reduce or increase downside risk depending on the specific ESG metric or context. For example, in Korea (2011-2019), findings on credit risk were mixed, as observed by [90] Additionally, in Korea (2010-2015), credit ratings and bond returns showed both positive and negative associations with ESG, as noted by [91]. This variation indicates that the impact of ESG on risk is context-dependent and may vary by industry, country, or measurement approach.

The overall conclusion of this section is that the reported evidence highlights a growing interest in integrating ESG principles into corporate strategies and investment decisions. Adopting ESG practices can enhance financial performance while also attracting investments with reduced downside risk. However, ESG portfolios do not always provide protection during severe market stress. When evaluating portfolio performance, investors should choose portfolio diversification in order to partially eliminate downside risks, as potential losses significantly influence their decision-making. Ultimately, investors and portfolio managers should consider industry effects into account when evaluating ESG metrics.

2.6 Gaps in current literature and future research

In this section, we highlight key gaps in the literature on the relationship between ESG factors and financial performance and offer some concluding remarks.

Within the DCF model framework, systematic risk influences a firm's cost of capital through the discount factor, while idiosyncratic risk directly affects future cash flows, profitability, and tail risk.

ESG factors play a crucial role in shaping a firm's financial profile, impacting both systematic and idiosyncratic risks. Proponents of the DCF model argue that firms with strong ESG performance are more resilient to market shocks, more competitive, and less exposed to tail risk. Reported summary results indicate that some studies show mixed findings depending on the ESG metrics considered, highlighting the complexity of the relationship between ESG and systematic risk.

Many studies focus on a single ESG rating agency, with limited attention to the individual pillars that constitute the overall ESG score. However, there are nuances that should be taken into account in the discussion. Socially responsible investment (SRI) practices primarily use negative screening, excluding firms involved in industries such as tobacco, weapons, gambling, nuclear power, and controversial financial or technology sectors. However, these broad exclusions fail to account for a firm's ability to manage risks within its specific industry. This omission of individual ESG pillars in investment screening represents a significant gap.

Another major gap is the lack of a standardized ESG classification system. Current ESG ratings utilize different methodologies, reducing comparability, timeliness, and reliability in financial decision-making. Without uniform reporting standards, ESG disclosures remain inconsistent among firms, countries, and economic contexts. This inconsistency distorts transparency, misleads investors, and can create biases against firms with low ESG ratings. Risk-averse investors and socially conscious portfolio managers often avoid lower ESG-rated firms due to asymmetric information, despite these firms potentially offering sound financial fundamentals. The lack of transparency penalizes lower-rated firms while benefiting those with greater disclosure, reinforcing ESG-related valuation disparities. Developing new ESG proxy systems and improving rating methodologies would improve the precision of ESG assessments. A unified ESG metric would enhance the transparency and applicability of active ESG investment strategies over time, encouraging firms to disclose ESG information more consistently and comprehensively.

Establishing the direction of causality within the ESG-CFP is a challenge. The size factor is crucial to determine ESG performance. Larger firms can invest more resources in sustainability. The measurement of idiosyncratic risk also presents challenges. The Carhart four-factor model, which defines firm-specific risk as the variance of residuals, may overlook other factors influencing firm value. A comprehensive methodology or theoretical framework explaining ESG risk dynamics over short and long-term horizons is still lacking.

Our review underscores the interdependence of CSR and ESG investments. Companies that integrate ESG principles into their corporate strategy enhance brand image, build customer loyalty, and drive sustainable long-term financial growth. The environmental pillar, for example, influences the corporate valuation by shaping the ecological commitment, social reputation, and brand image of a firm. Firms actively involved in environmental initiatives improve their public perception, increase customer trust, and strengthen long-term financial stability.

The social pillar reflects the ability of a firm to gain social trust and establish itself as a responsible corporate entity. ESG investments not only generate long-term economic benefits, but also improve operational efficiency by fostering strong relationships with stakeholders. Positive ESG performance attracts media attention, increases firm visibility, and improves supply chain efficiency.

Our review suggests several avenues for future research, particularly on the long-term value implications of ESG investments. Existing studies fail to fully quantify ESG-related intangible assets - such as reputation, goodwill, and employee satisfaction - and their impact on financial performance. Current ESG valuation models inadequately incorporate these intangibles, leading to the possible mispricing and misinterpretation of ESG benefits. Future research should develop a transmission mechanism that links intangible ESG value to stock prices.

Transparency in ESG policies is increasingly linked to profitability, earnings stability, and dividend yields, validating tail-risk and cash-flow channels. The academic literature correlates higher ESG scores with lower financial volatility as a natural resultof better risk management. Companies with strong ESG metrics effectively mitigate market shocks and maintain resilience, particularly during economic crises such as the 2008 financial crash and the COVID-19 pandemic.

Understanding the tail risk channel, which examines the risk of a stock price crash and downside asymmetry, is essential for investment decisions and long-term risk management. However, there is no clear consensus on whether ESG consistently improves financial performance or mitigates firm-specific risks. ESG generally reduces the risk of downside, as evidenced by most studies finding a negative relationship. Some studies show a positive or mixed relationship, suggesting that ESG may sometimes increase risk depending on market conditions (U.S, EU, vs emerging markets) context. The impact of ESG on risk varies by country, time period, and measurement method. More recent studies focus on ESG-specific risk measures, reflecting a growing interest in ESG integration into financial risk models. Research in this area remains fragmented, requiring a more systematic exploration of ESG-related risk transmission mechanisms.

Given this,it would be desirable to develop a theoretical model that considers both short-term shocks and the long-term effects of ESG performance on idiosyncratic risk and returns. This presents a promising area to extend current findings on idiosyncratic sustainability factors that seem to be under-examined in the literature. In addition, a better understanding of the interactions between ESG metrics and firm-specific risks is needed to adequately assess all the risks associated with various sustainability policies. Greater granularity is essential to acquire knowledge about the specific pillars of ESG, varying regulatory schemes, different societal cultures, specific macroeconomic conditions, and their effects on ESG metrics. Limited research has been conducted on controversy and individual pillar scores when considering an ESG factor of idiosyncratic risk.

Finally, researchers should continue to study the direction of causality between the ESG attributes and through the different channels.

2.7 Conclusions

The literature on environmental, social, and governance (ESG) performance does not provide automatic evidence that sustainability efforts translate into higher profitability or superior financial results. Most empirical studies still report a positive and statistically significant association, especially in developed markets and when the observation window is long, but a non-trivial minority documents negative or mixed outcomes. Such discrepancies appear in narrowly defined periods, as in the 2007 U.S. sample that relied on Tobin's Q, and are sensitive to market cycles, sectoral characteristics, and regulatory regimes. The bulk of existing work concentrates on long-run stock-market returns, yet findings remain heterogeneous across countries and industries, and the link between ESG or broader corporate social responsibility (CSR) metrics and idiosyncratic risk likewise varies by region, period, and measurement choice.

Differences in geography, time horizon, performance metric, and sector help explain this heterogeneity. U.S.-based studies most frequently report favorable results, whereas evidence is more variable in Europe and emerging markets. Analyses covering longer intervals tend to reveal clearer gains, while short-window studies often deliver volatile, neutral, or even negative estimates. Market-based indicators such as Tobin's Q or abnormal returns usually show stronger positive correlations than accounting ratios such as return on assets. In addition, sectors subject to cyclical swings or weaker regulation produce the widest dispersion of outcomes. Extending the projection period in a discounted-cash-flow model magnifies the benefit of the lower systematic risk that highly rated ESG firms exhibit, illuminating why long-term work so often uncovers a positive ESG–CFP relationship.

Four partially overlapping transmission mechanisms dominate current explanations. The cash-flow channel emphasizes that ESG initiatives cut costs through energy efficiency and waste reduction, while simultaneously raising revenue through brand loyalty, access to sustainability-oriented customers, and improved human-capital productivity, see also [25]. The risk mitigation channel stresses that explicit ESG commitment reduces environmental, regulatory, and social exposures, lowering long-term liabilities and volatility of earnings, as shown in [12]. The valuation channel argues that lower perceived distress and systematic risk feed through to a reduced cost of capital and higher valuation multiples. Growing investor demand for sustainable assets such as equity funds and green bonds reinforces this effect, see [24] and [38]. Finally, the idiosyncratic risk channel acts through the cash-flow channel and shows that higher composite, environmental, and social scores align with reduced firm-specific risk, an association that remains visible during systemic shocks such as the 2008 financial crisis and the COVID-19 downturn, see [92] and [93].

A slack-resources effect complicates causal inference: financially stronger firms can more readily finance ESG practices and often face greater stakeholder scrutiny. Profitable enterprises therefore display higher future ESG scores, as argued in [43]. High performers also turn to ESG to manage reputational and regulatory pressures, see [30], while institutional investors, customers, and regulators direct their demands for sustainability toward the same firms, see [77]. Empirical designs that fail to account for this feedback risk overstating the independent contribution of ESG to financial outcomes.

Placing these mechanisms within the broader context of the United Nations SDGs reveals additional implications. Enhancing cash flow advances SDG 8 on decent work and economic growth, waste and emissions reductions contribute to SDG 12 on responsible consumption and production, and lower carbon exposure supports SDG 13 on climate action. The ability to map discounted cash flow drivers to specific SDGs underscores the dual role of ESG as both a financial signal and a lever for long-term environmental and social resilience.

Our review provides insights relevant to all firm stakeholders. Investors should view ESG not merely as an ethical consideration, but as a tool for enhancing risk-adjusted returns. Managers are encouraged to integrate ESG factors into their strategies to improve long-term firm valuation and mitigate firm-specific risks. Finally, policymakers should promote ESG disclosure as a means to enhance market efficiency and stability. For scholars, the evidence highlights the importance of longitudinal, multi-country research designs that disentangle causality from correlation, test channel-specific hypotheses, and control for profitability. ESG should be treated as context dependent, with sector, geography, and firm size informing integration into capital-allocation and risk-management models, while a move toward consistent, standardized disclosure would narrow information gaps and further decrease the cost of capital.

Overall, the literature provides compelling evidence that ESG engagement contributes positively to both firm value and risk management. On the one hand, numerous studies demonstrate that ESG performance is value-enhancing, particularly over the long term, with consistent positive effects observed on equity returns, firm valuation metrics such as Tobin's Q, and broader market-based performance indicators. On the other hand, ESG is also associated with lower idiosyncratic risk, reflecting the role of sustainability practices in enhancing a firm's operational stability, reputational strength, and governance quality. While short-term or accounting-based measures often yield mixed or neutral results, likely due to lag effects or methodological limitations, the long-term strategic nature of ESG initiatives emerges as a unifying explanation for its beneficial impact. Ultimately, the dual evidence in performance and risk frameworks positions sustainability commitment not only as an ethical imperative but also as a financially prudent strategy that supports resilient and value-generating firms.

In the next phase of this project, we will investigate the mechanisms that generate the Idiosyncratic Equity Premium, with particular attention to firm characteristics, investor behavior, and market frictions that may amplify idiosyncratic risk pricing. I plan to extend the empirical framework by examining whether the IEP varies systematically across sectors, business cycles, and financial crises, and by testing its robustness in international equity markets. Furthermore, I will explore the potential interactions between the IEP and established asset pricing anomalies to assess whether it captures novel sources of risk or overlaps with known factors. This agenda aims to refine the theoretical foundations of the IEP and establish its role within the broader asset pricing literature.

Chapter 3 Excess Stock Returns and the Idiosyncratic Equity Volatility Premium in the S&P500

Abstract

This chapter develops a theoretical and empirical framework that decomposes stock price and market shocks into systematic, idiosyncratic, and microstructure-driven components. We introduce the Idiosyncratic Equity Premium (IEP), a measure of the excess return investors demand for bearing firm-specific risk. Using cross-sectional data on S&P 500 firms covering the 2004–2023 period, we find that the IEP significantly explains excess returns, with an average annual impact of 13.93%, even after controlling for traditional risk factors.

Keywords— CAPM, Idiosyncratic equity volatility premium, factor models, firm-specific profitability .

3.1 Introduction

The use of an idiosyncratic component in the firm valuation process dates back to [5]. In his presidential address at the American Finance Association, Merton distinguished between "free" investors and "constrained" investors. "Free" investors have no limitations on diversifying their portfolios, whereas "constrained" investors cannot hold the market portfolio due to market restrictions such as transaction costs, taxes, short-selling prohibitions, and budget constraints. These constraints compel investors to consider total risk, not just market risk. Merton used this framework to derive equilibrium risk premia associated with idiosyncratic volatility, market capitalization, and related characteristics, aligned with observed empirical anomalies. The contribution of Merton challenges the capital asset pricing model (CAPM) developed by [94], [95], which shows that market risk is the only factor to be priced in equilibrium, excluding the effect of idiosyncratic risk through the role of diversification.

In this study, we develop a novel theoretical framework that captures the dynamic relationship between stock returns and market returns, allowing the influence of both common and idiosyncratic shocks. Unlike traditional asset pricing models, which often assume a single source of systematic risk affecting all assets uniformly, our approach acknowledges the complexity of financial markets by incorporating multiple channels through which shocks propagate. Specifically, our framework allows for distinct stochastic processes governing stock and market returns, driven by shared information shocks as well as independent idiosyncratic disturbances at both the stock and market levels.

A central feature of this model is the decomposition of return innovations into orthogonal components, reflecting the dual nature of financial market fluctuations. On the one hand, stocks are subject to common market-wide shocks that arise from macroeconomic news, global risk factors, and shifts in aggregate market sentiment. However, stocks also experience idiosyncratic shocks that are specific to the firm, such as firm-level earnings surprises, product launches, or managerial decisions. Our decomposition approach enables us to disentangle these sources of variation and identify the distinct role each plays in driving stock and market return volatility.

We build on insights from previous studies, such as [96], which identify two primary sources of shocks: systematic and idiosyncratic. While systematic shocks affect all firms simultaneously, idiosyncratic shocks are unique to individual firms and arise from the presence of non-traded assets like human capital, intellectual property, and private business interests. By explicitly modeling these idiosyncratic components, we account for firm-specific fluctuations that are often overlooked in simpler asset pricing models.

In addition to these firm-specific shocks, our model also incorporates microstructure-related disturbances in the market itself. These microstructure shocks are driven by liquidity frictions, order flow imbalances, and other institutional trading effects that influence market returns. Unlike systematic market shocks, microstructure shocks have a disproportionate effect on market volatility compared to stock volatility. Empirical studies, such as [97], [98], highlight how microstructure effects contribute to increased market volatility without necessarily affecting the volatility of individual stocks. Recent work by [99] further demonstrates that market microstructure factors, such as the arrival of new information and order flow shocks, play a significant role in price dynamics, particularly in periods of increased uncertainty. Our framework formalizes this notion by decomposing market shocks into two orthogonal components: a common systematic component and a microstructure-driven component, each with distinct properties and implications for market volatility.

The key innovation of our approach lies in its explicit treatment of the interaction between these various sources of shock. We posit that both stock and market returns are influenced by a shared information shock, denoted as U_t, which follows a standard normal distribution $U_t \sim N(0, 1)$. This common shock is the main driver of systematic risk, capturing the impact of macroeconomic news, financial crises, and major policy announcements that simultaneously affect the prices of all stocks. However, each asset also experiences an independent response to the shock of the common market, reflecting firm-specific differences in sensitivity to aggregate risk. This component introduces heterogeneity in the way firms react to the same events across the market.

To account for firm-specific risk, we introduce an idiosyncratic component $V_{i,t}$ specific to stock returns. This component captures shocks that are unrelated to the common market shock, such as firm-specific news and company-level innovations. Importantly, this component is orthogonal to both the systematic market shock U_t and the microstructure market shock Q_t. On the market side, we introduce a separate microstructure component Q_t that represents the market's reaction to liquidity frictions, order flow dynamics, and other institutional factors that affect returns. The orthogonality assumption $U_t \perp V_{i,t}$, $U_t \perp Q_t$, and $V_{i,t} \perp Q_t$ allows us to distinguish between these sources of return variation, offering a clear and tractable decomposition of volatility at both the stock and market levels.

This decomposition draws on concepts found in the broader literature on general equilibrium models. For instance, [100] apply a similar decomposition to model biomass shocks, distinguishing between global and regional shocks in a spatially distributed fishery. By analogy, we treat the global systematic shock U_t as analogous to a "global" risk factor that affects all firms, while the microstructure noise Q_t and firm-specific idiosyncratic shocks $V_{i,t}$ play a role akin to "regional" shocks affecting specific subsets of agents within the market.

In this framework, the idiosyncratic equity premium (IEP) is generated endogenously as the spread volatility points between stock volatility and market volatility, scaled by the average cross effects of the shocks in the stock and the market. We relate this measure to the idiosyncratic risk most commonly argued in the literature, the standard deviation of the sum of squared errors estimated from a particular asset-pricing model such as the CAPM specification, the Fama French three-factor model [71], or the four-factor specification [17]. The Idiosyncratic Risk computed as in the literature and the idiosyncratic equity premium proposed here, represent a risk-premium nexus that is expected to be positively related. A higher idiosyncratic risk results in higher idiosyncratic premium.

Our empirical results from running panels with fixed effects on the idiosyncratic risk of each S&P500 components on the IEP document very strong association and high estimated coefficient values, 0.9 for CAPM based idiosyncratic risk, 0.82 for Fama-Frech three factor model idiosyncratic risk, and 0.78 for the four factor model of Carhart. The data of S&P500 components show that there is an annual average idiosyncratic equity volatility premium of 12.69%. Prominent hikes in the original data deliver annualized values exceeding 25 percentage points, and in some cases, reaching 30 percentage points. Notably, the IEP component peaked during the 2008-2009 Global Financial Crisis (GFC), indicating higher business-specific risk during that period. Other episodes of elevated IEP are observed during the 2020 COVID pandemic and the recent energy crisis caused by the Russian invasion of Ukraine. The FF-3 specification provides a daily cross-sectional average estimate of 0.8262, which is close to the observed value of 0.833 in the data.

In contrast, the CAPM specification overestimates the cross-sectional mean, while the four-factor Carhart model underestimates it, yielding a value of 0.783. Averaging the Idiosyncratic Equity Premium (IEP) across the three models produces a mean of 0.8370, equivalent to an annualized rate of 13.25%, which aligns closely with the 13.22% calculated using the S&P500 components for the 2004-2023 period. The R^2 of the cross-regression of the idiosyncratic risk of the three different factor models with heterogeneous fixed effects on the idiosyncratic equity premium produce high values of 75%, 63%, and 46% respectively. These results indicate that the proposed directly observable IEP measure captures a large percentage of the variation of the benchmark IR measures used in the literature.

Furthermore, we validate the derived empirical equation, that relates excess returns of each S&P500 component and run panels with fixed effects on the three factor model specifications each augmented with the IEP for the overall sample, and two sub-samples. We demonstrate that incorporating the proposed IEP variable reveals a positive and significant relationship with dally excess returns at the cross-sectional level. In an empirical application covering the 2004-2023 period, we find that a 1% increase in the IEP leads to a positive rise in equity excess returns of 5.55%, 5.53%, and 5.533% for the CAPM, FF-3, and Carhart four-factor models, respectively. The findings highlight that the Idiosyncratic Equity Premium (IEP) is embedded in excess stock returns, providing a novel perspective on the equity premium puzzle by suggesting that a portion of the excess return compensates for persistent, non-diversifiable idiosyncratic risks. Further this framework identifies microstructure constants that are accumulated in the drift.

The study is organized as follows. In Section 3.2, we provide a review of the literature and the theoretical framework leading to the specification of the empirical model. In Section 3.3, a description of the methods and the sample data used for the empirical analysis is discussed. In section 3.4, we establish the link between idiosyncratic risk, IR, defined relative to the CAPM, FF-3 and the four-factor Carhart model, with the idiosyncratic equity volatility premium measure, IEP. Empirical results and estimations are reported in section 3.5. Section 3.6, provides some robustness and prediction accuracy tests. We conclude in section 3.7.

3.2 Theoretical Framework: Idiosyncratic Volatility Premium and Excess Returns

Extensions of the CAPM model include the [18] three-factor model (FF-3 hereafter), which is designed to capture the determinants of average returns in terms of the size factor as well as the book-to-market price ratio B/M. These are the two well-known patterns in the cross section of average excess returns that remained unexplained by the CAPM. Extensions of this framework include additional factors, such as the momentum factor [17]. All these specifications aim to summarize the systematic risk that affects all assets traded in a reduced number of market-wide risk factors, implying that idiosyncratic risk is diversified and not priced in the cross-section of stock returns. The views of [5] are confirmed in later work introduced by [65], which establishes that part of the variance in average returns can be explained by idiosyncratic risk, confirming that restrictions on diversification give rise to positive idiosyncratic risk premia. [101] uses an AR(2) model for idiosyncratic volatility that allows expected and unexpected components, and they confirm a significantly positive association with expected returns. [102] also recognize that the estimated volatility captures all relevant information for the expected returns and finds a positive impact of expected idiosyncratic volatility on future returns.

Another strand of the literature questions the positive relationship between idiosyncratic risk and returns, highlighting a negative link between expected returns and past firm-specific volatility, often measured by its first lag. The seminal work of [103] demonstrates a negative relationship between idiosyncratic risk (IR) and future equity returns. Similar findings are reported by [104], [93], [96], [105], and [16]. This result challenges conventional financial theory, which posits that idiosyncratic volatility should be irrelevant due to diversification [94] or compensated with positive excess returns [5]. Notable explanations for this puzzle include [6], who shows that portfolios with high (low) idiosyncratic volatility relative to the [18] model have positive (negative) exposures to changes in average stock variance, leading to lower (higher) expected returns. [102] attributes this puzzle to risk reversal, where high idiosyncratic volatility initially boosts returns, but subsequent profit-taking by investors causes prices to fall, resulting in lower returns.

Several studies argue that the standard deviation of stock returns is predominantly idiosyncratic (see [53], [106], [107]) and employ it as a proxy for firm-specific risk. Another line of research focuses on portfolio-level analysis, using specific deciles of sorted equity portfolios to capture idiosyncratic risk (see [6]).[12]

Some studies in the literature present less conclusive evidence regarding the contribution of idiosyncratic risk (IR) to equity returns. [107] question the robustness of the relationship between IR and the cross-section of returns, attributing inconsistencies to differences in sample frequency (daily vs. monthly) and portfolio construction methods (value-weighted, equal-weighted, or inverse volatility-weighted). They employ two distinct measures of IR. The first is a daily measure replicating the approach of [103],[13] while the second is a rolling monthly average of daily IR over a 24 to 60-month window.[14] Using equally weighted portfolios, they find no significant negative relationship between IR and stock returns.

Similarly, [108] argue that corporate managerial decisions affecting investment and profitability should be considered part of idiosyncratic risk. Their empirical analysis of U.S. stocks from 1982 to 2009 shows a weak, non-significant negative relationship between firm-specific risk and expected returns. They attribute this to the influence of firm-level characteristics, such as investment and profitability, which are directly controlled by firm managers. Their findings suggest that incorporating these firm-specific factors helps explain the idiosyncratic volatility anomaly, highlighting the role of managerial decision-making in shaping firm-specific risk.

The relationship between idiosyncratic risk (IR) and expected excess returns (ER) remains unresolved, with no consensus on its direction. This ambiguity is partly due to the wide range of empirical methods used to measure IR. Common proxies include the squared residuals from asset-pricing models such as the CAPM, the three-factor model of [71] (FF-3), and the four-factor model of [17]. Since each factor model generates different residual series, the corresponding estimates of residual volatility also differ. For instance, [65] measure IR as the standard deviation of residuals from the FF-3 model, while [103] form portfolios based on IR defined as exposure to innovations in the Chicago Board Options Exchange VIX Index, which is then evaluated using the FF-3 model.[15]

Other approaches model the time-varying nature of residual volatility using Generalized Autoregressive Conditional Heteroskedasticity (GARCH) techniques (see [102]). Alternative methods approximate idiosyncratic risk using average firm-level volatility, as proposed by [109], who argue that most firm-level volatility is idiosyncratic in nature.

Here we develop a theoretical framework in which the dynamics of individual stock returns, $r_{i,t} = \frac{\Delta S_{i,t}}{S_{i,t}}$ and market returns, $r_{M,t} = \frac{\Delta M_t}{M_t}$, are influenced by both systematic and idiosyncratic shocks. μ_i denote the expected return on an individual security, i, r_f the risk-free rate. The stochastic shocks $\Delta\epsilon_{i,t}$ and $\Delta\epsilon_{M,t}$ drive the dynamics of stock and market returns, respectively. Then we state

$$\begin{aligned} r_{i,t} &= \mu_i + \sigma_{i,t}\Delta\epsilon_{i,t}, \\ r_{M,t} &= r_f + \sigma_{M,t}\Delta\epsilon_{M,t}, \end{aligned} \tag{2}$$

where $\sigma_{i,t}$ and $\sigma_{M,t}$ denote the total volatilities of the stock and market returns at time t. The terms $\Delta\epsilon_{i,t}$ and $\Delta\epsilon_{M,t}$ capture the random shocks driving the stock and market returns, respectively.

To understand the sources of risk affecting stocks and markets, we decompose these return shocks into systematic, idiosyncratic, and market microstructure components. For stock i, the total shock $\Delta\epsilon_{i,t}$ is written as

$$\Delta\epsilon_{i,t} = U_t + V_{i,t}, \tag{3}$$

where U_t represents a systematic shock that affects both the stock and the market simultaneously, and $V_{i,t}$ captures the idiosyncratic component that is specific to stock i. Similarly, the shock driving the return on the market portfolio is given by

$$\Delta\epsilon_{M,t} = U_t + Q_t, \tag{4}$$

[12] The relationship between idiosyncratic risk and Corporate Social Performance (CSP) or Environmental, Social, and Governance (ESG) issues is also significant. Firm-specific risk can be linked to human resource policies [67], [78], [13], as well as corporate ethical behavior or reputation [15]. Additionally, idiosyncratic risk may reflect firm-specific adaptation to environmental disasters and litigation risk [14], or responses to changes in regulatory policies.

[13] [103] use daily returns to estimate monthly volatility, incorporating market innovations proxied by the CRSP value-weighted index relative to VIX innovations.

[14] [107] compute daily idiosyncratic volatility based on the Fama-French (1993) three-factor (FF-3) model and sort stocks into portfolios according to estimated idiosyncratic volatility.

[15] The literature on Environmental, Social, and Governance (ESG) factors has also applied IR measures. For example, [7] use CAPM residual variances to assess the impact of ESG performance on firm-specific risk.

where U_t is the same systematic shock affecting the stock, while Q_t captures market-specific innovations related to trading frictions, market liquidity, or microstructure noise. The introduction of Q_t reflects the fact that changes in market returns are not solely driven by systematic macroeconomic shocks but also by trading activity and other institutional market effects.

The components U_t, $V_{i,t}$, and Q_t are orthogonal, reflecting their distinct sources of risk. Formally, we have

$$U_t \perp V_{i,t}, \quad U_t \perp Q_t, \quad V_{i,t} \perp Q_t, \quad \text{for all} \quad i.$$

This orthogonality condition ensures that the systematic, idiosyncratic, and market microstructure components are independent, making it possible to isolate their individual contributions to overall return volatility. In addition, we assume that $V_{i,t}$ is idiosyncratic to firm i, so that

$$V_{i,t} \perp V_{j,t}, \quad \text{for} \quad i \neq j.$$

This independence implies that firm-specific shocks are uncorrelated across firms. We decompose the idiosyncratic and microstructure shocks into persistent and purely stochastic components as follows:

$$V_{i,t} = \mu_{i,V} + \tilde{V}_{i,t}, \quad Q_t = \mu_Q + \tilde{Q}_t$$

where $\mu_{i,V}$ and μ_Q capture the persistent, non-diversifiable components of the idiosyncratic and microstructure shocks, respectively, while $\tilde{V}_{i,t}$ and $\tilde{Q}_t$ are zero-mean stochastic components. Each component is assumed to have the following properties:

$E[V_{i,t}] = \mu_{i,V}$, $E[Q_t] = \mu_Q$, $E[\tilde{V}_{i,t}] = 0$, $E[\tilde{Q}_t] = 0$.

Thus, the mean components $\mu_{i,V}$ and μ_Q remain as persistent effects, and the zero-mean components $\tilde{V}_{i,t}$ and $\tilde{Q}_t$ capture the purely stochastic nature of firm-specific and market microstructure risk.

The stochastic nature of these shocks is further characterized by assuming that:

$$U_t \sim N(0, \sigma_U^2), \quad \tilde{V}_{i,t} \sim N(0, \sigma_{i,\tilde{V}}^2), \quad \tilde{Q}_t \sim N(0, \sigma_{\tilde{Q}}^2)$$

where $\sigma_{U,t}^2$ denotes the variance of the systematic shock, $\sigma_{i,\tilde{V},t}^2$ the variance of the zero-mean component of the idiosyncratic shock for stock i, and $\sigma_{\tilde{Q},t}^2$ the variance of the zero-mean component of the market microstructure shock.

We define the variance processes zeroing the covariance terms due to the orthogonality assumptions:

$$V(\Delta\epsilon_{i,t}) = \sigma_{U,t}^2 + \mu_{i,V}^2 + \sigma_{i,\tilde{V},t}^2$$

$$V(\Delta\epsilon_{M,t}) = \sigma_{U,t}^2 + \mu_Q^2 + \sigma_{\tilde{Q},t}^2$$

The total variances of the stock-specific and market-specific shocks are captured by their total volatilities:

$$\begin{aligned} V(\Delta\epsilon_{i,t}) &= \sigma_{i,t}^2, \\ V(\Delta\epsilon_{M,t}) &= \sigma_{M,t}^2. \end{aligned} \tag{5}$$

Importantly, the total volatilities are defined as:

$$\sigma_{i,t} = \sqrt{\sigma_{U,t}^2 + \mu_{i,V}^2 + \sigma_{i,\tilde{V},t}^2}, \quad \sigma_{M,t} = \sqrt{\sigma_{U,t}^2 + \mu_Q^2 + \sigma_{\tilde{Q},t}^2}$$

These equations capture the total variances by combining the effects of common systematic market factors (U_t) and the unique part of the shocks. The terms, $\sigma_{i,\tilde{V},t}^2$ and $\sigma_{Q,t}^2$, are the stock-specific and market-specific variance shocks, respectively. These total volatilities capture both the systematic effects from U_t and the firm-specific idiosyncratic and market microstructure components. The inclusion of $\mu_{i,V}$ and μ_Q highlights the non-diversifiable nature of persistent idiosyncratic and market microstructure shocks.

This decomposition is consistent with prior research on return dynamics, particularly the work of [96], who highlight the importance of both systematic and idiosyncratic components in shaping asset returns. The term Q_t accounts for market microstructure noise, reflecting the influence of trading mechanisms, liquidity conditions, and other institutional factors on innovations in market returns.

$$
\begin{aligned}
r_{i,t} &= \mu_i + \sigma_{i,t}(U_t + V_{i,t}), \\
r_{M,t} &= r_f + \sigma_{M,t}(U_t + Q_t).
\end{aligned} \tag{6}
$$

The excess returns of the stock are built by subtracting the risk-free rate r_f from both sides and we further define $\tilde{r}_{i,t} = r_{i,t} - r_f$, $\tilde{r}_{M,t} = r_{M,t} - r_f$. Further, taking expectations of the above equations defined under (5), we have the following:

$$
\begin{aligned}
E(\tilde{r}_{i,t}) &= E(\mu_i - r_f) + E(\sigma_{i,t}(U_t + V_{i,t})), \\
E(\tilde{r}_{M,t}) &= E(\sigma_{M,t}(U_t + Q_t)).
\end{aligned} \tag{7}
$$

given that $E(U_t) = 0$ we write

$$
\begin{aligned}
E(\tilde{r}_{i,t}) &= E(\mu_i - r_f) + E(\sigma_{i,t}V_{i,t}), \\
E(\tilde{r}_{M,t}) &= E(\sigma_{M,t}Q_t).
\end{aligned} \tag{8}
$$

$$
E(\sigma_{i,t}V_{i,t}) = E(\sigma_{i,t}\mu_{i,V}) + E(\sigma_{i,t}\tilde{V}_{i,t})
$$

Since $E(\tilde{V}_{i,t}) = 0$, this reduces to $E(\sigma_{i,t}V_{i,t}) = \mu_{i,V}E(\sigma_{i,t})$.

$$
\begin{aligned}
E(\tilde{r}_{i,t}) &= E(\mu_i - r_f) + \mu_{i,V}E(\sigma_{i,t}) \\
E(\tilde{r}_{M,t}) &= \mu_Q E(\sigma_{M,t})
\end{aligned}
$$

Subtracting $(\tilde{r}_{M,t})$ from $(\tilde{r}_{i,t})$ in equation (7) and rearranging, we obtain the following:

$$
E(\tilde{r}_{i,t}) = E(\mu_i - r_f) + E(\tilde{r}_{M,t}) + \mu_{i,V}E(\sigma_{i,t}) - \mu_Q E(\sigma_{M,t}), \tag{9}
$$

where the third term, $[\mu_{i,V}E(\sigma_{i,t}) - \mu_Q E(\sigma_{M,t})]$, represents the expected idiosyncratic equity volatility premium (IEP). It quantifies the contribution of firm-specific factor uncertainties to the stock's overall risk-return profile.

The expected volatilities for the stock and the market are estimated empirically through rolling volatility estimates. Specifically, we define:

$$
E(\sigma_{i,t}|\mathcal{F}_{t-1}) = \hat{\sigma}_{i,t}, \quad E(\sigma_{M,t}|\mathcal{F}_{t-1}) = \hat{\sigma}_{M,t},
$$

where $\mathcal{F}_{t-1}$ represents the information set available up to time $t-1$. These rolling volatilities provide forward-looking estimates of expected returns based on market and stock-specific dynamics. Similarly [102] shows that conditional idiosyncratic volatility plays a more significant role in explaining cross-sectional excess returns than unconditional measures.

We rewrite Equation (8) as:

$$
E(\tilde{r}_{i,t}) = E(\mu_i - r_f) + E(\tilde{r}_{M,t}) + \mu_{i,V}\hat{\sigma}_{i,t} - \mu_Q\hat{\sigma}_{M,t} \tag{10}
$$

If the idiosyncratic shocks on the stock and market are not persistent ($\mu_{i,V} = 0$ and $\mu_Q = 0$), the equation collapses to standard CAPM frameworks. This serves as a testable hypothesis. After reorganizing:

$$
\mu_{i,V}\hat{\sigma}_{i,t} - \mu_Q\hat{\sigma}_{M,t} = \mu_Q\hat{\sigma}_{i,t} - \mu_{i,V}\hat{\sigma}_{M,t} + (\mu_{i,V} + \mu_Q)(\hat{\sigma}_{i,t} - \hat{\sigma}_{M,t}),
$$

we arrive at:

$$
E(\tilde{r}_{i,t}) = \tilde{\mu}_i + \mu_Q\hat{\sigma}_{i,t} - \mu_{i,V}\hat{\sigma}_{M,t} + E(\tilde{r}_{M,t}) + (\mu_{i,V} + \mu_Q)(\hat{\sigma}_{i,t} - \hat{\sigma}_{M,t}) \tag{11}
$$

where $\tilde{\mu}_i = \mu_i - r_f$.

Alternatively, this can be expressed as:

$$
E(\tilde{r}_{i,t}) = \alpha_{i,t} + E(r_{M,t} - r_f) + \Gamma\psi_{i,t}, \tag{12}
$$

with:

$$
\Gamma = \mu_{i,V} + \mu_Q, \quad \psi_{i,t} = \hat{\sigma}_{i,t} - \hat{\sigma}_{M,t}, \quad \alpha_{i,t} = \tilde{\mu}_i + \mu_Q\hat{\sigma}_{i,t} - \mu_{i,V}\hat{\sigma}_{M,t}.
$$

Here, Γ represents the average IEP effect on expected excess returns, while $\psi_{i,t}$ captures the spread of volatilities, quantifying the variation in total idiosyncratic shocks. The spread of volatilities, $(\hat{\sigma}_{i,t} - \hat{\sigma}_{M,t})$, reflects the relative impact of stock-specific versus market-wide shocks. When $\hat{\sigma}_{i,t} > \hat{\sigma}_{M,t}$, stock idiosyncratic shocks dominate, indicating higher firm-specific risk. In the case $\hat{\sigma}_{i,t} < \hat{\sigma}_{M,t}$, market-wide factors such as microstructure dynamics dominate.

Γ also captures the persistence of total idiosyncratic shocks, encompassing both $\mu_{i,V}$ and μ_Q. The omitted terms in $\alpha_{i,t}$ reflect cross-effects between expected idiosyncratic shocks of the stock and market volatilities. These terms include:

$$\mu_{i,V}\hat{\sigma}_{M,t}, \quad \mu_Q\hat{\sigma}_{i,t},$$

which quantify the interaction of firm-specific shocks with market-wide volatility and vice versa. Economically, these terms highlight how persistent idiosyncratic shocks influence stock returns and how market volatility propagates firm-specific risks. For instance, $\mu_{i,V}\hat{\sigma}_{M,t}$, measures the average effect of market volatility on firm-specific risk, linking to systemic risk propagation. The term $\mu_Q\hat{\sigma}_{i,t}$ captures the average cost of market microstructure factors on stock returns, such as liquidity and trading frictions [110]. This decomposition aligns with empirical studies on volatility dynamics and systemic risk, such as [97], [111], and [112]. More recent studies on high-frequency trading, such as those by [113], further elaborate on how modern market mechanisms influence volatility at the stock level. [114] introduced an early micro-structure model where information asymmetry and the structure of order flow can impact price volatility. [115] shows that trade-related information contributes significantly to price discovery, thus affecting stock volatility. [116] link the liquidity of equity prices (defined as a micro-structural factor) to their volatility, showing how lower liquidity levels can lead to higher volatility due to information asymmetry.

The empirical equation proposed that includes the average effect of idiosyncratic premium represented by Γ, the variable that quantifies the effects of firm-specific shocks on equity returns, and the estimated systematic risk premium β'. We estimate the following equation here, as:

$$\mathbf{E}\left(\tilde{r}_{i,t}\right) = \alpha_i + \beta'\phi + \Gamma\psi_{i,t} + \epsilon_{i,t} \tag{13}$$

with $\epsilon_{i,t} \sim N(0,1)$, and $\psi_{i,t} = \hat{\sigma}_{i,t} - \hat{\sigma}_{M,t}$. Here we consider three standard benchmark factor models which include the fundamental component $\beta'\phi$ and include the following factors: Market, Small minus Big (Size), High minus Low (value), and Momentum factors.

$$\begin{aligned}\beta'\phi =& \beta_M \cdot \tilde{r}_{M,t} + \beta_{\text{SMB}} \cdot \text{SMB}_t \\ &+ \beta_{\text{HML}} \cdot \text{HML}_t + \beta_{\text{MOM}} \cdot \text{MOM}_t\end{aligned}$$

3.3 Methods and Data

We utilize daily price data for all S&P 500 components from January 30, 2004, to June 1, 2023, sourced from FactSet. The price data include dividends, capital gains, and adjustments for corporate actions such as stock splits and scrip dividends. We supplement this with Fama-French factor data from the Fama-French database. To account for systematic risk and firm-specific attributes, we use four well-established control variables following [17]. These include the SMB (size) factor, representing the return spread between small and large firms, the HML (value) factor, capturing the difference between high and low book-to-market portfolios, and the MOM (momentum) factor, reflecting the return spread between stocks with positive and negative momentum. Summary statistics and correlations for the key variables are presented in Tables 3.1 and 3.2.

We calculate the market portfolio's realized volatility using a 30-day rolling window to compute the standard deviation of daily S&P 500 returns. This approach is justified since the S&P 500 serves as a reliable proxy for the U.S. market portfolio, given its high correlation with the true market portfolio [19].

Next, we estimate the daily return volatility for each S&P 500 component. Finally, we calculate the Idiosyncratic Equity Premium (IEP) as the spread between each stock's total volatility and market volatility. Using daily prices helps mitigate liquidity biases and ensures transparent price formation. To obtain unbiased standard errors in the panel data estimations, we adjust the covariance matrix using cluster-based methods aligned with [20].

Tables 3.1 and 3.2 present summary statistics and correlations for the variables considered. Returns are reported as percentages, based on daily observations from 2004 to 2023. The Idiosyncratic Equity Volatility Premium (IEP) averages 0.833% per day, equivalent to an annualized rate of 13.22%, across all SP 500 companies. The standard error for this measure is notably small at 0.000657.[16] The annualized market excess returns (Mkt_{RF}) range from -12% to 11.35%. Table 3.2 reports correlations among asset-pricing factors, revealing a low correlation between the (IEP) and the other variables. The lowest negative correlation is observed with the momentum factor (MOM) at -0.023, while the highest positive correlation is with the size factor (SMB) at 0.01.

Table 3.1: Summary Statistics 2004-2023

Variable	Mkt_{RF}	SMB	HML	MOM	ψ
Nº of observations	1976694	1976694	1976694	1976694	1944832
mean	0.044	-0.005	0.002	0.004	0.833
std	1.213	0.760	0.603	1.027	0.916
min	-12	-5.02	-3.79	-14.37	-3.132
25%	-0.41	-0.32	-0.35	-0.39	0.322
50%	0.08	-0.02	0	0.05	0.632
75%	0.58	0.28	0.35	0.46	1.104
max	11.35	6.74	5.54	7.12	23.128

The statistics reported are expressed in percentages and cover the whole period up to 2023.

Table 3.2: Correlation Matrix 2004-2024

Variable	Mkt_{RF}	HML	SMB	MOM	ψ
Mkt_{RF}	1.000	0.272	0.175	-0.233	0.006
HML	0.272	1.000	-0.019	-0.595	0.004
SMB	0.175	-0.019	1.000	0.018	0.010
Mom	-0.233	-0.595	0.018	1.000	-0.023
IEP	0.006	0.004	0.010	-0.023	1.000

In this table we report the correlations among the variables used in empirical equation 11.

3.4 Idiosyncratic Risk and Idiosyncratic Equity Volatility Premium

As a preliminary analysis, we compare the proposed ψ with the benchmark idiosyncratic risk measures used in the literature. The following analysis summarizes the relationship between the ψ factor and the idiosyncratic volatility risk factors relative to the CAPM, the FF-3 factor model and the [17] four factor model. Let $\tilde{r}_{i,t}$ denote the excess return on asset i in period t so that $\tilde{r}_{i,t} = r_{i,t} - r_f$: where $r_{i,t}$ is the return of stock i at time t, $r_{f,t}$ is the risk-free rate.

The linear relationship between the asset return and the risk factor under the one-factor model is:

$$\tilde{r}_{i,t} = \alpha_i + \beta_M(r_{M,t} - r_f) + e_{i,t}, \tag{14}$$

Where: $r_{M,t}$ is the market return, β_M is the stock's sensitivity to the market index, and $e_{i,t}$ represents the idiosyncratic error term. We define the market excess return as $\tilde{r}_{M,t} = r_{M,t} - r_f$

[16] To calculate the significance of the mean $\psi = 0.833$ based on the provided summary statistics, we can use the standard error of the mean and then calculate the standard error of the average ψ as

$$SE = \frac{\text{std}}{\sqrt{n}} \approx 0.000657$$

Where std = 0.916 (standard deviation of ψ) and $n = 1944832$ (number of observations) and assume no correlation between the market excess return and the idiosyncratic return, i.e., $\mathrm{Cov}(\tilde{r}_{M,t}, e_{i,t}) = 0$.

The idiosyncratic variance for the stock is then derived as follows:

$$\mathrm{Var}(\tilde{r}) = \mathrm{Var}(\beta_M \tilde{r}_{M,t} + e_{i,t}), \tag{15}$$

$$\sigma_e^2 = \sigma_{\tilde{r}}^2 - \beta_M^2 \sigma_{M,t}^2, \tag{16}$$

where σ_e^2 is the idiosyncratic variance, $\sigma_{\tilde{r}}^2$ is the total variance of the stock's excess returns, and $\sigma_{M,t}^2$ is the variance of the market's excess returns.

In order to calculate the stock's idiosyncratic variance, we employ daily data to run a rolling 30-day regression for each component of the S&P 500 index. The idiosyncratic variance $\mathbf{\Sigma}_e$ (see also [65]) for all component stocks of the S&P500 will be written as:

$$\mathbf{\Sigma}_e = \mathbf{\Sigma}_{\tilde{\mathbf{r}}} - \sigma_M^2 \beta\beta'.$$

Where: $\mathbf{\Sigma}_{\tilde{\mathbf{r}}}$ is the total return variance. Note that this definition can be extended to the more general FF-3 model and the Carhart four-factor model introduced by [17]. These can be specified by:

$$\tilde{r}_{i,t} = \alpha_i + \beta_M \tilde{r}_{M,t} + e_{\mathrm{CAPM}} \tag{17}$$

$$\tilde{r}_{i,t} = \alpha_i + \beta_M \tilde{r}_{M,t} + \beta_{\mathrm{SMB}} SMB_t + \beta_{\mathrm{HML}} HML_t + e_{\mathrm{FF3,t}} \tag{18}$$

$$\begin{aligned}\tilde{r}_{i,t} =& \alpha_i + \beta_M \tilde{r}_{M,t} + \beta_{\mathrm{SMB}} SMB_t + \beta_{\mathrm{HML}} HML_t + \\ &+ \beta_{\mathrm{MOM}} MOM_t + \mathrm{e}_{\mathrm{Carhart}}\end{aligned} \tag{19}$$

Where $\tilde{r}_{i,t}$, HML, and SMB are excess returns on the market portfolio, the value factor and the size factor respectively, and MOM is the [17] momentum factor. This model has been supported by the work of [65], [117], [104], [7], which shows that the four factor model removes all rational factors that affect the excess stock returns. Under these benchmark specifications, the idiosyncratic firm-specific information is preserved in the residuals of the estimated model.

We define the benchmark idiosyncratic risk (IR) metrics as the time series volatilities created for S&P 500 components based on the corresponding standard IR measures: $\sigma_{CAPM} = \sqrt{\mathrm{SSE}_{\mathrm{CAPM}}/\mathrm{df}_{\mathrm{CAPM}}}$ for the CAPM model, $\sigma_{\mathrm{FF3}} = \sqrt{\mathrm{SSE}_{\mathrm{FF3}}/\mathrm{df}_{\mathrm{FF3}}}$ for the Fama-French model, $\sigma_{\mathrm{Carhart}} = \sqrt{\mathrm{SSE}_{\mathrm{Carhart}}/\mathrm{df}_{\mathrm{Carhart}}}$ for the four-factor Carhart model. Here, SSE denotes the sum of squared errors, and df represents the degrees of freedom for each specification. These measures are based on company-specific characteristics and unique firm-specific risk to an individual stock that is not explained by broader market or sector movements.

We let the index $k = \{\mathrm{CAPM}, \mathrm{FF\text{-}3}, \mathrm{Carhart}\}$ run through the different factor specifications for the idiosyncratic risk and $e_{k,(i,t)}$ represents the residuals. Set $i = 1, 2, ..., 500$ to represent each of the S&P500 components.

In what follows, we relate the proposed idiosyncratic volatility spread premium measure to the benchmark IR measures used in the literature. [117] establish that if a given asset has a significant mis-pricing relative to the benchmark model, then there is a positive relation between the idiosyncratic equity volatility reflected in the residuals of the benchmark model and the asset exposure to the missing variable. If we assume that the missing variable is the IEP, which is represented with symbol ψ, then there should naturally be a positive relationship between the benchmark and idiosyncratic volatility and the idiosyncratic equity volatility premium.
We run the following empirical cross-section regression for the sample ranged from January 2004 until June 2023.

$$\sigma_{k,(i,t)} = \alpha_{k,i} + \Gamma_k \psi_{i,t} + e_{k,(i,t)} \tag{20}$$

Estimated results for equation 20 are reported in table 3.3. They show that there is a positive relationship between the idiosyncratic risk in all model specifications and the proposed idiosyncratic

Table 3.3: Factor based Idiosyncratic Risk vs Idiosyncratic Premium

Dependent	σ_{CAPM}	$\sigma_{\text{FF-3}}$	σ_{Carhart}
Parameters			
Γ_k	0.9019***	0.8262***	0.783***
	(605.09)	(122.96)	(70.888)
R^2	0.7543	0.6395	0.4675
Fixed Effects	Yes	Yes	Yes
Covariance Adjustment	Clustered	Clustered	Clustered
Nº of Observations	1809817	1809817	1809817

Regression between σ_{CAPM}, σ_{FF3} and σ_{Carhart} and ψ. Γ_k represents the average idiosyncratic volatility premium estimated under CAPM, FF-3, and Carhart specifications. Clustered covariance is used. Robust t-stats are provided in parentheses while ***denote statistical significance at 1%, **denote statistical significance at 5%, *denote statistical significance at 10%.

equity volatility premium, $\psi_{i,t}$. Γ_k captures the average cross IEP and show a strong positive relationship to the literature measure capturing the risk-reward profile. The FF-3 specification yields a Γ estimate of 0.8262, as reported in Table 3.3, Column 2, corresponding to an annualized value of 13.11%. This estimate is close to the reported value of 0.833 (13.22%) in table 3.1. The decline of Γ from 0.90 in CAPM to 0.826 in FF-3, and 0.783 in Carhart is compelling evidence of the positive relationship between IR and IEP. It highlights how improved systematic identification reduces both the level of idiosyncratic risk and the premium required to bear it. This premium compensates investors for shocks that affect specific stocks or market microstructure but cannot be diversified away. This premium exists because even well-diversified portfolios cannot fully eliminate idiosyncratic volatility when persistent firm-level and market-specific shocks exist. The decomposition in this model highlights that these shocks might be persistent have non-zero mean and impact returns systematically.

The CAPM specification overestimates the cross-sectional mean with a Γ estimate of 0.9019, equivalent to an annualized value of 14.31%. In contrast, the Carhart four-factor model underestimates it, producing a Γ estimate of 0.783, which corresponds to an annualized value of 12.42%. As the factor based idiosyncratic risk, averaging the Γ estimates across the three model specifications gives a value of 0.83703, or 13.28% annually, which closely aligns with the 13.22% reported in Table 3.1. All estimated parameters are statistically significant at the 1% significance level. The R^2 is decreases from 75.43% in the CAPM case to 46.75% under the four-factor Carhart model. These results indicate that the proposed directly observable IEP measure captures a large percentage of the variation of the benchmark IR measures used in the literature.

3.5 Empirical results: Impact of the proposed IEP on cross-sectional returns

In this section, we examine the influence of the Idiosyncratic Equity Premium (IEP) on the cross-section of S&P 500 constituent returns. Panels A, B, and C of table 4 provide the estimation results of equation (10) under six model specifications and across three different sub-sample periods. The model specifications include CAPM, CAPM+ψ, FF-3, FF-3+ψ, Carhart, and Carhart+ψ. The sub-sample periods analyzed are 2004-2023, 2004-2015, and 2016-2023.

The decision to split the sample period of 2004-2023 into two sub-periods, 2004 to the end of 2015 and 2016 to June 2023, is based on the Paris Agreement for a greener world. Signed in December 2015, the Paris Agreement marked a significant shift in global climate policy, aiming to limit global warming to well below 2 degrees Celsius above pre-industrial levels. This division captures the potential impacts of heightened environmental regulations and an increased focus on sustainability on financial markets and corporate returns. According to event studies in financial markets, such as those of [118] and [119], significant policy changes like the Paris Agreement can lead to changes in risk premiums, market volatility, and investment patterns. Idiosyncratic risk examined through the lens of firm-specific shocks, is seen in [72], who analyze how firm-level exposure to climate change impacts stock returns. Using the frequency of climate-related language in firm earnings calls, they capture firm-specific climate exposure and link it to stock returns. Their findings demonstrate how firm-specific environmental risks operate as idiosyncratic drivers of volatility and contribute to cross-sectional differences in expected returns.

Our main focus is on the signs, size and significance of the Γ average estimate of the idiosyncratic volatility equity premium, under the empirical equations (15-17) to address the explanatory power of the IEP in determining average excess stock returns of S&P500 components. Adjusting the covariance matrix with size-based sub-portfolios (clusters according to size) that matches the methods in [20] introduced for unbiased standard errors in the panel data estimations. Robust t-statistics are reported in parentheses. The dependent variable is defined as the cross-section of excess returns. We aim to determine the extent to which firm-specific risk as measured by ψ is priced in the cross-section of stock returns. We also analyze if ψ is positively related to excess returns. Firm-specific characteristics such as the company productivity arising from non-financial assets that are not included in the fundamental volatility factors are captured by the fixed effects used in the estimation, in line with [73].

As discussed in section 2, we consider extensions of the traditional CAPM market model, the FF-3 specification, and the four-factor Carhart model, to include the ψ coefficient Γ. Reported results show that the sign of Γ is always positive and remains statistically significant across all specifications and sub-samples. Reported findings show that for shorter sub-samples (2016-2023, and 2004-2015) the relationship remains positive and statistically significant at the 1% significance level. When considering the full sample period, we see that under the CAPM+ψ, FF-3+ψ and in the Carhart+ψ model specification, the effect of one 1% increase in the IEP has an average increase in excess average returns equal to $\Gamma = [13.93\%, 13.48\%, 12.92\%]$ respectively in annual terms.

A closer look of Panel A in table 3.4, shows that the explanatory FF-3 and Carhart four-factor parameter estimations do not change sign and size when including the ψ factor. This implies that the orthogonality condition preserves the values of the corresponding factor coefficients. We can however see, that the coefficient corresponding to the HML value factor decreases when MOM, the momentum factor is added from 0.215 to 0.159. This is consistent with the findings of [120], [17], [121], [122]. These studies indicate that momentum captures unique aspects of stock returns, which can reduce the explanatory power of the value factor when both are included in the same model. Several studies in the literature document findings that include negative loadings for the momentum factor, as we find here in Panel A, [120], [123], [124], [125], [126]. They find that high idiosyncratic volatility stocks often experience negative momentum strategy returns. This aligns with our findings, where higher idiosyncratic equity volatility premium Γ is associated with higher excess returns, while the momentum factor β_{MOM} is negative across all sub-samples.

Our results therefore show that excess returns can be explained by idiosyncratic factor, market, value, size, momentum for this period in the S&P500 market. We document an average increase in R^2 as we expand the number of explanatory variables with the idiosyncratic equity volatility premium, ψ. In fact, in the last model specification Carhart+ψ the R^2 becomes 0.3497, which represents a modest 0.018 increase when compared with the 0.3479 reported in the simple Carhart specification. However given the number of observations (N=1,944,832), the addition of more variables will not result in a dramatic change, since the degrees of freedom, df, are barely affected as $\mathrm{df} = N - \phi$, ϕ is the number of covariates and N=1,944,832 observations. Despite the expected small change in R^2 we observe a consistent improvement across different models and time periods, suggesting that the additional variables, including the idiosyncratic equity volatility premium, ψ do provide modest incremental explanatory power. Similar improvements are reported for the CAPM and FF-3 extension. Note the inclusion of one of the value or size factors to the CAPM specification leads to equivalent small increases in the R^2. But with the inclusion of the ψ factor the estimated alpha,the constant parameter becomes negative and significant. The change of sign in the constant is then additional strong evidence that the inclusion of the idiosyncratic equity volatility premium has significant impact in the estimations more sizable than the R^2 indicates.

The results indicate that a higher Idiosyncratic Equity Premium (IEP) is associated with higher excess returns. For the Carhart specification, the estimated IEP for the 2004-2023 period is 12.93%, which aligns closely with the 12.47% reported in Table 2.3 for the relationship between idiosyncratic risk and IEP. In Table 3.4, Panel B, covering the 2004-2015 period, the IEP reaches 15.82%, while for the 2016-2023 period, it declines to 9.75%.[17]

The demand for an idiosyncratic premium is higher during periods of market turbulence, as seen in the 2004-2015 sub-sample, which includes major financial disruptions such as the Global Financial Crisis, the European Debt Crisis, and the 2014 Commodities Price Shock. The effects of these crises are more pronounced in the 2004-2015 period compared to the entire 2004-2023 sample.

While much of the prior literature has focused on the sign of the relationship between idiosyncratic risk and returns, evidence on the magnitude of the idiosyncratic premium is mixed. [102] estimates an idiosyncratic risk premium of 11%, while [96] reports a premium of 8%, both using S&P 500 data from 1966 to 2006. In contrast, [103] finds a negative premium of -15%, suggesting that momentum-based strategies may experience reversals that reduce returns. Notably, [103] also find that tail risk accounts for an average of 34% of the total idiosyncratic equity risk premium.

Applying this insight to our 2004-2015 sub-sample, where the IEP is 15.82%, we estimate that tail risk contributes approximately 5.38% of this premium (34% of 15.82%). Excluding the tail risk component, the adjusted IEP for the 2004-2015 period would be 10.44%, which is consistent with the estimates reported by [102] (11%) and [96] (8%). This analysis reinforces the role of tail risk in shaping the idiosyncratic equity volatility premium and highlights how market disruptions and extreme events increase investors' demand for compensation for firm-specific risks.

It is interesting to note that the estimated market risk exposure measured by β_M decreases when the ψ factor is included for the second sub-sample covering the 2016-2024 period. However Γ is the lowest under all the specifications in this subsample. During the last and the shortest sub-sample period (2016-2024) which includes the COVID-19 period and the start of the current war in Ukraine, the firm-specific risk coefficient remains significant at the 1% level. It is notable that the loadings on the value factor (HML) are the highest in this sample compared to those in Panel A and Panel B.

Estimations reported in table 3.4, show that investors need to be compensated for holding higher idiosyncratic risk, suggesting that there are restrictions to portfolio diversification as claimed in [5]. Consistent with these results, we find that stocks with higher exposure to idiosyncratic innovations as measured by Γ earn higher average excess returns. Our setup allows for variations in idiosyncratic volatility to affect expected asset returns, implying that investors are not able to diversify idiosyncratic risk.

The overall conclusion is that the ψ variable has positive and significant effect in all samples and model specifications. This implies that higher exposures to firm-specific ψ are expected to deliver increased average returns. The ψ is therefore an additional metric that should be included in benchmark asset pricing models. Figure 3.1 (see below), represents the idiosyncratic equity volatility premium at cross section level calculated for all S&P500 constituents over the whole sample period ranging from 2004 till May 2024. The solid line is the annualized mean-implied volatility spread of individual securities.

The annualized mean calculated from the data fluctuates around the estimated Γ under the Carhart $+\psi$ specification. This is equal to 0.0513, which, when annualized by multiplying by 252 trading days, delivers an estimated annual Γ of 12.93%. Overall, this estimated premium provides a good fit for the data. Prominent hikes in the original data deliver annualized values exceeding 25 percentage points, and in some cases, reaching 30 percentage points. Notably, the ψ component peaked during the 2008-2009 Global Financial Crisis (GFC), indicating higher business-specific risk during that period. Other episodes of elevated ψ are observed during the 2020 COVID pandemic and the recent energy crisis caused by the Russian invasion of Ukraine.

[17] These values are computed by multiplying the estimated coefficient of the cross-sectional Γ estimate by 252, representing the number of trading days in a year.

Table 3.4: Inter-temporal Analysis of Idiosyncratic Equity Volatility Premium (IEP) Across Three Factor Models.

Panel A: 2004–2023

Models	CAPM	CAPM+ψ	FF-3	FF-3+ψ	Carhart	Carhart+ψ
α	0.0115***	-0.0347***	0.0143***	-0.0304***	0.0144***	-0.0285***
	(9.045)	(-7.079)	(11.261)	(-6.260)	(11.434)	(-5.868)
β_M	1.0534***	1.0535***	1.0063***	1.0066***	1.0014***	1.0017***
	(503.73)	(503.54)	(462.96)	(462.78)	(907.13)	(461.07)
β_{HML}			0.215***	0.215***	0.1593***	0.1599***
			(66.441)	(66.518)	(76.137)	(47.845)
β_{SMB}			0.1181***	0.1176***	0.1207***	0.1198***
			(32.384)	(32.149)	(56.739)	(32.784)
β_{Mom}					-0.0721***	-0.0707***
					(-47.019)	(-27.696)
Γ		0.0553***		0.0535***		0.0513***
		(8.622)		(8.439)		(8.118)
R^2	0.3413	0.3431	0.3472	0.3490	0.3479	0.3497
Clustered:	YES	YES	YES	YES	YES	YES
Fixed Effects:	YES	YES	YES	YES	YES	YES

Panel B: 2004–2015

Models	CAPM	CAPM+ψ	FF-3	FF-3+ψ	Carhart	Carhart+ψ
α	0.0196***	-0.0373***	0.0200***	-0.0357***	0.0209***	-0.0325***
	(11.986)	(-5.757)	(12.226)	(-5.534)	(12.757)	(-5.062)
β_M	1.0806***	1.0813***	1.0354***	1.0364***	1.0254***	1.0266***
	(420.09)	(419.46)	(343.62)	(343.12)	(670.73)	(345.91)
β_{HML}			0.1437***	0.1428***	0.0856***	0.0861***
			(24.728)	(24.624)	(26.939)	(14.496)
β_{SMB}			0.1476***	0.1474***	0.1590***	0.1577***
			(28.150)	(27.912)	(53.931)	(29.766)
β_{Mom}					-0.0799***	-0.0775***
					(-37.814)	(-24.344)
Γ		0.0669***		0.0656***		0.0628***
		(8.037)		(7.911)		(7.602)
R^2	0.3483	0.3510	0.3505	0.3532	0.3513	0.3539
Clustered:	YES	YES	YES	YES	YES	YES
Fixed Effects:	YES	YES	YES	YES	YES	YES

Panel C: 2016–2023

Models	CAPM	CAPM+ψ	FF-3	FF-3+ψ	Carhart	Carhart+ψ
α	**-0.0018**	-0.0391***	0.0042**	-0.0296***	**0.0026**	-0.0295***
	(-0.88)	(-5.582)	(2.007)	(-4.326)	(1.266)	(-4.315)
β_M	1.0036***	1.0020***	0.9773***	0.9750***	0.9790***	0.9777***
	(259.14)	(252.06)	(252.61)	(245.62)	(550.16)	(247.56)
β_{HML}			0.2775***	0.2810***	0.2231***	0.2283***
			(70.186)	(70.467)	(78.985)	(54.983)
β_{SMB}			0.0452***	0.0427***	0.0393***	0.0378***
			(8.381)	(7.823)	(12.158)	(6.909)
β_{Mom}					-0.0717***	-0.0699***
					(-31.191)	(-15.742)
Γ		0.0443***		0.0410***		0.0387***
		(4.812)		(4.562)		(4.332)
R^2	0.3273	0.3270	0.3434	0.3437	0.3444	0.3446
Clustered:	YES	YES	YES	YES	YES	YES
Fixed Effects:	YES	YES	YES	YES	YES	YES

Notes: Results from estimating equation (13) are reported. We focus on the IEP coefficient (Γ). Extensions of the CAPM, FF-3, and Carhart four-factor model are considered for each sub-sample. Robust t-statistics are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Non-significant parameters are reported in bold.

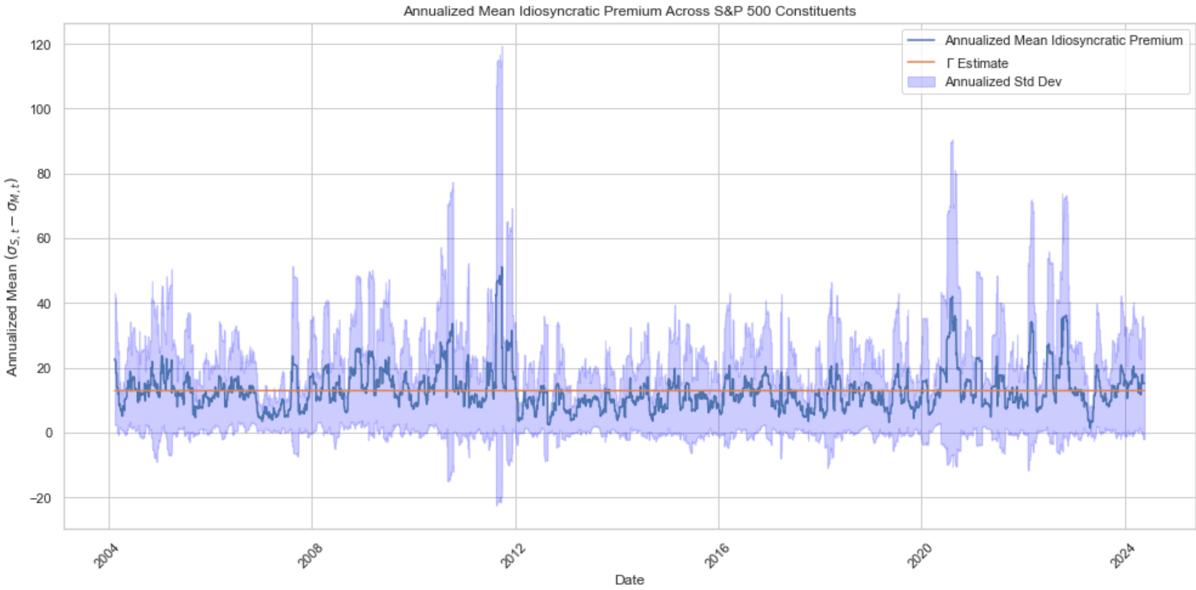

Figure 3.1: This figure illustrates the time series of the annualized mean idiosyncratic premium of the constituents of the S&P 500, spanning from the year 2004 through 21-05-2024. The additional data still fluctuate around the estimated Γ. The mean premium is indicated by the central solid line, and the shaded area reflects the annualized standard deviation, showing the variability among the constituents' premiums. Notable peaks correspond to periods of economic stress, which suggests a greater idiosyncratic risk perceived by the investors.

3.6 Prediction Accuracy and Robustness tests

This section reports model diagnostics for various model configurations, including CAPM, CAPM+ψ, FF-3, FF-3+ψ, Carhart, and Carhart+ψ. The objective is to demonstrate the significance of the idiosyncratic equity volatility premium in reducing the pricing error of the underlying factor pricing models. We present performance metrics to statistically test the importance of ψ. Table 3.5 reports the Mean Squared Error (MSE), Root Mean Squared Error (RMSE), and Mean Absolute Error (MAE). We employ tests commonly used in time-series forecasting to evaluate the best specification within the panel data context. All metrics indicate that the Carhart+ψ model is the best-fitting specification across all samples, as it exhibits the smallest average prediction error.

The evaluation of model performance across the CAPM, Fama-French 3-factor (FF-3), and Carhart models, with and without the inclusion of ψ the idiosyncratic equity premium provides critical insights into the explanatory power and predictive accuracy of asset pricing specifications over time.

Over the full sample, a clear progression in model fit is evident from CAPM to Carhart, with MSE decreasing from 3.013 (CAPM) to 2.982 (Carhart). This trend is consistent across RMSE, MAE, and R^2, with the latter improving from 0.349 in CAPM to 0.355 in Carhart. The inclusion of the idiosyncratic premium ψ, leads to marginal yet consistent improvements across all models. For instance, the Carhart + ψ, specification shows the best performance in terms of the lowest MSE (2.980), RMSE (1.726), and AIC/BIC values, indicating better overall model fit. The modest but systematic gains suggest that ψ captures additional variation not explained by standard risk factors.

In the earlier sub-period, performance metrics are generally worse, with higher MSE and RMSE across all models, reflecting the greater volatility or lower signal strength in returns during this phase. Again, moving from CAPM to Carhart results in a reduction in MSE from 3.312 to 3.298, and an improvement in R^2 from 0.347 to 0.350. Importantly, the addition of ψ has a more noticeable impact here, improving by approximately 0.003 points in each model and reducing MSE more substantially (e.g., from 3.298 to 3.290 in Carhart). The AIC and BIC also improve consistently with the inclusion of ψ, suggesting that the idiosyncratic premium was particularly

Table 3.5: Forecasting Performance Metrics

Sample 2004-2024							
Models	MSE	RMSE	MAE	R^2	Log_likelihood	AIC	BIC
CAPM	3.013	1.735	1.071	0.349	-3550679.63	7101363.26	7101388.07
CAPM + ψ	3.010	1.735	1.071	0.349	-3550160.30	7100326.60	7100363.81
FF-3	2.986	1.72	1.068	0.354	-3542588.87	7085185.74	7085235.36
FF-3+ ψ	2.983	1.727	1.068	0.354	-3542093.87	7084197.74	7084259.77
Carhart	2.982	1.726	1.068	0.355	-3541598.96	7083207.91	7083269.94
Carhart + ψ	2.980	1.726	1.068	0.355	-3541143.60	7082299.20	7082373.63
Sample 2004-2015							
CAPM	3.312	1.820	1.102	0.347	-2628768.80	5257541.57	5257565.74
CAPM+ψ	3.304	1.817	1.101	0.350	-2601569.65	5203145.31	5203181.52
FF-3	3.301	1.816	1.102	0.349	-2626564.03	5253136.06	5253184.38
FF-3+ψ	3.293	1.814	1.101	0.352	-2599403.16	5198816.31	5198876.67
Carhart	3.298	1.816	1.102	0.350	-2625921.71	5251853.42	5251913.82
Carhart+ψ	3.290	1.813	1.101	0.353	-2598805.02	5197622.04	5197694.46
Sample 2016-2024							
CAPM	2.865	1.692	1.074	0.327	-1286404.36	2572812.73	2572835.53
CAPM+ψ	2.835	1.683	1.069	0.326	-1258201.51	2516409.01	2516443.16
FF-3	2.797	1.672	1.065	0.343	-1278386.61	2556781.21	2556826.82
FF-3+ψ	2.764	1.662	1.059	0.343	-1250021.35	2500052.70	2500109.61
Carhart	2.793	1.671	1.065	0.344	-1277900.21	2555810.42	2555867.43
Carhart+ψ	2.760	1.661	1.059	0.344	-1249582.60	2499177.20	2499245.50

Results for the periods 30-01-2004 up to 21-05-2024, 2004-2015 and 2016-2024 report performance metrics for all panel specifications with and without idiosyncratic premium, ψ.

relevant during this period when ESG investing was still emerging and likely less integrated into standard factor models.

In the more recent sample, the performance of all models improves overall, with lower MSE and RMSE values compared to the earlier period, reflecting either improved model fit or more stable return-generating processes. The Carhart model again outperforms simpler specifications, and the inclusion of ψ yields the most accurate models (e.g., Carhart + ψ: MSE = 2.760, RMSE = 1.661, MAE = 1.059, R^2 = 0.344). While the increase in R^2 with ψ, is marginal, the substantial improvements in AIC and BIC suggest that ψ contributes to a more parsimonious model without overfitting. Notably, the reduction in AIC from 2555810.42 (Carhart) to 2499177.20 (Carhart + ψ) is significant, reinforcing the value of accounting for idiosyncratic premia in recent periods.

Although the log-likelihood is maximized under this specification (i.e., least negative), all models considered reject the null hypothesis that the simpler model is better than the IEP-extended model. Indeed, the corresponding Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) are lowest for the Carhart+ψ model across all samples, indicating that including the ψ factor delivers the best balance between goodness-of-fit and model complexity.[18] The methods presented here are consistent with the work of [127], which established that including momentum in pricing models improves the reduction of mean absolute pricing errors in the CAPM and FF-3 specifications. Our results also support the claim that the Carhart model generally reduces pricing errors compared to CAPM and FF-3 across all samples.

The consistent improvement across models when including ψ, suggests that idiosyncratic factors, possibly linked to firm-specific ESG exposure or other latent characteristics, are increasingly relevant in explaining asset returns. This is especially true post-2016, aligning with broader trends

[18]Model complexity is defined as the number of parameters and the degrees of freedom in the specification.

in ESG investing and factor innovation.

Moreover, the diminishing explanatory gap between FF-3 and Carhart in recent years, alongside the improved performance with ψ, may indicate that traditional momentum and size/value factors are insufficient alone in capturing the nuanced drivers of modern return variation. The findings support the argument for extended factor models that incorporate firm-level or latent variables beyond traditional risk premia.

3.7 Conclusions

The finance literature has traditionally focused on defining risk-return trade-offs. While the positive effect of systematic risk on expected returns is widely accepted among academics and market practitioners, there is ongoing debate regarding the role of idiosyncratic risk characteristics in explaining expected excess returns. This chapter contributes to the literature by proposing a theoretical and empirical framework that addresses three important issues regarding the relationship between stock idiosyncratic risk and expected excess returns. Our approach builds on the legacy of [5], who emphasized the importance of total risk in the valuation process under investor constraints, and extends it by introducing a decomposition of the sources of shocks affecting both stock and market dynamics.

Firstly, we develop a novel theoretical framework that decomposes shocks into three orthogonal components: a systematic shock common to both stock and market returns, an idiosyncratic shock unique to the stock, and a market microstructure shock that affects only the market. This decomposition introduces a richer structure for understanding how market-wide and firm-specific events shape the volatility of returns. Our approach extends the classical Capital Asset Pricing Model (CAPM) of [94] and [95], which assumes that only systematic risk is priced, by explicitly recognizing the role of idiosyncratic and microstructure-driven shocks in determining returns. Importantly, we posit that while systematic risk affects all firms simultaneously, idiosyncratic shocks arise from firm-specific factors such as human capital, private business interests, and innovation, in line with the insights of [96]. Meanwhile, microstructure shocks, driven by liquidity frictions, order flow imbalances, and institutional effects, play a crucial role in shaping market-level volatility, a point emphasized by [97], [98], and [99].

Secondly, we define and introduce the concept of the Idiosyncratic Equity Premium (IEP), denoted as ψ, which provides a systematic measure of the additional compensation investors demand for bearing idiosyncratic volatility. Unlike classical models that downplay the role of idiosyncratic risk in pricing, the IEP offers a way to quantify and track the excess return attributable to firm-specific uncertainty. We show that ψ can be constructed from observable equity market data in real time, providing a practical tool for market participants and researchers alike. Our results demonstrate that the IEP is not only economically significant but also robust across different model specifications. This highlights the importance of including ψ as an explanatory variable in benchmark asset pricing models, much like traditional factors such as market risk, size, and value.

Thirdly, we present empirical evidence suggesting that higher idiosyncratic equity volatility leads to a higher IEP, resulting in elevated expected excess returns for individual stocks. Our results support the notion that investors demand a premium for idiosyncratic risk, consistent with Merton's earlier observations on the role of investor constraints. The empirical analysis reveals that the IEP plays a meaningful role in driving cross-sectional equity returns. We estimate that the impact of Γ, the coefficient on the idiosyncratic risk premium, ranges from 9.75% to 15.82% annually for the Carhart specification, with 13.93% to 15.82% for the 2004-2015 sub-period, and 9.75% for the 2016-2023 sub-sample. The inclusion of ψ as a factor strengthens the explanatory power of the model and reveals time-variation in the magnitude of idiosyncratic risk premia, particularly during periods of market turmoil like the COVID-19 pandemic.

Our findings on the role of the IEP complement the broader literature on factor models. During the entire period analyzed for the S&P 500 index, the value factor consistently exhibits a stronger effect than the size factor, with both significant at the 1% level (see Table 3.4). This divergence becomes especially pronounced in the sub-sample from 2016-2023 (the COVID-19 and post-COVID period), where the size factor's influence diminishes, with an average coefficient of 0.04 across model specifications, while the value factor grows to an average of 0.2525. Importantly, when we introduce the ψ factor into these models, it consistently emerges as a significant factor at the 1% level, with an average impact of 13.93% in annualized terms. This finding underscores the potential value of including the IEP in standard asset pricing models to better capture firm-specific risks, particularly in periods of heightened uncertainty when idiosyncratic volatility tends to increase. By formally decomposing the shocks that affect both stock and market returns into systematic, idiosyncratic, and microstructure components, our framework provides a richer understanding of volatility and excess returns. Unlike traditional models where idiosyncratic risk is diversified away, our analysis highlights the economic relevance of firm-specific volatility. This perspective is particularly important in contexts where investor constraints, as highlighted by [5], prevent full diversification. This approach aligns with findings from [96], who emphasize the role of human capital and private business exposure as drivers of idiosyncratic risk.

In conclusion, this chapter develops a comprehensive framework for understanding the role of systematic, idiosyncratic, and microstructure shocks in driving equity returns. By introducing the Idiosyncratic Equity Premium (IEP), ψ, as a quantifiable measure of the compensation investors demand for bearing idiosyncratic volatility, we offer a new perspective on asset pricing. Our findings reveal that idiosyncratic risk matters—not only as a source of volatility but also as a driver of excess returns. The empirical analysis provides compelling evidence that the IEP plays a significant role in shaping stock returns, especially during periods of market stress. By integrating the IEP into standard asset pricing models, we offer a practical tool for portfolio managers and investors seeking to better understand the returns to firm-specific risk. This chapter thus bridges theoretical insights from Merton's work on constrained investors with modern perspectives on volatility decomposition, offering a unified view of stock and market dynamics that is relevant for both academics and practitioners.

An important avenue for future research is to identify the determinants of the IEP and understand its time-variation. While our model offers a tractable framework for measuring the IEP, the fundamental drivers of idiosyncratic volatility premia remain an open question. We suggest that future studies explore proxies for firm-specific shocks, such as analyst forecast disagreements, innovation indices, and corporate governance events. Additionally, firm-level sustainability factors, as captured by environmental, social, and governance (ESG) metrics, may play a role in shaping idiosyncratic volatility and its associated premium. ESG initiatives can alter firm risk profiles by changing how firms are exposed to regulatory risk, social backlash, and reputational shocks, all of which have firm-specific consequences.

In the next stage of this research, I will deepen the analysis by disentangling how individual ESG pillars, environmental, social, and governance, contribute differently to the pricing of idiosyncratic risk across sectors and market conditions. This will involve testing for heterogeneity in ESG effects during periods of financial turbulence, regulatory change, and heightened investor scrutiny. I also plan to extend the empirical framework by incorporating international markets to examine whether the observed relationships hold beyond U.S. firms, thereby assessing the global relevance of ESG-driven idiosyncratic risk. Finally, I will investigate the dynamic interactions between ESG evolution and other asset pricing anomalies to determine whether ESG factors represent a distinct source of priced risk or interact with established factors in shaping firm-level excess returns.

Chapter 4 ESG performance, Corporate performance, and Idiosyncratic risk in the S&P500 Index.

Abstract

This chapter contributes to current academic research by analyzing the relationship between sustainability (both global ESG score and the social, environmental and governance dimen- sions) considerations and corporate performance and hence illustrating the broad link between ESG engagement and a firm´s specific business idiosyncratic risk. The main underlying argument is that ESG rates provide valuable information about uncompensated risk. A pricing framework is introduced with two sources of innovations for excess returns which arise from idiosyncratic as well as market-related forces. The model is estimated using real time prices given from the secondary market of all the SP 500 components with their respective ESG pillars and global ESG score. A panel data-set of 8176 firm year observations is used to cover the period 2004-2022 and relate both idiosyncratic risk and ESG sustainability evolution in the same equation. Reported results show a positive link between idiosyncratic risk and expected excess returns in the long-run along with moderate upside return potential when considering the effects of the ESG dimensions. Overall, there is a business case for firm-specific risks when adopting ESG practices which decrease portfolio volatility and exert a moderate positive impact on the expected excess returns. In the short run, an increase or corrective ESG action on behalf of a firm can become more costly for the firm.

Keywords— ESG, Idiosyncratic equity volatility premium, ESG pillars, firm-specific profitability.

4.1 Introduction

This study focuses on the U.S. equity market, where interest in environmental, social, and governance (ESG) investing has significantly intensified over the past two decades. ESG considerations have moved from the periphery to the mainstream of investment strategies, evidenced by a surge in sustainable fund launches, 38 in Q3 of 2021 alone, surpassing the 30 launched during the same period in 2020. According to the US SIF Foundation, the total assets under sustainable investment strategies in the U.S. reached 16.6 trillion dollars in 2020, growing at an annual compound rate of 14%, with the most rapid expansion occurring since 2012.

Alongside this market evolution, the academic debate over the relationship between stakeholder engagement and shareholder value has gained momentum, particularly in response to the COVID-19 crisis. Empirical research suggests that firms with stronger ESG profiles exhibit greater resilience to market volatility ([78], [57]), with some outperforming benchmarks during crisis periods, for instance, the Parnassus Core Equity Fund posted a 28% return in 2021. ESG investing is increasingly viewed not only as a tool for ethical alignment but also as a mechanism for value enhancement and risk mitigation. A meta-analysis by [24]) finds that approximately 90% of empirical studies report a non-negative relationship between ESG and financial performance.

This chapter contributes to this growing literature by examining the relationship between ESG engagement and idiosyncratic risk,defined here as firm-specific, diversifiable risk—and its implications for long-term excess returns. Drawing on a two-asset theoretical framework, we develop a market-based definition of idiosyncratic volatility derived directly from observable daily returns, thus improving on traditional residual-based estimations from models such as CAPM or Fama-French.

Our empirical investigation builds on prior literature suggesting that idiosyncratic risk may, under certain conditions, be priced in financial markets (e.g., [6]). We posit that ESG performance and disclosure can serve as mechanisms to reduce this uncompensated risk, leading to lower cost of capital and improved creditworthiness ([128]; [27]). This is consistent with evidence linking high ESG scores to reduced exposure to litigation, regulatory sanctions, and reputational damage ([14], [15]).

Traditional asset pricing models generally assume that only systematic risk is priced, with idiosyncratic risk considered diversifiable. However, growing evidence suggests that poor ESG engagement may elevate firm-specific risk even within diversified portfolios, particularly under investor constraints ([5]). Studies such as [16] and [129] find that firms with superior ESG practices exhibit lower idiosyncratic volatility, supporting the view that ESG engagement serves as an implicit risk management strategy.

Building on this, our study offers three main contributions. First, it introduces a novel theoretical model that incorporates ESG considerations into the pricing of firm-specific risk. Second, it provides granular empirical evidence from a large panel of U.S. firms (8,176 firm-year observations between 2004 and 2022), examining how ESG performance, both overall scores and disaggregated into environmental, social, and governance pillars, affects excess returns through the channel of idiosyncratic volatility. Third, our study adds contextual depth by segmenting the sample into sub-periods (2004–2016, 2016–2022), with the latter period reflecting post-Paris Agreement regulatory developments.

Our findings indicate that firms with higher ESG scores generally exhibit lower idiosyncratic volatility, and that this risk-reduction effect is increasingly priced in the market. However, the effect is not uniform across all ESG dimensions or time periods. Notably, during 2016–2022, only the environmental pillar shows a statistically significant (negative) relationship with returns, possibly reflecting higher compliance and transition costs. In contrast, social and governance indicators are positively associated with long-run returns once idiosyncratic risk is controlled for.

We further demonstrate that incorporating idiosyncratic volatility as a priced factor, defined as the spread between firm-specific return volatility and market portfolio volatility, enhances the explanatory power of asset pricing models. When added to an extended Fama-French framework, this idiosyncratic volatility factor remains significant across most periods, underscoring the importance of firm-specific ESG engagement in understanding excess return dynamics. Overall, our analysis provides strong empirical and theoretical support for integrating ESG metrics into asset pricing frameworks. By establishing a link between ESG disclosure, idiosyncratic volatility, and financial performance, we argue for a reassessment of standard asset pricing models to more fully capture the implications of sustainability engagement.

The remainder of this chapter is structured as follows: Section 4.2 presents the theoretical model and asset pricing dynamics. Section 4.3 describes the data and methodology. Section 4.4 discusses empirical results. Section 4.5 explores the broader implications for theory and practice. Finally, section 4.6 concludes.

4.2 The Model

Consider two risky assets the market, M and asset S. Let´s write down the dynamics for S and M:

$$r_{S,t} = \frac{\Delta S}{S_t} = \mu_S \Delta t + \sigma_{S,t} \sqrt{\Delta t} \epsilon_{S,t} \tag{21}$$

and for the market:

$$r_{M,t} = \frac{\Delta M}{M} = \mu_M \Delta t + \sigma_{M,t} \sqrt{\Delta t} \epsilon_{M,t} \tag{22}$$

we have $\epsilon_{M,t} \sim N(0,1)$.

The stock innovations will be partly coming from the market, and partly driven by the company idiosyncratic shocks, $\epsilon_{I,t}$. We follow [96] and assume that the market shocks and the idiosyncratic shocks are uncorrelated. This implies:

$$\epsilon_{S,t} = \rho \cdot \epsilon_{M,t} + \sqrt{1-\rho^2} \cdot \epsilon_{I,t} \tag{23}$$

with $Cov(\epsilon_{M,t}, \epsilon_{I,t}) = 0$

We define the idiosyncratic return, that is the firm specific risk as the asset spread to the market $r_{I,t} = r_{S,t} - r_{M,t}$.

$$r_{I,t} = \mu_{S,t} \Delta t + \sigma_{S,t} \sqrt{\Delta t} \epsilon_{S,t} - \mu_{M,t} \Delta t - \sigma_{M,t} \sqrt{\Delta t} \epsilon_{M,t}$$

substitute the individual stock innovation $\epsilon_{S,t}$ with its error decomposition in equation three and after some rearranging:

$$r_{I,t} = (\mu_{S,t} - \mu_{M,t})\,\Delta t + \left(\rho \cdot \sigma_{S,t}\epsilon_{M,t} + \sqrt{1-\rho^2} \cdot \sigma_{S,t}\epsilon_{I,t} - \sigma_{M,t}\epsilon_{M,t}\right)\sqrt{\Delta t}$$

The excess idiosyncratic returns $\tilde{R}_t = r_{I,t} - (\mu_{S,t} - \mu_{M,t})$ will be subject to idiosyncratic shock, plus the market shock as in the following equation:

$$\tilde{R}_t = (\rho\sigma_{S,t} - \sigma_{M,t})\sqrt{\Delta t} \cdot \epsilon_{M,t} + \sqrt{1-\rho^2} \cdot \sigma_{S,t} \cdot \sqrt{\Delta t} \cdot \epsilon_{I,t} \tag{24}$$

This indicates that the excess idiosyncratic return is directly related to the idiosyncratic volatility component for each asset firm $r_{I,t}$, and it will be $\psi_{i,t} = (\rho\sigma_{S,t} - \sigma_{M,t})$ being directly observable in the market.

This implies the following panels for the expected excess returns:

$$E\left(r_{S,t} - r_{f,t}\right) = \lambda'\beta + \gamma'\psi + e_t \tag{25}$$

where $\lambda'\beta = \sum_{k=1}^{N} \lambda_k \cdot \beta_k$, $beta = (Mrk - r_f, HML, SMB, MOM)$, are the four- factor Carhart model [17]. $\gamma'\psi = \sum_{k=1}^{N} \gamma_k \cdot \psi_k$, $q'Q = \sum_{k=1}^{N} q_k \cdot Q_k$, $Q = (Environmental, Social, Governance)$, therefore expanding we have the following:

$$E\left(r_{S,t} - r_{f,t}\right) = \sum_{k=1}^{N} \lambda_k \cdot \beta_k + \sum_{q=1}^{Q} \gamma_q \cdot \psi_q \tag{26}$$

Equation 6 transforms to our empirical equation 17 that we define further in section 4.

The total variance of the excess idiosyncratic returns is

$$Var\left(\tilde{R}\right) = (\rho\sigma_{S,t} - \sigma_{M,t})^2\,\Delta t \cdot \epsilon^2_{M,t} + \left(1-\rho^2\right) \cdot \sigma^2_{S,t} \cdot \Delta t \cdot \epsilon^2_{I,t}$$

$$Var\left(\tilde{R}_t\right) = \rho^2\left(1-\rho^2\right)\sigma^2_{S,t} + \sigma^2_{M,t} - 2 \cdot Cov\left(\sigma_{S,t}, \sigma_{M,t}\right) \geq 0 \tag{27}$$

that implies $Cov\left(\sigma_{S,t}, \sigma_{M,t}\right) \geq \frac{\sigma^2_{M,t}}{2\rho}$ with $\rho \neq 0$ and $\rho \neq 1$.

Then total variance of the excess idiosyncratic returns $Var\left(\tilde{R}_t\right) = \sigma^2_{\tilde{R},t}$ will be:

$$\sigma^2_{\tilde{R},t} = (1-\rho)^2\,\sigma^2_{S,t}\Delta t \geq 0 \tag{28}$$

$$\lambda = \frac{\partial E\left(r_S\right)}{\partial \beta} = \frac{1}{2\rho} \tag{29}$$

$$\gamma = \frac{\partial E\left(r_S\right)}{\partial \psi} = \frac{1}{2\rho\left(1-\rho\right)^2}\frac{\sigma^2_{M,t}}{\sigma^2_{S,t}} \tag{30}$$

How β & γ change with respect to ρ:

$$\frac{\partial \beta}{\partial \rho} = \frac{1}{2} \tag{31}$$

$$\frac{\partial \gamma}{\partial \rho} = \frac{(3\rho - 1)}{2\rho^2\left(1-\rho^2\right)^2}\frac{\sigma^2_{M,t}}{\sigma^2_{S,t}} \tag{32}$$

$$\sigma^2_{S,t} = \frac{\sigma^2_{M,t}}{\left(1-\rho^2\right) - \tilde{\theta} \cdot \sigma^2_{M,t}} \tag{33}$$

In 33, $\tilde{\theta}$, is the long run risk averse parameter. It pops out as a weight on the market variance when rearranging equations. Its size is $\tilde{\theta} = \frac{1}{2} - \frac{2}{\sqrt{2}}$. The investor being risk averse will charge a required spread on the market variance to a perpetual $\theta = \tilde{\theta} - 1 = 9.89\%$. The idiosyncratic factor will reduce the variance of the market portfolio, by $\xi\left(\rho\right) = \frac{1-\rho^2}{\tilde{\theta}}$ and equation 33, will be a concave interplay between market variance and correlation for the investor of the following form:

$$\sigma^2_{M,t} - \xi\left(\rho\right) > 0 \tag{34}$$

Our approach is consistent [130] who show how an unconditional factor model necessarily links to a conditional factor model. Our framework is also related to [73] who calculate the relative expected returns as function of the expected variance and the spread variance from some mean level.

The idiosyncratic risk defined here follows [96] where the measure of total risk is decomposed into his systematic and idiosyncratic parts. Idiosyncratic risk refers to the distribution of the return on security S that is not explicitly related to the market shocks. It depends on factors that determine firm specific risk. This risk is expected to be dependent on the value of intangibles, RD, technology innovation, CSR standards, ESG policies.

Our model is able to estimate a company´s risk entailing three different risks measures that affect directly the value of company: total risk, systematic risk and idiosyncratic risk. Beyond the traditional portfolio theory Firm specific business risk implies that stock returns will react in a different manner to ESG shocks through the idiosyncratic channel and the price formation of each common stock differs given the market conditions. We test the existence of idiosyncratic risk following the work of [53], [131], [65], [102], [96]. The idiosyncratic risk is defined as the difference between the total risk minus the systematic risk. The idiosyncratic factor used here can be calculated with observable market data.

4.3 ESG Data and Methodology

We use daily prices of S&P500 components downloaded from Bloomberg. This includes dividends and capital gains, and adjusted for capital changes such script dividends and splits. We explore the sample period from April 2000 through April 2021 and therefore include the the Global Financial Crisis in 2007-2008 as well as the Paris Agreement in December 2015. Both events have contributed significantly to the increase reliance on ESG investing. We analyze the information contained in each stock traded in the SP500 by directly computing the distribution of returns not attributable to market risk.

Three measures of risk are used for this purpose. Firstly, we use the standard deviation of S&P500 daily returns to measure realized volatility of the market portfolio. Secondly, we calculate the standard deviation of daily returns of each company that belongs to the S&P500 index. Thirdly, we calculate the idiosyncratic volatility as the spread between total volatility and market volatility. It is constructed from one-month rolling standard deviation.

ESG data come from Thomson Reuters during the same sample and are annual. This is a benchmark source of ESG data designed to transparently and objectively measure the ESG relative performance related to its commitment and effectiveness of a firm across the environmental (E) social (S) and governance (G) dimension. The ratings are available on more than 6500 companies and the SP index is included in the Thomson Reuters ESG universe since 2002. They use more than 400 data points and analytic of which 178 aggregated comparable measures are extracted and used in scoring.

This information is grouped into 10 main categories. Environmental scores reflect the environmental awareness shown by active involvement in resource use, emissions and innovation. Social scores take into account issues like human rights, labor relations and workforce (working conditions, union relationships, employee relationship), community work practices (charities, education programs, sponsoring), and product responsibility (quality assurance, research and development, product safety). Finally, governance scores involve management, corporate responsibility and shareholders. These 10 categories are weighted in proportion to the number of measures within each category. According to the number of indicators that comprise each category in comparison to the total number of indicators the respective weight is calculated. For example, categories that contain various issues such as management,(compensation, committees, diversity, composition, etc) and the companies disclosure is higher on these issues will have a higher weight than other categories. To calculate the score for each category a percentile rank methodology is used. Therefore, the rank measure is not sensitive to outliers. It is based on three main factors, how many companies are doing worse that the one we use, how many companies have the same value and how many companies have a numeric value. Each measure is assured to have the correct polarity meaning that the higher value may be positive or negative. In this way we assure that the higher the sustainability control level the more weight it has to the overall score. The combination of these categories weighted proportionally to the number of measures within each one comprise the final overall ESG score.

Because ESG data is highly variable in size (with value ranging in $[0, 100]$.), we standardize to avoid dominance in scale. We accordingly adjust the ESG data by creating a score for each pillar as well as for the global score using the formula:

$$y = \frac{Y - Y_{min}}{100 - Y_{min}} \tag{35}$$

where $Y = \{ESG, Environmental, Social, Governance\}$

4.4 Empirical Model and Results

Our estimation approach is organized as follows. We first use daily data to run the following empirical equation:

$$r_{S,t} = \alpha + \beta \cdot r_{m,t} + \gamma \cdot \psi_t + v_t \tag{36}$$

where the $r_{S,t}$ is the daily return of company stock S on day t, the $r_{m,t}$ is the daily return of the proxy for the market return, that is the SP500 index at time t, the ψ_t is the idiosyncratic volatility factor computed daily for each company in the following manner: $\psi_{i,t} = (\rho\sigma_{S,t} - \sigma_{M,t})$, and v_t is the error term distributed as $v_t \sim N(0, \sigma_v)$

The γ coefficient in this regression can be interpreted as the firm's adaptation to time changing idiosyncratic risk highly determined by investor preferences for expansion or contraction of sustainable, responsible impact investing. The level of integration of ESG processes into productivity plans and corporate strategies is determines the fir-specific risk for both short and longer periods. In the short run estimated γ coefficients can be zero, negative or positive. If the company adjusts quickly to firm specific risk conditions, then its γ factor approximates to 0 and its returns will be solely conditioned on market risk. We contend that a firm with a strong positive γ is investing continuously in new technologies to adapt to firm specific CSR risk conditions while a significantly negative estimated γ indicates restrictions to adapt due to the existence of transition related risk such as stranded asset risks. Negative coefficients reflect that the company is not a leading institution compared to it's peers in terms of the implementation of sustainability-related targets. The level of the spread indicates the change in the expectations on the firms ability to respond to the new investment opportunities.

By running equation (36) we are able to create a volatility spread factor that is directly formed by idiosyncratic shocks as well as the market shock loadings with continuous innovations both firm-ESG specific and partly coming from the market. This is estimated using monthly rolling OLS regression estimates of γ. We run rolling one-month regressions in order to construct the rolling regression OLS estimator γ coefficient from equation 36, for a fixed period of 30 days, daily. From one-month rolling standard deviation, monthly values are then used to compute annual averages in a second stage, for each individual firm in order to construct idiosyncratic volatility factor Ψi_t. This spread factor should reflect the short run shocks with respect to overall ESG scores as well as environmental, social and corporate governance measures. Table 4.1, contains a short description of all the variables used in equation 37.

The integration of both ESG pillars and idiosyncratic risk into empirical asset pricing models is theoretically justified by the evolving understanding of risk premia and investor behavior in incomplete markets. ESG factors, encompassing environmental, social, and governance dimensions, have increasingly been recognized as financially material and capable of capturing systematic variation in asset returns. Recent studies demonstrate that ESG-related characteristics can function as priced risk factors within multi-factor models, extending traditional frameworks such as the Fama-French and Carhart models [132], ESG performance influences firm valuation through mechanisms such as reputational capital, regulatory resilience, and stakeholder legitimacy, thereby affecting both systematic and firm-specific risk exposures [3]. Simultaneously, idiosyncratic risk, traditionally considered diversifiable and thus unpriced, has gained empirical relevance due to market frictions, investor constraints, and behavioral biases. The study of [10] shows that idiosyncratic risk may be conditionally priced, particularly in states of low diversification or heightened volatility. Moreover, ESG performance has been empirically linked to reductions in both systematic and idiosyncratic risk, suggesting a risk-mitigating role that interacts with firm-specific volatility, see also the work of [9]. The joint modeling of ESG and idiosyncratic risk thus captures the nuanced interplay between sustainability practices and firm-level uncertainty, offering a more comprehensive framework for estimating expected returns and understanding asset price formation in modern financial markets.

As a consequence, in a third stage we estimate panel regressions where annual abnormal excess returns are regressed against the market excess return, the idiosyncratic volatility spread factor as well as a number of control variables as specified in equation (37) bellow:

$$r_{S,t} - r_{f,t} = \alpha + \lambda \cdot (r_{M,t} - r_{f,t}) + \Gamma \cdot \Psi i_t + Controls + e_t \tag{37}$$

Where:

- $r_{S,t}$: Return of security or portfolio S at time t
- $r_{f,t}$: Risk-free rate at time t

- $r_{S,t} - r_{f,t}$: Excess return on the asset at time t
- α: Intercept term (abnormal return or alpha)
- $r_{M,t}$: Return on the market portfolio at time t
- λ: Market beta (sensitivity of asset returns to market returns)
- $(r_{M,t} - r_{f,t})$: Market risk premium
- Ψ_{it}: Vector of firm-specific or time-varying characteristics (firm-specific risk)
- Γ: Vector of loadings (sensitivities) on the characteristics Ψ_{it}
- Controls: Additional control variables (e.g., ESG scores and pillars, size, value, momentum, industry effects)
- e_t: Error term at time t

where $r_{S,t}$ represents the returns on the S&P500 constituents and $r_{f,t}$ is the risk free rate. λ gives the market beta, telling how sensitive the asset is to overall market movements. Controls account for the ESG global score as well as the social, environmental and governance dimension attributed to each firm, given by Reuters Eikon (see section 3), and the four factor Carhart model, (FF-4) model variables. Those stock returns are excess returns and therefore the coefficient Γ represents the weights in a zero cost portfolio. Thus $\Gamma \cdot \Psi i_t$, indicates the portfolio return, resembles the factor Ψ that proxies the arrival of new information on idiosyncratic innovation for each firm at year t. The most sustainable investors continue to look for new radical responsible ways to push the envelope and focus to even more specific ESG mature firms with further sustainable criteria and products.

To further investigate the role of sustainability in asset pricing, we extend our analysis by directly examining the relationship between the sensitivity coefficient $\Gamma_{S,t}$, and the global ESG index. Specifically, we estimate the linear specification of equation (38), captures the exposure of asset S, to idiosyncratic risk or other conditional factors, and $\text{ESGGlobal}_{S,t}$, represents the firm's global ESG score at time t. This formulation allows us to test whether firms with higher ESG ratings exhibit systematically different sensitivities to risk factors, particularly through the idiosyncratic channel. The coefficient δ, reflects the marginal effect of ESG performance on the firm's risk exposure, and its significance would imply that ESG characteristics are not only priced directly but also influence the transmission of risk. This approach is consistent with recent literature suggesting that ESG performance can mitigate firm-specific volatility and enhance resilience to shocks [9], [3]. By linking ESG scores to the dynamic behavior of $\Gamma_{S,t}$, we provide empirical evidence on how sustainability practices shape the risk-return profile of individual assets beyond traditional factor exposures.

Therefore, we examine directly the relationship between the Γ coefficient of equation 37 as the dependent variable and the overall ESG index as the explanatory variable:

$$\Gamma_{S,t} = \alpha + \delta \cdot \text{ESGGlobal}_{S,t} + e_t \tag{38}$$

Where:

- $\Gamma_{S,t}$: Exposure or sensitivity of asset or portfolio S at time t
- α: Intercept term
- δ: Coefficient capturing the effect of changes in ESGGlobal on $\Gamma_{S,t}$
- $\text{ESGGlobal}_{S,t}$: Global ESG (Environmental, Social, and Governance) score or rating for asset S at time t
- e_t: Error term at time t

at an annual basis for all the periods considered. We do that in order to shed light on the evolution regarding the size and significance of the relationship along with the results from equation 37 for the three different sample periods and evolution of the idiosyncratic risk when the ESG pillars are included to the equation and when they are not. This contributes to current literature by suggesting when is the case for considering special attention for ESG and at which dimension. Results for the different periods are reported in tables 4.4, and 4.5. In what follows, we show the main data summary statistics description table, including the scale adjustment given by equation 35.

We run a whole sample preliminary correlation analysis for the control variables and the volatility spread premium.

Note that specification equation 37 is similar to [134] in the estimation of a factor equation including idiosyncratic volatility. We expect that the volatility factor will exhibit a negative

Table 4.1: Definition of Variables used by equation (17) for all periods considered.

CAPM	Model 1, 2, 3 in table 3, 4, 5 panel A, B, C ([94]Sharpe, [95], [133]) market factor model of individual stocks.
Mkt-RF	Rm-Rf, the excess return on the market, value-weight return of all CRSP firms incorporated in the US and listed on the NYSE, AMEX, or NASDAQ that have a CRSP share code of 10 or 11 at the beginning of month t, good shares and price data at the beginning of t, and good return data for t minus the one-month Treasury bill rate (from Ibbotson Associates).
HML	HML (High Minus Low) is the average return on the two value portfolios minus the average return on the two growth portfolios
SMB	SMB (Small Minus Big) is the average return on the three small portfolios minus the average return on the three big portfolios,
Premium Ψi_t	Rolling regression OLS estimator, gamma coefficient from equation 16, rolling regressions for a fixed period of 30 days rolling 1 day, averaged monthly and then annualised for each individual firm included in the sample of the SP500 Index.
ESG Global	Refinitiv Eikon provides scores from 0 to 100% for individual firms from company disclosure,capturing information on environmental (resource use, emissions, innovation), social (workforce, human rights, community, product responsibility) and governance (management, shareholders, CSR strategy) based on a comprehensive subset of metrics).
Environmental	Refinitiv Eikon provides annual scores from 0 to 100% for individual firms based on environmental issues focusing mainly on resource use, emissions, and innovation.
Social	Refinitiv Eikon provides annual scores from 0 to 100% for individual firms based on social issues focusing mainly on workforce, human rights, community and product responsibility.
Governance	Refinitiv Eikon provides anual scores from 0 to 100% for individual firms based on governance issues focusing mainly on management, shareholders and CSR strategies.

Table 4.2: Summary Statistics

Variable	Count	Mean	St. Deviation	Min	Max	25%	50%	75%
Ret_RF	8273.0	-0.0033	0.0100	-0.0725	0.0686	-0.0093	-0.0023	0.0032
Mkt_RF	8964.0	0.1249	0.3653	-0.5556	0.7378	-0.0586	0.1488	0.3478
HML	8964.0	-0.0518	0.2278	-0.6971	0.2343	-0.1156	-0.0419	0.1271
SMB	8964.0	-0.0189	0.2497	-0.3278	0.6733	-0.1929	-0.0611	0.0856
esg_ind	7199.0	0.5072	0.2010	0.0000	0.9513	0.3493	0.5133	0.6728
soc_ind	7199.0	0.5325	0.2187	0.0000	0.9799	0.3585	0.5371	0.7052
gov_ind	7199.0	0.5519	0.2187	0.0000	0.9953	0.3931	0.5721	0.7260
env_ind	7199.0	0.4236	0.2942	0.0000	0.9855	0.1607	0.4409	0.6810
Prem	8260.0	0.0089	0.0075	-0.0076	0.0873	0.0042	0.0071	0.0115

Table 4.3: Correlation matrix among variables

Variable	Mkt_RF	HML	SMB	esg_ind	soc_ind	gov_ind	env_ind	Prem Γ
Mkt_RF	1.0000	0.4404	0.6854	-0.0870	-0.0924	-0.0181	-0.0947	-0.0749
HML	0.4404	1.0000	0.1970	-0.1605	-0.1633	-0.0711	-0.1465	-0.1289
SMB	0.6854	0.1970	1.0000	-0.1055	-0.1005	-0.0315	-0.1243	0.0425
esg_ind	-0.0870	-0.1605	-0.1055	1.0000	0.8899	0.7013	0.8663	-0.1229
soc_ind	-0.0924	-0.1633	-0.1005	0.8899	1.0000	0.4109	0.7390	-0.0762
gov_ind	-0.0181	-0.0711	-0.0315	0.7013	0.4109	1.0000	0.4383	-0.1210
env_ind	-0.0947	-0.1465	-0.1243	0.8663	0.7390	0.4383	1.0000	-0.1118
Premium Γ	-0.0749	-0.1289	0.0425	-0.1229	-0.0762	-0.1210	-0.1118	1.0000

relationship with excess returns in line with [103], [135], who find that stocks with high idiosyncratic volatility spread exhibit low average returns. This also consistent with [136] who suggest that when idiosyncratic volatility is jointly evaluated with the market volatility it exerts negative effect on stock returns.

Similar to recent academic research, we incorporate as control variables the FF-4 factor model by [17]. We estimate various specifications of equation 37. Firstly, we estimate the cross variation of the classic CAPM ([94], [95], [133] market factor model along with the premium idiosyncratic volatility spread factor (we shall call it IV from now on), the Γ loading, and FF3 model, call it model 1. The second panel regression, call it model 2, estimates the loadings of the CAPM model, FF3 factors, the Γ loading and will augment the factors predicting abnormal excess returns by introducing the ESG global score for each firm-year. The third model (Model 3), specification increases the ESG dimension of our analysis by introducing the three pillars increasing ESG granularity and also see if the idiosyncratic volatility risk factor is still significant as in the previous specifications model 1 and 2. Model 4, considers the four-factor Carhart model plus the ESG global score for each firm-year combination. Last but not least, model 5 considers the FF-4 model plus the 3 pillars without considering the ESG global score. In this context we can observe whether each pillar has an explanatory power and it's magnitude.

In the panel estimations, the company productivity gain from the intangible assets that are not included in the fundamentals factors (including the idiosyncratic volatility factor, will be captured by the fixed effects used in the estimation, similar to [73]. Also, the empirical specification in equation (37) is compatible with the assumption that investors will demand an extra risk premium for firms that face an "extraordinary" specific risk (see [65]) especially in situations where ESG is considered a market friction seen as a costly incomplete signal. That is, introducing the idiosyncratic element of each firm reflected by γ along with the ESG global metric and the ESG individual pillars, transforms the Γ loading to a measure of idiosyncratic signaling with respect the ESG metrics. By performing fixed effect panel OLS regressions and adjusting the covariance matrix with clusters according to size we provide evidence that there is a case for caring about corporate sustainability. All five models are estimated for the three sub-sample periods. Estimation results covering the sample period 2004-2022, 2004-2016 and 2016-2022 are reported in tables 4.1, 4.2, and 4.3.

Panel A of Table 4.4.1 presents the results from five regression models examining the impact of ESG-related variables on portfolio returns, while controlling for traditional risk factors such as market excess returns (Mkt-RF), size (SMB), value (HML), momentum (MOM), and a gamma exposure term (Γ). We cover 8176 panel data set of firm year observations for the five models. Across all models, the coefficient on the market risk premium (Mkt-RF) remains positive and statistically significant at the 1% level, with values close to 1, indicating a strong and consistent market exposure. Similarly, the HML factor is positive and significant in all specifications, suggesting that value characteristics positively contribute to returns. The SMB factor is significant only in Model 1 and becomes statistically insignificant in subsequent models, implying limited explanatory power of size when ESG factors are introduced.

The known contribution of FF3 factors in explaining excess long term returns is indicated in all 3 models. Both the SMB and the HML factors are significant in model 1 but when ESG metrics are included the SMB factor is not significant (model 2 and model 3). In model 1, we see that loadings on the FF3 are positive (0.2097 for HML and 0.1259 for SMB) and significant implying that the index is formed by high value companies. We find significant the HML factor at 1% and its coefficient is 0.1244 in model 2 (FF3 Factor model) when we add the ESG global score. Also it is positive in both cases indicating that the index is formed by high value companies and that the excess returns are explained mainly by the market excess returns. In model 2, we can see that the inclusion of the sustainability measure reduces the size of the coefficient parameters of the HML factor as well as the size of the Γ factor. This suggest that there is a case that both pillars and the global score have a significant effect on excess returns. Moreover, the Γ factor remains significant in all 3 models even after ESG metrics are included to equation (37).

The coefficient on Γ is consistently positive and highly significant, suggesting that this factor, potentially capturing exposure to a systematic characteristic or latent risk, plays a robust role in return generation. Models 2 and 3 introduce the aggregate ESG Global score, which is negatively and significantly associated with portfolio returns at the 1% level, implying that higher ESG scores are linked to lower expected returns after adjusting for risk factors. This finding aligns with the interpretation that ESG-compliant firms may be perceived as lower risk and, therefore, offer lower risk premiums. Also, all the intercepts are significant at 1% and varies from -0,0311 in the case of model 1 where FF3 are included up to -0,0371 in the case of model 2 where the ESG global score is introduced.

The impact of idiosyncratic risk factor on the excess returns is positive and highly significant with an estimated value of 0.0544. This suggests that investors demand a positive risk premium for higher firm-specific idiosyncratic volatility firms increasing on average long-run portfolio performance. This is consistent with the literature as seen in the work of [103], [137], [138], [93], [5], where a negative impact of the idiosyncratic volatility on the portfolio returns is also reported. The Fama French factor parameter HML estimation are not affected by the addition of the idiosyncratic volatility spread, remains significant at 1% with a positive coefficient The value premium factor effect decreases in model 2 and 3 from 0,2097 to 0,1244 and 0,1266 respectively making the spread of high book to market ratio minus low book to market companies contribution in explaining excess returns lower due to the inclusion of the sustainability measures. Also, the presence of idiosyncratic volatility which remains significant contributes to the lower impact of the value premium factor in the portfolio.

Table 4.4: Table 4.4.1 Panel A, reports results for the period 2004-2022 (robust t-stats) ***denote statistical significance at 1%, **denote statistical significance at 5%, *denote statistical significance at 10%. Bold typeface means NOT SIGNIFICANT

Table 4.4.1:	**Panel A**				
Models	Model 1	Model 2	Model 3	Model 4	Model 5
Parameters					
α	-0,0311***	-0,0371***	-0,0333***	0,0426***	0,0386***
(t-stat)	(-8,2861)	(7,2746)	(5,9322)	(7,972)	(6,59)
Mkt-RF	1,0109***	0,9920***	0,9918***	0,9149***	0,9145***
(t-stat)	(89,358)	(49,066)	(49,016)	(38,64)	(38,61)
HML	0.2097***	0,1244***	0,1266***	0,082***	0,0842***
(t-stat)	(9,2012)	(4,8513)	(4,9130)	(2,903)	(2,966)
SMB	0.1259***	**0,0627**	**0,0680**	**-0,0404**	**-0,0346**
(t-stat)	(8.9979)	(1,2026)	(1,3031)	(-0,726)	(-0,621)
Γ	0,0544***	0,0166***	0,0164***	0,0141***	0,0139***
(t-stat)	(-6,6166)	(7,2546)	(7,1450)	(5,905)	(5,773)
MOM				-0,1209***	-0,1213***
(t-stat)				(-5,911)	(-5,928)
ESG Global		-0,0738***		-0,0751***	
(t-stat)		(-8,0842)		(-8,112)	
Environmental			-0,0308***		-0.0328***
(t-stat)			(-3,6566)		(-3.86)
Social			-0,0022**		-0.02*
(t-stat)			(-1,9853)		(-1,775)
Governance			-0,0156*		-0.0169**
(t-stat)			(-1,9464)		(-2,077)
R-squared	0,3449	0,2979	0,2976	0,3065	0,3063
Fixed Effects:	YES	YES	YES	YES	YES

We estimate equation 37 by expanding our factors in order to account for the individual pillars. In Models 4 and 5, the disaggregated ESG components are analyzed. The Environmental and Governance scores both exhibit negative and statistically significant coefficients, further supporting the notion that stronger performance in these dimensions is associated with lower excess returns. Interestingly, the Social component shows mixed results: a positive and marginally significant coefficient in Model 4, and a negative but significant coefficient in Model 5. Overall, the R-squared values range from 0.2976 to 0.3449, and all models include fixed effects, suggesting that the explanatory power of the models is reasonably stable across specifications.

Table 4.4.2: Results for the period 2004-2015 (robust t-stats) ***denote statistical significance at 1%, **denote statistical significance at 5%, *denote statistical significance at 10%. Bold typeface means NOT SIGNIFICANT

Table 4.4.2:	**Panel B**				
Models	Model 1	Model 2	Model 3	Model 4	Model 5
Parameters					
α	-0.0319***	-0.0270***	0,0245***	0,0351***	0.0322***
(t-stat)	(-7.2156)	(-3.9379)	(3.2174)	(4.9667)	(4.1213)
Mkt-RF	1.0364**	0.9937***	0,9950***	0.9147***	0.9157***
(t-stat)	(84.615)	(41.263)	(41.280)	(32.567)	(32.594)
HML	0.1357***	**0.0278**	**0.0279**	**-0.0141**	**-0.0149**
(t-stat)	(4.8415)	(0.5291)	(0.5274)	(0.0534)	(-0.2779)
SMB	0.1465***	0.2336***	0.2369***	0.1290*	0.1323*
(t-stat)	(8,6519)	(3,1153)	(3,1568)	(1.665)	(1.7065)
Γ	0,0622***	0,0240***	0,0238***	0.0191***	0.0188***
(t-stat)	(12,300)	(8,4282)	(8,3205)	(6.3411)	(6.2317)
MOM				-0.1207***	-0.1213***
(t-stat)				(-5.432)	(-5.460)
ESG Global		-0,0616***		-0.0631***	
(t-stat)		(-4,5934)		(-4.7013)	
Environmental			-0,0295***		-0.0314***
(t-stat)			(-2,6222)		(-2.793)
Social			**-0,0058**		**-0.0053**
(t-stat)			(-0,3770)		(-0.345)
Governance			-0,0228**		-0.0224**
(t-stat)			(-2,1182)		(-2.0697)
R-squared	0,3486	0,3320	0,3323	0.3395	0.3398
Fixed Effects:	YES	YES	YES	YES	YES

Table 4.4.3: Results for the period 2016-2022 (robust t-stats) ***denote statistical significance at 1%, **denote statistical significance at 5%, *denote statistical significance at 10%. Bold typeface means NOT SIGNIFICANT

Table 4.4.3:	**Panel C**				
Models	Model 1	Model 2	Model 3	Model 4	Model 5
Parameters					
α	-0.0285***	-0.0309***	-0.0351***	-0.033*	-0.0396*
(t-stat)	(-4.7023)	(-1.6760)	(-1.8598)	(-1.646)	(-1.918)
Mkt-RF	0.9871***	1.0376***	1,0333***	1.008***	1.0318***
(t-stat)	(85.613)	(24.980)	(24,815)	(12.315)	(12.60)
HML	0.2728***	0.1305***	0.1341***	0.1540*	0.1929**
(t-stat)	(11.677)	(4.3792)	(4.4725)	(1.764)	(2.1846)
SMB	0.0631***	**-0.0538**	**-0.0659**	**-0.0577**	**-0.0008**
(t-stat)	(4.0136)	(-0.7925)	(-0.9696)	(-0.309)	(-0.041)
Γ	0,0398***	**-0.0026**	**-0.0021**	**-0.0005**	**-0.000**
(t-stat)	(5.8441)	(-0.5144)	(-0.4080)	(-0.0979)	(-0.0176)
MOM				**-0.0003**	**0.0744**
(t-stat)				(-0.0016)	(0.4225)
ESG Global		**0.0558**		0.0560*	
(t-stat)		(1.8417)		(1.7438)	
Environmental			0.075***		0.0796***
(t-stat)			(3.3656)		(3.411)
Social			-0.0018**		**-0.0265**
(t-stat)			(-2.5881)		(-0.8921)
Governance			**0.0259**		**0.0221**
(t-stat)			(1.5737)		(1.1456)
R-squared	0.3401	0.2817	0.2862	0.2814	0.2860
Fixed Effects:	YES	YES	YES	YES	YES

Table 4.5: Results for all sub-sample periods of the empirical cross-section panel estimation of equation (18), Γ is the dependent variable and ESG global score is the independent variable. (robust t-stats) ***denote statistical significance at 1%, **denote statistical significance at 5%, *denote statistical significance at 10%. Bold typeface means NOT SIGNIFICANT

Table 4.5:	**Panel D**		
Models	1. 2004-2022	2. 2004-2015	3. 2016-2022
Parameters			
α	0,9262***	1,0264***	0,6398***
(t-stat)	(37,724)	(30,426)	(7.7433)
ESG Global	-0,2309***	-0,5143***	0,3412**
(t-stat)	(-4,9464)	(-7.2176)	(2,5026)
R-squared	0,0037	0,0123	0,2862
Fixed Effects:	YES	YES	YES

Although R-squared remains practically unchanged between model 2, 3, 4 and 5 the ESG pillars are all significant as well as the idiosyncratic volatility factor and contribute to explaining the variability of excess returns. In model 5, the size of the Γ factor is reduced with respect to model 2 and model 1 from 0,0544 to 0,0166 to 0,0139 maintaining the positive sign in line with the concept that in the long run, stocks with high ESG performance have lower systematic risk and investors demand a positive idiosyncratic risk premium or explain the fact that high ESG firms are under-priced by market participants (see also [27]). Our results confirm the fact that as firms become more sustainable in the long run firm-specific risk is decreasing in size see also [16].

When introducing ESG measures to the panel the SMB factor becomes insignificant. The market factor remains significant at 1% level as well as the Γ factor and all 3 pillars suggesting there is a role for idiosyncratic risk as a corporate firm specific sustainability risk. The environmental pillar seems to be the greater in size -0,0308 and most significant in comparison with social and governance issues. Adding the 3 pillars increases the portfolios diversification as the constant remains negative. The size variable is insignificant when all variables are used simultaneously which means that it will replace the role of idiosyncratic risk.

It is worth noting that the above results are very important considering that our idiosyncratic factor is not constructed and estimated by the error term of the FF3 or CAPM models but instead directly by the proper stock prices traded in the secondary equity market. In this way we avoid the error-in-variables problem as noted by [65]. Estimating idiosyncratic volatilities is rational by the rationale that it is un-diversified idiosyncratic risk that matters when explaining abnormal returns. Equation 37 implies that high idiosyncratic risk, measured by the idiosyncratic volatility spread factor, is associated to higher excess returns on average.

Panels A, B, and C of Tables 4.4.1 to 4.4.3 present regression results from various model specifications incorporating ESG factors into an extended asset pricing framework. Across all panels, traditional risk factors such as the market excess return (Mkt-RF) remain statistically significant and positive, with coefficients close to or exceeding unity, reaffirming the dominant role of market risk in explaining portfolio returns. The HML factor generally retains its significance across specifications, although its magnitude and relevance increase noticeably in Panel C, particularly in Model 5 (β=0.1929,p<0.05), suggesting a stronger value premium in that sample. In contrast, the SMB factor becomes insignificant in Panels B and C from Model 2 onward, indicating a diminishing size effect once ESG-related variables are introduced.

We give special interest on the case of the third sample period 2016 up to 2022 for being both the covid-19 crisis as well as the post Paris agreement of 2015. Regarding this period, in table 6, the FF3 factors, HML remains highly significant and positive after incorporating the firm specific risk factor, the ESG global score and finally the three pillars. The HML maintains the positive sign and its significance at 1% level where the SMB factor becomes not significant when the ESG global and the pillar score is introduced. This implies that investors bet on high capitalization companies.

Turning to Γ, a notable pattern emerges: while this factor is highly significant and positive in Panels A and B, its effect disappears entirely in Panel C, becoming statistically insignificant in all models after Model 1. This suggests that in periods of high systematic risk (covid-19), Γ captures may be less relevant in the context or subsample underlying Panel C, due to differing economic environments or time periods. This implies that in this period ESG issues are highly idiosyncratic canceling out the explanatory power of the Γ factor. The effect of the idiosyncratic risk factor loses its explanatory power when we consider a shorter period (note that the Paris agreement was signed in 2015). More importantly the market factor parameter is increasing in size 1,0333 in model 3 and 1,0376 in model 2 versus 0,9871 in model 1, suggesting there is higher market risk in this period (covid-19). It is worth to point out that the environmental pillar is the only significant sustainability proxy risk factor for this period as in previous periods which makes this pillar a robust factor in all three sub-sample periods.

Focusing on Model 5, which includes the disaggregated ESG components (Environmental, Social, Governance), stark differences emerge across panels. In Panels A and B, the Environmental factor is consistently negative and highly significant (e.g., -0.0328***) in Panel A), implying a trade-off between environmental performance and financial returns. However, in Panel C, this relationship reverses: Environmental scores have a positive and significant impact on returns (0.0796***), suggesting that in this context, environmentally responsible firms are actually rewarded in the market. Similarly, the Social score is negatively significant in Panel A, insignificant in Panel B, and again mixed in Panel C, significant in Model 4 but losing significance in Model 5. Governance, by contrast, shows weaker and less consistent effects across all panels, never exceeding marginal significance levels.

The ESG Global variable is significantly negative in Models 2–3 of Panels A and B but becomes positive and marginally significant in Panel C (Model 5: 0.0560), further highlighting the variability in ESG return implications across datasets or model assumptions. R-squared values are relatively stable across all panels, clustering between 0.28 and 0.35, indicating modest explanatory power.

In summary, Model 5 results suggest that while ESG components, particularly Environmental, tend to reduce expected returns in Panels A and B, the reverse is true in Panel C, where environmental scores appear to be positively priced. This contrast may reflect differences in investor preferences, market structures, or time periods. The findings underscore the importance of context (post-Paris Agreement) when assessing the pricing of ESG characteristics and caution against drawing uniform conclusions about their financial materiality.

Table 4.5 presents the regression results, applying the empirical equation (38), analyzing the relationship between firm-level ESG Global scores and factor exposure, denoted by γ, across three distinct time periods: the full sample (2004–2022), the pre-ESG momentum period (2004–2015), and the post–Paris Agreement period (2016–2022). Across all specifications, the intercept α is positive and highly statistically significant, indicating a persistent average level of factor exposure that is independent of ESG characteristics. This indicates a positive baseline level of exposure $\Gamma_{S,t}$, when ESG scores are held constant. The magnitude of α declines in the post-2015 period, suggesting a structural shift in average exposure levels after 2015. In contrast, the estimated coefficient on ESG Global (δ) suggests that the relationship between ESG performance and factor exposure undergoes a structural change over time.

In Model 1, covering the full 2004–2022 period, ESG Global is negatively and significantly associated with $\delta = 0.2309$***, suggesting that firms with higher ESG ratings tended to exhibit lower exposure to this latent factor. The effect is even more pronounced in the earlier subperiod (Model 2), where the coefficient nearly doubles in magnitude ($\delta = 0.5143$***) and the explanatory power, though still low, increases slightly ($R^2 = 0.0123$). This indicates a strong negative relationship between ESG scores and γ during a time when ESG investing was still gaining traction.

Interestingly, this relationship reverses in the more recent period (Model 3: 2016–2022), where ESG Global becomes positively and significantly associated with $\delta = 0.3412$**), accompanied by a substantial increase in explanatory power ($R^2 = 0.2862$). This reversal suggests that higher ESG scores are associated with higher exposure in more recent years, potentially reflecting changing market perceptions of ESG, regulatory shifts, or increased ESG-related investment flows that alter asset sensitivities. This shift reflects a changing market perception, wherein ESG-compliant firms are increasingly viewed as having desirable exposure to certain priced risks or investor preferences. The reversal in sign suggests that ESG characteristics have evolved from being neutral or negatively associated with priced factors to being positively priced in more recent years, potentially due to heightened investor demand, policy developments, or shifts in risk awareness.

Overall, the temporal variation in the sign and magnitude of δ highlights a dynamic and evolving relationship between ESG performance and risk factor exposures, underscoring the need to account for time-specific market structures and investor sentiment when evaluating the pricing and impact of ESG metrics.

4.5 Discussion

With respect to the idiosyncratic risk-return perspective we find a positive relationship between firm specific risk and returns meaning that investors actually demand a higher compensation for holding stocks with higher idiosyncratic risk. This result is compatible with [65], and [89], which implies that on average ESG or idiosyncratic risk can provide a hedge against market risk. According to table 4.5, in samples 2004-2022 and 2004-2015 the higher the ESG score for a company the lower the firm-specific risk as explained by the Γ coefficient establishing a negative trade-off significant for both periods at 1% level. This implies that companies able to adapt quickly to market ESG conditions are able to reduce their cost and hence overall risk converging to market risk and therefore reducing their idiosyncratic risk premium demanded by investors in the long run.

According to the results reported in tables 4.4.1, 4.4.2, 4.4.3, companies in a highly significant manner can accomplish diminishing idiosyncratic risks when introducing policies aiming to achieve a higher social and environmental performance. Given the firm specific risk premium, introducing ESG pillars environmental risk can have overall a negative effect on returns on average by 3 basic annual points. It seems that it is more costly to adapt to climate changes than to social or governance issues. The same applies for the governance pillar with a negative effect of 1.5 basic points on returns half the effect of the environmental pillar and significant only at the 5% level. Social responsibility such us human rights and labor, employee relations, transparent business goals can actually increase returns at a 0.22 basic points annually. Therefore, we find that the fundamental trade-off between risk and reward is maintained when caring about ESG but on average there is lower upside return potential for the environmental and governance pillar and higher return potential for the social pillar.

Indeed, investigating the market´s incorporation of sustainability metrics including both the firm specific factor along with the ESG measures results in explaining further the granularity patterns augmenting the information on the way investors use ESG information. That is information available is captured by the specific firm-case commitment in constructing reputation, R&D innovations, lowering the lack of information asymmetry presented in the market. (see also [13], [139], [93]). In line with our results in table 4.4 and table 4.5, we see that in a context where market risk is high as in period 2016-2022, investors perceive high ESG companies as assets with lower systematic risk, and increases directly the idiosyncratic spread factor attracting higher positive values. In table 4.4, in the third column the ESG global score has a positive coefficient parameter in contrast to the first two periods significant at a 5% level. When considering equation (37) that is, introducing all the variables to the equation the Γ variable becomes insignificant along with the ESG global score, the social and governance score. Only the environmental pillar remains significant at a 1% level for the 2016-2022 period increasing by double its negative effect on returns.

This is compatible and expected, as in the short-term period, a company faces greater uncertainty and hence risk when taking decisions about ESG policies. The firm-specific premium factor reflects very little ESG information on innovations about being a good company, making it less valuable in the short run. There is greater uncertainty about the effect of ESG decisions on operating income and future revenues, resulting in a higher cost-of- capital for any given set of sustainability issues. The short run failure risk, in the sense of larger probability of failure or negative events taking place resulting in higher risk has adverse effects on excess returns. This is also captured by the negative sign of the environmental ESG score and its greater significance at that period. Adding the fact that market risk is increased by the pandemic effect of the covid-19 the role of the firm-specific risk became less significant except the environmental feature.

In practice, CEOs might take decisions that increase short-term profit but damage the company s reputation and reduce shareholder value by constantly changing suppliers in order to find cheaper products or by reducing spending on employee safety or pollution. In this way, the firm increases short term profits but does not promote trusted and confident relationships with its suppliers or increases its risk, and hence costs of lawsuits, or regulatory risks. Therefore, having said that ESG can become a negative predictor of excess returns when investors are willing to accept lower returns for more responsible stocks (see also [8]).

Moreover, in order to examine and give some perspective on the results presented on the previous section, it is worthy having a look on the USSIF data report during the period 2016 up to 2022. Assets under management (AUM) increased by 38 percent from 8.7 trillion dollars up to 12 trillion dollars at the beginning of 2018. In 2018, money managers overall incorporated social factors more than environmental and governance criteria. The social feature of the sustainability increased by 39% from 2016 to 10.8 trillion dollars [19]. This year the expenditure in climate change reaches 3 trillion dollars, tobacco related restrictions increased by 432% and transparency and anti-corruption criteria doubled in the same period. This is in line with our results that both environmental and social are highly significant pillars in explaining the excess returns patterns with the environmental coefficient having the greatest size effect and remaining significant during all periods.

Given the above data, the idiosyncratic risk factor remains significant during all the sample periods except the 2016-2022 where the market risk predominates, after controlling for the CSR/ESG component. With higher CSR/ESG disclosure firms can lower their idiosyncratic risk implying that investors make decisions with higher level of information based on both systematic and non-systematic risk. Our results suggest that the coefficient of the firm-specific risk premium represents the non-systematic risk and the loading on the flexibility of a company to adjust to continuous ESG innovations. This is a very important result that increases the level of analysis and add granularity in the sense that investor can gain the ability to distinguish whether a company can achieve higher returns being both ESG responsible and at the same time receive higher risk premium.

As opposed to [50], models 1, 2 and 3 establish that there is an explicit channel through which the idiosyncratic volatility risk premium transmits through the ESG pillars mapping the pattern of the price of common stock. This result is also intuitive as companies with the ability to manage and employ specific investment policies have a specific ESG cost but at the same time investors have segmented information criteria on intangible ESG risk such as reputation, RD innovations, patent citations, demanding a positive risk premium for holding firms with a high idiosyncratic risk.

The results presented in Panel 4.5 reveal important temporal dynamics in the relationship between ESG performance and the factor exposure γ. Over the full sample period from 2004 to 2022, there is a significant negative association between the ESG Global score and the exposure factor ($\delta = 0.2309$***), indicating that firms with higher ESG ratings tended to have lower exposure to this factor. This finding suggests that, historically, higher ESG standards were linked to reduced sensitivity to the latent risk or characteristic captured by γ, potentially reflecting a risk mitigation role of ESG practices or a market perception of ESG-compliant firms as lower-risk entities demanding lower premiums.

When splitting the sample into sub-periods, the negative relationship is even more pronounced in the 2004–2015 period ($\delta = 0.5143$***), a time when ESG considerations were still emerging as a key focus for investors. The stronger negative coefficient and low but increased explanatory power during this earlier phase indicate that ESG was likely priced as a form of risk reduction, consistent with traditional views of socially responsible investing as a strategy to avoid negative externalities and regulatory risks.

The results in Table 4.5 (Panel D) suggest a structural break in the relationship between ESG performance and asset exposure around 2015, coinciding with the adoption of the Paris Climate Agreement. Prior to 2016, higher ESG scores are significantly associated with lower exposure, indicating that ESG characteristics functioned primarily as a risk-mitigating signal. During this period, ESG adoption was largely voluntary and concentrated among firms with stronger governance and lower environmental and social risks, leading to reduced sensitivity to systematic shocks.

In stark contrast, the post-2016 period shows a reversal in this pattern, with ESG Global exerting a positive and significant influence on $\delta = 0.3412$**, and a marked increase in explanatory power ($R^2 = 0.2862$). Higher exposure here means that assets with higher ESG scores are more sensitive to idiosyncratic risk factors. This shift coincides with heightened global focus on sustainability initiatives, such as the Paris Agreement, increased investor activism, and a growing body of empirical evidence linking ESG factors to firm value and performance. This reversal is consistent with the interpretation that, following the Paris Agreement, ESG factors transitioned from a defensive screening mechanism to a priced source of systematic exposure. Increased regulatory pressure, mandatory climate disclosures, and the rapid growth of ESG-oriented investment vehicles may have led to capital reallocation toward high-ESG firms, thereby increasing their market sensitivity. The positive relationship suggests that ESG-compliant firms are now associated with greater exposure to the factor γ, which represents a rewarded risk factor or a proxy for growing investor preferences for sustainability.

These temporal shifts underscore the evolving role of ESG in financial markets, from a risk-mitigating attribute to a potentially value-enhancing characteristic that investors actively seek.

[19]Source:https://www.ussif.org, in the social category is included all the community-related criteria

The findings highlight the importance of accounting for market regime changes and evolving investor behavior when assessing the financial implications of ESG performance. Moreover, the substantial increase in R^2 in the most recent period signals that ESG factors have become a more integral component of asset pricing models, reinforcing the need for ongoing research into their nuanced effects.

Overall, stock markets foster the assumption that there is a business case to incorporate the consequences of intangible risks (as measured by both global as well as ESG individual pillar scores) when introducing both the firm specific risk factor and the ESG metrics for each company. In other words, intangible ESG commitment manifest into tangible in the long run that are valued by the market. Strong CSR practices by firms with high individual scores will exhibit a more stable and lower in size idiosyncratic volatility in the long term profile obtaining moderate returns. The beneficial effect of the ESG pillars on reducing the idiosyncratic risk in the long run is consistent with [57] who claim in the long-run lower intangible risk creates value for the company lowering idiosyncratic volatility. [140] assume the actual market portfolio consists of observable and measurable information, under the strict assumption that investors can hold the whole market "available market portfolio", there is still a larger risk premium priced in returns due to responsible investing and intangible assets (ESG value). This happens because some of the systematic risk would be considered as firm-specific risk relative to the whole market portfolio.

In the long run, the intangible commitment to ESG manifests itself in tangible outcomes that are valued by the market. [29] claim that CSR can increase long-term profits by strengthening the firm´s market position. For example, higher investment and monitoring in employee relations can attract high-skilled professionals, which can results in higher profits. [27] argue that intangible ESG risks are material for investment decisions and include governance leadership and board, energy management, anti-corruption policies to factors that enable a company to achieve full ESG integration and long-term economic growth.

4.6 Conclusions

This study investigates the relationship between ESG performance and asset pricing dynamics through a series of panel regressions incorporating traditional risk factors alongside ESG variables. Across multiple data-sets and time-frames, the findings offer a nuanced understanding of how ESG characteristics influence expected returns and factor exposures.

This chapter concludes that by integrating both the idiosyncratic risk factor and the Environmental, Social, and Governance (ESG) dimension of firms, we achieve a more comprehensive understanding of their respective effects on excess returns, as well as the temporal dynamics in which these effects manifest. When incorporating all relevant variables into a firm-year cross-sectional panel regression, both the idiosyncratic risk factor, and ESG metrics exhibit statistical significance at the 1% level. Overall, our findings indicate that superior ESG performance, as reflected in higher scores, is associated with reduced idiosyncratic risk but also with diminished upside return potential. Notably, ESG ratings provided investors with a mechanism to hedge market risk, particularly during the 2008 financial crisis, while preserving the fundamental risk-return relationship.

Consistently across Panels A and B, traditional risk factors such as the market premium (Mkt-RF) and the latent factor Γ remain significant determinants of portfolio returns. The inclusion of ESG Global and its components reveals a generally negative and significant relationship with returns, particularly for the Environmental and Governance dimensions, suggesting that firms with higher ESG ratings tend to exhibit lower expected returns. This may reflect a trade-off where ESG compliance is associated with lower risk profiles and, consequently, lower risk premiums demanded by investors. Notably, the Social dimension presents mixed results, underscoring the complexity and heterogeneity of social factors in financial pricing.

Panel C introduces further complexity, as ESG components display different patterns compared to earlier panels. Most striking is the reversal in the Environmental factor, which exhibits a positive and significant coefficient, indicating that under certain market conditions or samples, strong environmental performance may be rewarded rather than penalized. This divergence highlights the importance of market context and the evolving perception of ESG factors over time.

Panel D provides a temporal dimension to this analysis by examining the relationship between ESG Global scores and factor exposure Γ over different sub-periods. A clear structural shift is evident: while ESG scores were negatively associated with Γ in the earlier period (2004–2015), this relationship reverses in the post-2016 period, with ESG positively linked to factor exposure and a substantially higher explanatory power. This evolution likely reflects broader shifts in investor preferences, regulatory frameworks, and the mainstreaming of ESG investing.

We develop a real-time pricing framework in which equity returns are determined by both systematic and idiosyncratic factors. We construct an idiosyncratic factor to estimate portfolio abnormal returns and examine how ESG considerations influence portfolio returns once this factor is incorporated. Analyzing a panel encompassing all firms within the S&P500, we identify a robust long-term relationship between ESG scores and stock excess returns. Our results suggest that ESG initiatives impose real costs on individual firms, generally resulting in moderate upside return constraints. However, firms highly committed to social and governance issues can achieve slightly elevated returns and earn a positive risk premium for bearing additional idiosyncratic risk. Investments in climate-change-related sustainability efforts entail costs that may suppress returns, supporting the argument that sustainability considerations are pertinent to explaining excess returns.

Specifically, we: (a) quantify the extent to which ESG performance characteristics remain significant explanatory factors for excess return variation, beyond traditional Fama-French 3 factors, four factor Carhart model, and market beta; and (b) empirically assess the incremental informational content contributed by ESG pillars and overall ESG scores after controlling for idiosyncratic risk. These insights hold practical implications for active portfolio managers, who must account for idiosyncratic risk in identifying and selecting socially responsible stocks with superior performance potential. Our analysis demonstrates that market beta alone is insufficient to capture the influence of ESG innovations on stock prices. Incorporating ESG criteria alongside idiosyncratic risk enhances the analytical framework for evaluating firm-specific dynamics and supports the long-term promotion of socially responsible policies, including for firms currently lagging in sustainability.

Therefore, we establish a distinct channel through which ESG intangibles are priced, mediated by idiosyncratic risk, which influences common stock returns. ESG rating agencies might consider incorporating idiosyncratic risk measures to more accurately assess corporate responsibility. This approach enables a dual evaluation: not only whether a firm exhibits high ESG standards but also the cost implications of improving sustainability given the firm's idiosyncratic risk profile. Asset managers can augment their stock-selection processes by leveraging ESG information alongside firm-specific volatility. Market-observable idiosyncratic volatility forms an explicit conduit linking social performance to stock price formation. The traditional beta metric fails to adequately distinguish the effects of ESG innovations on excess returns. Thus,, the inclusion of intangible risk factors, as captured by ESG metrics and reflected in firm-specific risk, is essential.

Future research should continue to explore these dynamics across diverse markets and asset classes, while considering the evolving regulatory landscape and investor behavior. The integration of ESG into asset pricing models remains a promising avenue for understanding how sustainability considerations reshape financial markets.

Building on the empirical findings and theoretical advancements presented in the preceding analysis, it becomes evident that ESG factors exert influence on corporate financial performance through multiple, nuanced channels. While the integrated framework highlights the interplay between ESG metrics and idiosyncratic risk in asset pricing, a deeper understanding requires unpacking the underlying pathways through which ESG practices translate into tangible financial outcomes. To this end, the following section delineates the core mechanisms, ranging from operational efficiency and risk mitigation to reputational signaling and investor utility, that underpin the ESG–CFP relationship. This exploration provides a more granular view of how sustainability strategies create, preserve, or sometimes erode firm value across varying contexts.

Chapter 5 General Conclusions & Discussion

While the relationship between ESG performance and corporate financial outcomes is not uniformly positive, the weight of evidence, particularly in long-term and developed market studies, supports a favorable association. Variations in geography, time horizon, and sectoral context explain much of the heterogeneity observed across the literature. ESG engagement contributes to firm value primarily through four mechanisms: enhanced cash flows, reduced risk exposure, lower cost of capital, and diminished idiosyncratic volatility. Importantly, ESG also plays a strategic role during periods of systemic disruption, such as financial crises or pandemics. However, causality remains difficult to isolate due to confounding factors such as resource slack and stakeholder targeting of already successful firms. ESG performance is thus best understood as both a signal of operational resilience and a lever for long-term value creation, with implications that span investor strategy, corporate governance, and public policy.

We develop a comprehensive framework to understand the role of idiosyncratic risk in asset pricing by introducing the Idiosyncratic Equity Premium (IEP), a novel, quantifiable measure of compensation investors demand for bearing firm-specific volatility. By decomposing return shocks into systematic, idiosyncratic, and market microstructure components, the study extends traditional CAPM models and demonstrates that idiosyncratic risk is economically relevant, especially under investor constraints where full diversification is infeasible.

Empirical results show that the IEP significantly improves the explanatory power of asset pricing models across multiple periods, particularly during times of market stress, such as the COVID-19 crisis. The idiosyncratic premium is shown to be time-varying, robust across specifications, and significantly influences expected excess returns, with annual effects ranging from 9.75% to 15.82%. The findings challenge the classical assumption that idiosyncratic risk is diversifiable and irrelevant for pricing. Instead, they position it as a meaningful factor, comparable in significance to size and value, and deserving of explicit consideration in portfolio construction and risk assessment.

This study presents an integrated framework combining idiosyncratic risk and Environmental, Social, and Governance (ESG) metrics to better explain stock excess returns. Empirical analysis using SP index firms confirms that both factors are statistically significant at the 1% level, with ESG scores associated with lower idiosyncratic volatility but also diminished upside return potential. The findings emphasize that while high ESG standards serve as a risk-hedging mechanism, especially during crisis periods like 2008, they also represent a tangible cost to firms in terms of foregone return opportunities.

By introducing a real-time pricing model that incorporates a novel idiosyncratic risk factor, the study demonstrates that ESG metrics retain explanatory power for excess return variability even after accounting for traditional Fama-French factors and market beta. ESG-linked firm intangibles influence asset pricing through their impact on firm-specific volatility, creating a direct transmission channel between sustainability practices and return formation.

The results have practical implications for portfolio managers: integrating ESG considerations alongside idiosyncratic risk measures enhances the ability to identify financially resilient, socially responsible investments. The beta coefficient alone is insufficient for assessing ESG-related effects on returns; firm-specific risk must also be accounted for. Finally, the study calls for standardization across ESG rating agencies, noting that methodological convergence would improve the consistency and reliability of ESG-integrated asset pricing models.

5.1 Mechanisms in the ESG/RISK/CFP process

Based on this investigation, the relationship between ESG (Environmental, Social, and Governance) or CSR (Corporate Social Responsibility) practices and firm performance is supported by several interrelated mechanisms. We can identify several key mechanisms that link ESG (Environmental, Social, and Governance) practices to Corporate Financial Performance (CFP, both positively and negatively, and in bidirectional ways. These mechanisms help explain both the value-enhancing effects of ESG/CSR and the heterogeneous empirical findings across countries, time periods, and firm sizes.

The cash-flow channel (Operational Performance Mechanism). A primary transmission mechanism is through the cash-flow component of firm valuation, as outlined in the Discounted Cash Flow (DCF) model. ESG/CSR initiatives can: 1) enhance revenues by improving brand image, customer loyalty, and attracting ESG-conscious consumers and investors, 2) reduce costs through energy efficiency, waste reduction, and improved supply chain management, 3) increase employee productivity via higher job satisfaction, stronger retention, and improved morale. These outcomes directly affect operating performance metrics such as ROA (Return on Assets) and ROE (Return on Equity), though in the short run, accounting-based metrics may understate this effect due to implementation lags.

The risk management and Cost-of-Capital (Discount Rate Mechanism). Strong ESG/CSR profiles may lead to lower perceived risk by investors, creditors, and insurers, which can reduce the firm's cost of capital. This occurs through: 1) better regulatory compliance, minimizing the probability of fines or litigation, 2) enhanced reputation, reducing reputational risk and attracting long-term investors, 3) improved stakeholder relationships, especially with governments, NGOs, and local communities. Lower risk translates into lower discount rates in valuation models, thereby increasing firm value, even if cash flows remain constant.

Intangible assets and competitive advantage, according to the resource-based view (RBV) of the firm, ESG/CSR initiatives contribute to building valuable intangible assets such as: Strong corporate culture and identity. Reputational capital, stakeholder trust, and loyalty. These elements can create sustainable competitive advantages that, in turn, support long-term profitability and value creation.

In the context of investor utility and nonpecuniary preferences mechanism, models that include shareholder utility, ESG/CSR engagement can increase firm valuation even when financial returns are neutral. Investors may derive psychological or ethical utility from supporting sustainable firms (as in [63]), and this preference manifests itself in a higher demand for "green" equities. This is particularly relevant in the case of Socially Responsible Investment (SRI) or Impact Investment, where investors actively seek alignment with ethical values.

The argument of the reputation and signaling theory supports that CSR initiatives also serve a signaling function, indicating quality management, forward-thinking leadership, and long-term strategic orientation. Firms with long-term strong ESG reporting and credible ESG commitments signal lower information asymmetry and may benefit from increased transparency and trust. Disclosure of sustainability practices (e.g., in ESG reports) helps reduce informational asymmetries between firms and investors ([49]).

The holistic view of sustainability engagement with internal and external CSR alignment mechanism. Recent findings emphasize the synergistic effect of aligning internal and external CSR efforts ([30]). Firms that simultaneously invest in internal practices (e.g., employee satisfaction, ethical governance) and external activities (e.g., community programs, environmental impact) tend to achieve higher market valuations than those with misaligned efforts. Misalignment, by contrast, may lead to perceived hypocrisy or green-washing, undermining trust and eroding firm value.

While ESG practices can positively impact a firm's cash-flow, it is also possible that inherently competitive and profitable firms are more likely to adopt these practices. This bidirectional relationship highlights the complexity of assessing the true impact of ESG on financial performance. The reverse causality advocates that financial health enables ESG commitment. Financially successful firms are more likely to adopt ESG/CSR practices due to: 1) greater resource availability to fund long-term strategic initiatives, 2) increased public and regulatory scrutiny, prompting proactive sustainability efforts, 3) ability to absorb short-term costs in anticipation of long-term gains. Controlling for this bidirectional causality is essential for properly identifying ESG's causal effect on firm performance.

Finally, there are also contextual and conditional effects. The effectiveness of ESG/CSR strategies depends on contextual factors, such as: Firm size: 1) Larger firms tend to benefit more due to economies of scale and greater capacity to implement and report ESG actions ([47], [48]), 2) Market conditions: In times of crisis (e.g., the 2008 financial crisis), firms with high ESG spending may suffer if oversight is weak or if CSR is perceived as inefficient ([51]), 3) Geographic location: The impact of ESG varies between countries, with more consistent positive effects in developed markets such as the US and Europe, and mixed or lag effects in emerging markets like China ([42], [50]).

5.2 Theoretical and Practical contributions

5.2.1 Theoretical Contributions

The empirical results of [141], and [3], indicate that ESG transparency is associated with materially lower firm-specific risk, with magnitudes that depend on market context and horizon. In a broad cross-section of U.S. equities (1991–2018), the receipt of an ESG rating is linked to an average 0.62 percentage-point reduction in monthly idiosyncratic volatility in fully controlled models, 31% lower relative to the sample mean of 1.99%. Across specifications, the effect ranges from -0.75 to -0.18 pp (38% to 9%), and remains -0.36 pp (-18%) in the post-2009 subsample, suggesting durability albeit with attenuation as markets matured after the Global Financial Crisis. Moreover, higher rating levels amplify the reduction through an interaction effect, consistent with incremental risk mitigation when ESG quality strengthens. In the IPO setting, voluntary ESG disclosure at listing is associated with 8–10% lower first-year aftermarket idiosyncratic volatility (log-IVOL coefficients -0.08 to -0.095 in pooled and matched samples), and with lower downside tail risk (VaR/CVaR), consistent with a reduction in ex-ante uncertainty when issuers reveal credible non-financial fundamentals at flotation.

Seen through the lens of global climate policy, these patterns are coherent with the Paris Agreement's role as a regime-shifting, economy-wide commitment that embedded climate transition expectations into the information environment for firms and capital markets. Adopted on December 12, 2015 and in force since November 4, 2016, the Agreement catalyzed nationwide decarbonization pathways (NDCs), transparency requirements, and iterated ambition cycles, thereby raising the salience and comparability of climate-related corporate actions and disclosures. This normative and (increasingly) regulatory pressure heightened investor demand for decision, useful ESG information and sharpened the penalty for opacity mechanisms that help explain why ESG signals reduce perceived firm-specific risk and why their materiality has persisted and, in some channels, intensified in the post-Paris period. Complementing Paris, the Task Force on Climate-related Financial Disclosures (TCFD) (final recommendations published June 2017), provided a market standard for disclosing governance, strategy, risk management, and metrics/targets on climate, further institutionalizing ESG data into pricing and risk processes.

The theoretical conduits connecting these policy shifts to our results are legitimacy and signaling. For IPO firms, voluntary ESG disclosure serves as a legitimacy-enhancing signal that the firm's strategy aligns with globally recognized climate norms (Paris), reducing investor skepticism when financial histories are thin and information asymmetries acute; empirically, this maps to the 8-10% IVOL reduction and to lower VaR/CVaR reported by [3]. For seasoned firms, the ongoing presence and quality of an ESG rating functions as a repeated (and updated) signal of risk management capabilities and transition readiness, rationalizing Horn's large and robust IVOL reductions (-31% on average in fully controlled models), with attenuation post-2009 as the ESG information premium was progressively arbitraged into prices in a maturing disclosure ecosystem.

From a valuation standpoint, these risk effects are consistent with the ESG-adjusted DCF "transmission channels" documented by [4]. ESG characteristics operate through a cash-flow channel (fewer controversies, more operational resilience), an idiosyncratic-risk channel (lower tail-risk exposure, more stable earnings), and a valuation/cost-of-capital channel (lower discount rates via reduced risk premia). The post-Paris codification of climate expectations likely strengthens each channel by elevating transition risks (and thus the premium for credible mitigation), and by standardizing climate disclosure via TCFD-aligned practices

We expect that the coefficient δ associated with idiosyncratic risk factor $\Gamma_{S,t}$ to be negative,consistent with the empirical evidence documented documented in [141], [3], [4],as well as with the prevailing policy context. Interpreting the specification in equation (38), a negative δ implies that higher values of ESGGlobal are associated with lower firm-specific risk, reflecting the risk-mitigating role of strong ESG performance.

In the pre-Paris regime (Model 2), we report a $\delta < 0$ and highly significant, higher ESGGlobal is associated with lower Γ. Since Γ proxies the idiosyncratic risk exposure, this matches with established evidence that ESG transparency and ratings reduces firm-specific risk, see [141], [57], [3], [4]. In the post-Paris regime (Model 3), we report a $\delta > 0$ and significant at 1% level, and explanatory power is an order of magnitude higher (R-square = 0.2862 versus 0.0123 in previous models). The sign flip suggests a structural change in what Γ is capturing after 2016: either firstly markets begun to price ESG as a positive exposure to a "transition/green" factor (e,g, demand/flows toward Paris-aligned assets), or secondly Γ corresponds to a transition-readiness/resilience sensitivity rather than a pure risk metric, an interpretation consistent with our earlier note that the sign may flip when Γ measures exposure to opportunity channels rather than risk channels. The whole-period estimate (Model 1) averages these regimes, yielding the expected small negative δ.

Moreover, the literature highlights the endogeneity of ESG performance, noting that financially stronger firms may adopt ESG practices due to greater slack resources, thereby complicating causal inference, a notion rooted in Slack Resources Theory. It bridges firm-level ESG strategies with global sustainability objectives by mapping ESG practices onto specific UN Sustainable Development Goals, reinforcing ESG's dual role as a driver of both financial and societal outcomes. Thus, ESG is re-framed as a strategic asset for investors, managers, and policymakers, enhancing long-term value and market efficiency, consistent with Modern Portfolio Theory and Strategic Management principles. Lastly, the literature underscores the need for longitudinal, multi-country, and channel-specific research designs to better isolate causality and clarify the mechanisms through which ESG contributes to firm resilience and value creation.

This study enriches the ESG–finance literature by advancing several key theoretical contributions. First, it provides empirical support for the positive pricing of idiosyncratic risk, confirming that investors demand a higher risk premium for firms with elevated firm-specific risk, consistent with the arguments in the work of [65]. However, it also demonstrates that higher ESG performance systematically reduces idiosyncratic risk, particularly over longer time horizons, aligning with theories of risk mitigation and informational efficiency.

Second, the findings suggest a risk–return trade-off embedded within ESG dimensions, where environmental and governance investments tend to reduce returns in the short term due to adjustment costs, while social performance is positively associated with returns. This reinforces the multi-dimensional nature of ESG and supports a differentiated pillar-based analysis, a theoretical refinement beyond viewing ESG as a homogeneous construct.

Third, the analysis builds on asymmetric information theory, suggesting that firm-level ESG commitments, such as innovations in RD, reputation-building, and transparency, reduce informational frictions, thus improving capital allocation efficiency. This aligns with the signaling theory view that ESG performance communicates intangible firm qualities (e.g., credibility, resilience).

Fourth, the text introduces a dynamic ESG adaptability framework, wherein firms that quickly adjust to changing ESG conditions exhibit lower firm-specific risk over time. This supports a capability-based perspective in which ESG responsiveness becomes a strategic intangible asset. Furthermore, the study finds that in periods of heightened systematic risk (e.g., 2016–2022), the idiosyncratic risk channel weakens, suggesting a context-contingent transmission of ESG impacts, consistent with contingency theory and market-state dependency frameworks.

Fifth, the present research adds granularity by modeling ESG pillars as explicit risk-pricing channels, establishing a direct transmission mechanism from ESG scores to excess returns through the idiosyncratic volatility risk premium. This challenges previous findings (e.g., [50] and contributes to a more nuanced asset pricing theory that incorporates intangible ESG factors as priced components of expected returns.

Finally, the long-term findings align with stakeholder theory and strategic CSR frameworks, showing that sustained ESG efforts translate into more stable idiosyncratic volatility and moderate, but more predictable, returns. This reflects a convergence of ESG and intangible asset valuation theory, where intangible risks (e.g., reputational or environmental liabilities) are gradually internalized by the market, turning non-financial disclosures into financially material outcomes.

5.2.2 Implications & Practical Contributions

The present study has important implications for companies, practitioners, and policy makers. Some specific contributions for companies include the following. It encourages firms to integrate ESG factors into corporate strategy to enhance resilience, brand reputation, and long-term financial performance. Emphasizes the value of disclosing ESG information transparently and consistently, which can improve investor confidence and reduce the cost-of-capital. Finally, it suggests that a granular approach to ESG management, focusing on individual pillars (Environmental, Social, Governance), can help firms manage industry-specific risks more effectively.

For practitioners (Investors, Analysts, Asset Managers), it provides insights to refine ESG-based investment strategies, emphasizing the importance of dis-aggregating ESG scores and understanding the limitations of existing ESG rating systems. In addition, it highlights the need to incorporate idiosyncratic and tail risk channels into financial models when evaluating ESG performance of firms. The present analysis supports the development and application of enhanced ESG valuation frameworks that include intangible assets such as reputation, goodwill, and employee satisfaction.

For firms, the results imply a clear financial case for Paris-aligned strategy and disclosure. Pre-2015, the strongly negative *delta* (0.5143) indicates a clear risk dividend to credible ESG disclosure/performance,aligning with legitimacy/signaling theory and IPO evidence. Post-2016, positive δ (0.3412) and high R-square imply that markets now also price ESGGlobal as a transition exposure, firms that disclose Paris-aligned strategies and adopt TCFD (Task Force on Climate-related Financial Disclosures), can benefit on both fronts: lower risk earlier and higher priced alignment later. Concretely, firms can lower idiosyncratic risk, and plausibly reduce their cost of equity, by (i) publishing credible, decision-useful ESG disclosures (particularly at IPO), (ii) obtaining and maintaining an ESG rating and improving its underlying pillars, and (iii) aligning reporting with TCFD so that transition pathways, governance, and scenario analysis are transparent to markets. In Paris-aligned economies, failure to disclose can be read as non-alignment risk, inviting higher risk premia.

For portfolio managers, they should treat δ as a sensitivity parameter. The evidence supports explicit integration of ESG signals into risk models and portfolio construction. In the pre-Paris window, tilting to higher ESGGlobal reduced risk exposure (δ<0). In the post-Paris window, higher ESGGlobal identifies transition-aligned loadings (δ>0) with much greater explanatory power. They should incorporate both risk and transition channels (and test with the interaction term) to avoid mis-specifying the direction of ESG effects. This is consistent with the risk reduction documented in [141], and the TCFD-enabled integration of climate metrics into pricing. A "has-rating" indicator and rating-level exposures can be used to tilt portfolios toward issuers with lower idiosyncratic risk, while TCFD-aligned climate metrics (e.g., financed emissions, transition scores) can be embedded in scenario-aware risk budgeting. Such integration is consistent with the idiosyncratic-risk channel and valuation channel documented by [4]. and with the market demand for comparable climate disclosures post-Paris/TCFD.

For investors, our results related to the convergence of policy (Paris), standards (TCFD), and market evidence, see also [141], [3], suggests that ESG integration is financially material for risk control even absent an explicit "tilt for impact." Results support a two-regime view. ESG delivered risk mitigation (large negative δ) before Paris, and priced transition exposure (positive δ) after-ESG integration is financially material across regimes, but what is priced changes as policy and standards evolve (Paris; TCFD). Allocating to ESG-rated or ESG-disclosing names can reduce exposure to idiosyncratic shocks without a priori conceding returns, where investors do target impact, Paris-aligned strategies may simultaneously advance climate goals and dampen firm-specific volatility.

Finally, our findings underscore the urgency of establishing standardized ESG disclosure frameworks and classification systems to enhance data quality, comparability, and transparency at a global scale. The current lack of uniform ESG reporting contributes to market inefficiencies and divergent ESG ratings, which impede investors' ability to make fully informed decisions. Regulatory reforms aimed at harmonizing ESG standards, coupled with international cooperation, are essential to address these challenges. Moreover, more precise and consistent ESG metrics would reduce information asymmetries and mitigate distortions in asset pricing. Such improvements in disclosure practices could facilitate greater investor confidence, thereby supporting the broader adoption of sustainable finance initiatives and enabling capital markets to more effectively integrate environmental, social, and governance considerations into investment decisions.

5.3 Concluding Remarks

The extant literature on environmental, social, and governance (ESG) performance presents mixed evidence regarding its financial implications. While many studies report a positive and statistically significant link between ESG and profitability, particularly in developed markets and over extended horizons, others document neutral or adverse outcomes, especially within short-term or sector-specific contexts. Such heterogeneity arises from differences in geography, performance metrics, time-frames, and regulatory environments. Long-term studies, particularly those that use market-based indicators such as Tobin's Q or abnormal returns, more consistently associate ESG with financial gains. In contrast, short-term or accounting-based evaluations tend to yield volatile results. Sectors with weaker oversight or greater cyclical variation exhibit the greatest variability in ESG outcomes.

Our empirical framework builds on this foundation by incorporating an Idiosyncratic Equity Premium (IEP) into asset pricing models. We decompose return volatility into systematic, idiosyncratic, and microstructure components, offering a more granular view of excess return formation. Contrary to traditional asset pricing assumptions, idiosyncratic risk is neither fully diversifiable nor negligible. Instead, it is economically significant and positively priced, particularly in periods of elevated market uncertainty.

Analyzing a panel of S&P500 firms, we find that both ESG scores and idiosyncratic risk are significant at the 1% level in explaining cross-sectional excess returns. High ESG performance is consistently associated with lower idiosyncratic risk but also with diminished upside return potential, reinforcing the notion of ESG as both a risk mitigator and a cost factor. This relationship held during systemic shocks, such as the 2008 financial crisis and the COVID-19 pandemic, when ESG ratings offered a hedge against downside volatility.

The analysis provides a real-time pricing model and demonstrates that ESG considerations materially influence stock returns once idiosyncratic risk is accounted for. Traditional factors like market beta and Fama-French variables are insufficient alone. Incorporating ESG metrics provides additional explanatory power, especially when assessing firm-specific dynamics. Notably, firms deeply committed to social and governance practices may still earn a positive risk premium despite ESG-related costs.

There is an argument of a plausible regime shift. A Policy normalization and disclosure uplift. The Paris Agreement codified NDCs, iterative ambition cycles, and transparency, shifting in a significant manner climate-transition expectations into the core of corporate strategy and investor risk assessment. The TCFD recommendations then provided a common frame for governance/strategy/risk/metrics disclosures. Together, these moves lowered information asymmetry and raised the market salience of ESG signals, a setting in which ESG can act (depending on dependent variable definition) as risk mitigation (negative δ pre-Paris) or as priced exposure to transition opportunities (positive δ post-Paris), with markedly higher R-square once disclosure quality/coverage improved. Within a DCF framework, [4], show ESG characteristics transmit via (i) cash-flow stability, (ii) idiosyncratic risk, and (iii) cost-of-capital/valuation. Post-Paris, all three channels plausibly strengthen, while markets also price transition exposure—consistent with your positive δ and larger R-square after 2016 if Γ reflects transition sensitivity rather than a pure risk metric.

This study demonstrates that ESG performance and disclosure have evolved from being peripheral considerations to becoming central determinants of financial risk and valuation. Empirical evidence from both IPO and seasoned equity markets confirms that ESG transparency significantly reduces idiosyncratic volatility and downside tail risk, particularly in periods of heightened uncertainty. The strong negative association observed in the pre-Paris era underscores ESG's role as a risk-mitigating mechanism, consistent with legitimacy and signaling theory. Post-Paris Agreement, however, the relationship shifts, reflecting a structural change in market dynamics: ESG factors are increasingly priced not only as risk controls but also as indicators of transition readiness and long-term resilience. This transformation aligns with global climate policy developments and disclosure standards such as TCFD, which have amplified the financial materiality of ESG information.

These findings yield practical implications for multiple stakeholders. Asset managers should integrate ESG information and idiosyncratic risk into their selection frameworks to enhance risk-adjusted performance. ESG rating agencies are encouraged to incorporate firm-specific volatility into their methodologies to more accurately quantify corporate sustainability. Policymakers should promote standardized ESG disclosure frameworks to reduce information asymmetries, improve data comparability, and lower the cost-of-capital.

For firms, these findings highlight the strategic imperative of integrating ESG into core business models and reporting frameworks to secure investor confidence and optimize capital costs. For portfolio managers and investors, the results reinforce the need to incorporate ESG metrics into risk models and asset allocation strategies, recognizing their dual role in mitigating firm-specific risk and capturing transition opportunities. Ultimately, ESG is no longer optional; it is a quantifiable driver of risk-adjusted performance and a cornerstone of sustainable value creation in a post-Paris financial ecosystem.

While this study provides a robust framework for integrating ESG factors and idiosyncratic risk into asset pricing models, several avenues remain open for future exploration. First, the dynamic nature of ESG ratings, subject to changes in disclosure practices, regulatory environments, and stakeholder expectations, warrants the development of time-varying models that capture ESG momentum and its impact on risk sensitivities. Second, future research could explore non-linear relationships between ESG scores and the sensitivity coefficient $\Gamma_{S,t}$, potentially using machine learning techniques or regime-switching models to uncover threshold effects or structural breaks. Third, expanding the analysis to cross-country datasets would allow for the examination of institutional and cultural differences in ESG integration and their implications for asset pricing. Additionally, incorporating alternative ESG metrics, such as controversy scores or sentiment-based indicators, may offer deeper insights into how qualitative aspects of sustainability influence firm-level risk. Finally, future work could investigate the role of ESG in shaping investor behavior under uncertainty, particularly in the context of climate risk, social unrest, or governance crises, thereby enriching the behavioral foundations of sustainable finance.

Finally, our analysis motivates further research into the heterogeneity among ESG rating providers and the quality of their assessments. A deeper understanding of the methodologies underlying different ESG data sources could enhance the rigor of risk-return analyses. Moreover, our findings support efforts towards standardized ESG rating methodologies, fostering convergence rather than the current divergence, thus improving the reliability and comparability of ESG-related investment decisions. This research bridges theoretical insights into constrained diversification with practical integration of ESG in financial markets. It advocates for further investigation into the temporal variation of the IEP and the methodological divergence among ESG providers, paving the way for more reliable and responsible investing paradigms.

References

[1] Sakhr Bani-Khaled, Graça Azevedo, and Jonas Oliveira. Environmental, social, and governance (esg) factors and firm value: A systematic literature review of theories and empirical evidence. *AMS Review*, pages 1–33, 2025.

[2] Felippe Aparecido Cippiciani, José Roberto Ferreira Savoia, Frédéric de Mariz, and Daniel Reed Bergmann. Sustainability practices, corporate value, and financial risk: Is there an academic consensus? a systematic bibliometric review. *Journal of Risk and Financial Management*, 18(10):536, 2025.

[3] Beat Reber, Agnes Gold, and Stefan Gold. Esg disclosure and idiosyncratic risk in initial public offerings. *Journal of Business Ethics*, 179(3):867–886, 2022.

[4] Guido Giese, Linda-Eling Lee, Dimitris Melas, Zoltán Nagy, and Laura Nishikawa. Foundations of esg investing: How esg affects equity valuation, risk, and performance. *Journal of portfolio management*, 45(5):69–83, 2019.

[5] Robert C Merton et al. A simple model of capital market equilibrium with incomplete information. 1987.

[6] Huafeng Chen, Shaojun Chen, and Feng Li. Empirical Investigation of An Equity Pairs Trading Strategy. *Working Paper, Texas A & M University, University of British Columbia, and University of Michigan*, 2012.

[7] Dayong Liu, Kaiyuan Gu, and Wenhua Hu. Esg performance and stock idiosyncratic volatility. *Finance Research Letters*, page 104393, 2023.

[8] Lasse Heje Pedersen, Shaun Fitzgibbons, and Lukasz Pomorski. Responsible investing: The esg-efficient frontier. *Journal of Financial Economics*, 142(2):572–597, 2021.

[9] Jooh Lee and Kyungyeon Koh. Esg performance and firm risk in the us financial firms. *Review of Financial Economics*, 42(3):328–344, 2024.

[10] Rajnish Mehra, Sunil Wahal, and Daruo Xie. Is idiosyncratic risk conditionally priced? *Quantitative Economics*, 12(2):625–646, 2021.

[11] Maximilian Görgen, Andrea Jacob, Martin Nerlinger, Ryan Riordan, Martin Rohleder, and Marco Wilkens. Carbon risk. *Available at SSRN 2930897*, 2020.

[12] Philipp Krüger. Corporate goodness and shareholder wealth. *Journal of financial economics*, 115(2):304–329, 2015.

[13] Alex Edmans. Does the stock market fully value intangibles? employee satisfaction and equity prices. *Journal of Financial economics*, 101(3):621–640, 2011.

[14] Ping-Sheng Koh, Cuili Qian, and Heli Wang. Firm litigation risk and the insurance value of corporate social performance. *Strategic Management Journal*, 35(10):1464–1482, 2014.

[15] Harrison Hong and Marcin Kacperczyk. The price of sin: The effects of social norms on markets. *Journal of financial economics*, 93(1):15–36, 2009.

[16] Darren D Lee and Robert W Faff. Corporate sustainability performance and idiosyncratic risk: A global perspective. *Financial Review*, 44(2):213–237, 2009.

[17] Mark M Carhart. On persistence in mutual fund performance. *The Journal of finance*, 52(1):57–82, 1997.

[18] Eugene F Fama and Kenneth R French. Common risk factors in the returns on stocks and bonds. *Journal of financial economics*, 33(1):3–56, 1993.

[19] Bruce N Lehmann. *Fischer black on valuation: the CAPM in general equilibrium*. Oxford University Press, Inc., New York, NY, 2005.

[20] Mitchell A Petersen. Estimating standard errors in finance panel data sets: Comparing approaches. *The Review of financial studies*, 22(1):435–480, 2008.

[21] M Reza Bradrania, Maurice Peat, and Stephen Satchell. Liquidity costs, idiosyncratic volatility and expected stock returns. *International Review of Financial Analysis*, 42:394–406, 2015.

[22] Xi Li, Rodney N Sullivan, and Luis Garcia-Feijóo. The low-volatility anomaly: Market evidence on systematic risk vs. mispricing. *Financial Analysts Journal*, 72(1):36–47, 2016.

[23] Rui Albuquerque, Yrjö Koskinen, and Chendi Zhang. Corporate social responsibility and firm risk: Theory and empirical evidence. *Management Science*, 65(10):4451–4469, 2019.

[24] Gunnar Friede, Timo Busch, and Alexander Bassen. Esg and financial performance: aggregated evidence from more than 2000 empirical studies. *Journal of Sustainable Finance & Investment*, 5(4):210–233, 2015.

[25] Robert G Eccles, Ioannis Ioannou, and George Serafeim. The impact of corporate sustainability on organizational processes and performance. *Management Science*, 60(11):2835–2857, 2014.

[26] Ramón Bermejo Climent, Isabel Figuerola-Ferretti Garrigues, Ioannis Paraskevopoulos, and Alvaro Santos. Esg disclosure and portfolio performance. *Risks*, 9(10):172, 2021.

[27] Amir Amel-Zadeh and George Serafeim. Why and how investors use esg information: Evidence from a global survey. *Financial Analysts Journal*, 74(3):87–103, 2018.

[28] Gerhard Halbritter and Gregor Dorfleitner. The wages of social responsibility—where are they? a critical review of esg investing. *Review of Financial Economics*, 26:25–35, 2015.

[29] Roland Bénabou and Jean Tirole. Individual and corporate social responsibility. *Economica*, 77(305):1–19, 2010.

[30] Olga Hawn and Ioannis Ioannou. Mind the gap: The interplay between external and internal actions in the case of corporate social responsibility. *Strategic management journal*, 37(13):2569–2588, 2016.

[31] Sakis Kotsantonis, Chris Pinney, and George Serafeim. Esg integration in investment management: Myths and realities. *Journal of Applied Corporate Finance*, 28(2):10–16, 2016.

[32] Feifei Li and Ari Polychronopoulos. What a difference an esg ratings provider makes. *Research affiliates*, 24:1–15, 2020.

[33] Wolfgang Breuer, Torbjörn Müller, David Rosenbach, and Astrid Salzmann. Corporate social responsibility, investor protection, and cost of equity: A cross-country comparison. *Journal of Banking & Finance*, 96:34–55, 2018.

[34] Elisa Aracil and Ibrahim Sancak. *Essential Concepts of Sustainable Finance: An AZ Guide*. Taylor & Francis, 2023.

[35] Christophe Revelli. Socially responsible investing (sri): From mainstream to margin? *Research in International Business and Finance*, 39:711–717, 2017.

[36] Caroline Flammer. Corporate green bonds. *Journal of financial economics*, 142(2):499–516, 2021.

[37] Vanessa C Burbano. The demotivating effects of communicating a social-political stance: Field experimental evidence from an online labor market platform. *Management Science*, 67(2):1004–1025, 2021.

[38] Alan Gregory, Rajesh Tharyan, and Julie Whittaker. Corporate social responsibility and firm value: Disaggregating the effects on cash flow, risk and growth. *Journal of business ethics*, 124:633–657, 2014.

[39] Simin Chen, Yu Song, and Peng Gao. Environmental, social, and governance (esg) performance and financial outcomes: Analyzing the impact of esg on financial performance. *Journal of Environmental Management*, 345:118829, 2023.

[40] Wang Yuer. Research on the esg investment from the perspective of corporate social responsibilities. *Advances in Economics, Management and Political Sciences*, 2023.

[41] L'uboš Pástor, Robert F Stambaugh, and Lucian A Taylor. Dissecting green returns. *Journal of financial economics*, 146(2):403–424, 2022.

[42] Xiaoli Zhao. Is esg a new trick for the chinese stock market? an empirical analysis of the relationship between corporate esg and financial performance. *Advances in Economics, Management and Political Sciences*, 28:1–12, 11 2023.

[43] Beiting Cheng, Ioannis Ioannou, and George Serafeim. Corporate social responsibility and access to finance. *Strategic management journal*, 35(1):1–23, 2014.

[44] Gordon L. Clark, Andreas Feiner, and Michael Viehs. From the stockholder to the stakeholder: How sustainability can drive financial outperformance, 2015. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2508281.

[45] Jennifer J Griffin and John F Mahon. The corporate social performance and corporate financial performance debate: Twenty-five years of incomparable research. *Business & society*, 36(1):5–31, 1997.

[46] George Serafeim. Social-impact efforts that create real value. *Harvard Business Review*, 98(5):38–48, 2020.

[47] Kenneth E Aupperle, Archie B Carroll, and John D Hatfield. social resonsilty and proftabilty. 1985.

[48] Alan Murray, Yongqiang Gao, and Jun Chen. Size, esg performance, and financial performance. *Asian Review of Accounting*, 19(4):386–395, 2011.

[49] Mohamad Iruwan Ghuslan, Romlah Jaffar, Norman Mohd Saleh, and Mohd Hasimi Yaacob. Corporate governance and corporate reputation: The role of environmental and social reporting quality. *Sustainability*, 13(18):10452, 2021.

[50] Simon Gloßner. Esg risks and the cross-section of stock returns. *Finance Meetings*, 2017.

[51] Bonnie Buchanan, Cathy Xuying Cao, and Chongyang Chen. Corporate social responsibility, firm value, and influential institutional ownership. *Journal of Corporate Finance*, 52:73–95, 2018.

[52] Alberta Di Giuli and Leonard Kostovetsky. Are red or blue companies more likely to go green? politics and corporate social responsibility. *Journal of Financial Economics*, 111(1):158–180, 2014.

[53] Eugene F Fama and James D MacBeth. Risk, return, and equilibrium: Empirical tests. *Journal of political economy*, 81(3):607–636, 1973.

[54] Ching-Hung Chang, Sheng-Syan Chen, Yan-Shing Chen, and Shu-Cing Peng. Commitment to build trust by socially responsible firms: Evidence from cash holdings. *Journal of Corporate Finance*, 56:364–387, 2019.

[55] Marcia Millon Cornett, Otgontsetseg Erhemjamts, and Hassan Tehranian. Greed or good deeds: An examination of the relation between corporate social responsibility and the financial performance of us commercial banks around the financial crisis. *Journal of Banking & Finance*, 70:137–159, 2016.

[56] Jacquelyn E Humphrey, Darren D Lee, and Yaokan Shen. Does it cost to be sustainable? *Journal of Corporate Finance*, 18(3):626–639, 2012.

[57] Indrani De and Michelle Clayman. The benefits of socially responsible investing: An active manager's perspective. *Journal of Investing (Jul. 9, 2014), available at http://ssrn.com/abstract*, 2464204, 2014.

[58] Ting-Kun Liu. Esg, corporate social responsibility and business effectiveness in taiwan's banking industry: Cost and risk perspectives. *Asian Economic and Financial Review*, 14(1):12–28, 2024.

[59] Souad Lajili Jarjir, Aya Nasreddine, and Marc Desban. Corporate social responsibility as a common risk factor. *Global Finance Journal*, 52:100577, 2022.

[60] Patrick Bolton and Marcin Kacperczyk. Do investors care about carbon risk? *Journal of financial economics*, 142(2):517–549, 2021.

[61] Patrick Bolton and Marcin Kacperczyk. Are carbon emissions associated with stock returns? comment. *Review of Finance*, 28(1):107–109, 2024.

[62] Patrick Bolton and Marcin Kacperczyk. Global pricing of carbon-transition risk. *The Journal of Finance*, 78(6):3677–3754, 2023.

[63] L'uboš Pástor, Robert F Stambaugh, and Lucian A Taylor. Sustainable investing in equilibrium. *Journal of financial economics*, 142(2):550–571, 2021.

[64] Amir Gholami, John Sands, and Syed Shams. Corporates' sustainability disclosures impact on cost of capital and idiosyncratic risk. *Meditari Accountancy Research*, 2022.

[65] Burton G Malkiel and Yexiao Xu. Idiosyncratic risk and security returns. *University of Texas at Dallas (November 2002)*, 2002.

[66] Francois Boutin-Dufresne and Patrick Savaria. Corporate social responsibility and financial risk. *The Journal of investing*, 13(1):57–66, 2004.

[67] Beat Reber, Agnes Gold, and Stefan Gold. Esg disclosure and idiosyncratic risk in initial public offerings. *Journal of Business Ethics*, pages 1–20, 2021.

[68] Woei Chyuan Wong, Jonathan A Batten, Shamsul Bahrain Mohamed-Arshad, Sabariah Nordin, Azira Abdul Adzis, et al. Does esg certification add firm value? *Finance Research Letters*, 39:101593, 2021.

[69] Irene M Herremans, Parporn Akathaporn, and Morris McInnes. An investigation of corporate social responsibility reputation and economic performance. *Accounting, organizations and society*, 18(7-8):587–604, 1993.

[70] Burton G Malkiel and Yexiao Xu. Risk and return revisited. *Journal of Portfolio Management*, 23(3):9, 1997.

[71] Eugene F. Fama and Kenneth R. French. The Cross-Section of Expected Stock Returns. *Journal of Finance*, 47(2):427–465, 1992.

[72] Zacharias Sautner, Laurence Van Lent, Grigory Vilkov, and Ruishen Zhang. Pricing climate change exposure. *Management Science*, 69(12):7540–7561, 2023.

[73] Ian WR Martin and Christian Wagner. What is the expected return on a stock? *The Journal of Finance*, 74(4):1887–1929, 2019.

[74] Fousseni Chabi-Yo, Chukwuma Dim, and Grigory Vilkov. Generalized bounds on the conditional expected excess return on individual stocks. *Management Science*, 69(2):922–939, 2023.

[75] Leonardo Becchetti, Rocco Ciciretti, and Iftekhar Hasan. Corporate social responsibility, stakeholder risk, and idiosyncratic volatility. *Journal of Corporate Finance*, 35:297–309, 2015.

[76] Mozaffar Khan, George Serafeim, and Aaron Yoon. Corporate sustainability: First evidence on materiality. *The accounting review*, 91(6):1697–1724, 2016.

[77] Jody Grewal, Clarissa Hauptmann, and Georgios Serafeim. Stock price synchronicity and material sustainability information. 2017.

[78] Karl V Lins, Henri Servaes, and Ane Tamayo. Social capital, trust, and firm performance: The value of corporate social responsibility during the financial crisis. *the Journal of Finance*, 72(4):1785–1824, 2017.

[79] Francesco Pistolesi and Emanuele Teti. Shedding light on the relationship between esg ratings and systematic risk. *Finance Research Letters*, 60:104882, 2024.

[80] Adrian Cheung. Corporate social responsibility and corporate cash holdings. *Journal of corporate finance*, 2016.

[81] Sudheer Chava, Jeong Ho John Kim, and Jaemin Lee. Risk, return, and environmental and social ratings. *HKIMR Applied Research Paper*, (03), 2021.

[82] Andreas GF Hoepner, Ioannis Oikonomou, Zacharias Sautner, Laura T Starks, and Xiaoyan Zhou. Esg shareholder engagement and downside risk. 2018.

[83] Hoje Jo and Haejung Na. Does csr reduce firm risk? evidence from controversial industry sectors. *Journal of business ethics*, 110(4):441–456, 2012.

[84] Sajid M Chaudhry, Xihui Haviour Chen, Rizwan Ahmed, and Muhammad Ali Nasir. Risk modelling of esg (environmental, social, and governance), healthcare, and financial sectors. *Risk Analysis*, 2023.

[85] Hemendra Gupta and Rashmi Chaudhary. An analysis of volatility and risk-adjusted returns of esg indices in developed and emerging economies. *Risks*, 11(10):182, 2023.

[86] Binh Do, Robert Faff, and Kais Hamza. A New Approach to Modeling and Estimation for Pairs Trading. In *Proceedings of 2006 Financial Management Association European Conference*, pages 87–99. Citeseer, 2006.

[87] Wei Xiong. Convergence Trading with Wealth Effects: An Amplification Mechanism in Financial Markets. *Journal of Financial Economics*, 62(2):247–292, 2001.

[88] David C Broadstock, Kalok Chan, Louis TW Cheng, and Xiaowei Wang. The role of esg performance during times of financial crisis: Evidence from covid-19 in china. *Finance research letters*, 38:101716, 2021.

[89] Hans Lööf, Maziar Sahamkhadam, and Andreas Stephan. Is corporate social responsibility investing a free lunch? the relationship between esg, tail risk, and upside potential of stocks before and during the covid-19 crisis. *Finance Research Letters*, 46:102499, 2022.

[90] Yujin Kim and Su-In Kim. Environmental risk and credit ratings, and the moderating effect of market competition. *International Journal of Environmental Research and Public Health*, 19(9):5341, 2022.

[91] Ga-Young Jang, Hyoung-Goo Kang, Ju-Yeong Lee, and Kyounghun Bae. Esg scores and the credit market. *Sustainability*, 12(8):3456, 2020.

[92] Mauro Sciarelli, Giovanni Landi, Lorenzo Turriziani, and Anna Prisco. Does corporate sustainability mitigate firm risk? an empirical analysis on s&p 500 controversial companies. *Social Responsibility Journal*, (ahead-of-print), 2023.

[93] Remmer Sassen, Anne-Kathrin Hinze, and Inga Hardeck. Impact of esg factors on firm risk in europe. *Journal of business economics*, 86(8):867–904, 2016.

[94] William F Sharpe. Capital asset prices: A theory of market equilibrium under conditions of risk. *The journal of finance*, 19(3):425–442, 1964.

[95] John Lintner. Security prices, risk, and maximal gains from diversification. *The journal of finance*, 20(4):587–615, 1965.

[96] Amit Goyal and Pedro Santa-Clara. Idiosyncratic risk matters! *The Journal of Finance*, 58(3):975–1007, 2003.

[97] John Y Campbell, Martin Lettau, Burton G Malkiel, and Yexiao Xu. Have individual stocks become more volatile? an empirical exploration of idiosyncratic risk. *The journal of finance*, 56(1):1–43, 2001.

[98] Federico M Bandi and Jeffrey R Russell. Separating microstructure noise from volatility. *Journal of Financial Economics*, 79(3):655–692, 2006.

[99] Dion Bongaerts, Richard Roll, Dominik Rösch, Mathijs van Dijk, and Darya Yuferova. How do shocks arise and spread across stock markets? a microstructure perspective. *Management Science*, 68(4):3071–3089, 2022.

[100] Jose Pizarro and Eduardo Schwartz. Fisheries optimal harvest under price and biomass uncertainty. *Environmental and Resource Economics*, 78(1):147–175, 2021.

[101] Choong Tze Chua, Jeremy Goh, and Zhe Zhang. Expected volatility, unexpected volatility, and the cross-section of stock returns. *Journal of Financial Research*, 33(2):103–123, 2010.

[102] Fangjian Fu. Idiosyncratic risk and the cross-section of expected stock returns. *Journal of financial Economics*, 91(1):24–37, 2009.

[103] Andrew Ang, Robert J Hodrick, Yuhang Xing, and Xiaoyan Zhang. The cross-section of volatility and expected returns. *The Journal of Finance*, 61(1):259–299, 2006.

[104] Stanislav Bozhkov, Habin Lee, Uthayasankar Sivarajah, Stella Despoudi, and Monomita Nandy. Idiosyncratic risk and the cross-section of stock returns: the role of mean-reverting idiosyncratic volatility. *Annals of Operations Research*, 294:419–452, 2020.

[105] Andrew Ang, Robert J Hodrick, Yuhang Xing, and Xiaoyan Zhang. High idiosyncratic volatility and low returns: International and further us evidence. *Journal of Financial Economics*, 91(1):1–23, 2009.

[106] Seha M Tinic and Richard R West. Risk, return, and equilibrium: A revisit. *Journal of Political Economy*, 94(1):126–147, 1986.

[107] Turan G Bali, Nusret Cakici, Xuemin Yan, and Zhe Zhang. Does idiosyncratic risk really matter? *The Journal of Finance*, 60(2):905–929, 2005.

[108] Juliana Malagon, David Moreno, and Rosa Rodríguez. The idiosyncratic volatility anomaly: Corporate investment or investor mispricing? *Journal of Banking & Finance*, 60:224–238, 2015.

[109] Yexiao Xu and Burton G Malkiel. Idiosyncratic risk and security returns. *Available at SSRN 255303*, 2004.

[110] David Easley and Maureen O'Hara. Market microstructure. *Handbooks in operations research and management science*, 9:357–383, 1995.

[111] Nicholas Barberis, Andrei Shleifer, and Jeffrey Wurgler. Comovement. *Journal of financial economics*, 75(2):283–317, 2005.

[112] Robin Greenwood, Samuel Hanson, and Andrei Shleifer. Asset price dynamics in partially segmented markets. *The Review of Financial Studies*, 31(9):3307–3343, 2018.

[113] Jonathan Brogaard, Terrence Hendershott, and Ryan Riordan. High-frequency trading and price discovery. *The Review of Financial Studies*, 27(8):2267–2306, 2014.

[114] Albert S Kyle. Continuous auctions and insider trading. *Econometrica: Journal of the Econometric Society*, pages 1315–1335, 1985.

[115] Joel Hasbrouck. Measuring the information content of stock trades. *The Journal of Finance*, 46(1):179–207, 1991.

[116] David Easley, Nicholas M Kiefer, Maureen O'hara, and Joseph B Paperman. Liquidity, information, and infrequently traded stocks. *The Journal of Finance*, 51(4):1405–1436, 1996.

[117] Zhanhui Chen and Ralitsa Petkova. Does idiosyncratic volatility proxy for risk exposure? *The Review of Financial Studies*, 25(9):2745–2787, 2012.

[118] A. Craig MacKinlay. Event studies in economics and finance. *Journal of Economic Literature*, 35(1):13–39, 1997.

[119] John Y Campbell, Andrew W Lo, and A Craig MacKinlay. *The Econometrics of Financial Markets*. Princeton University Press, 1997.

[120] Eugene F Fama and Kenneth R French. Multifactor explanations of asset pricing anomalies. *The Journal of Finance*, 51(1):55–84, 1996.

[121] Clifford S Asness, Tobias J Moskowitz, and Lasse Heje Pedersen. Value and momentum everywhere. *The Journal of Finance*, 68(3):929–985, 2013.

[122] Kewei Hou, Chen Xue, and Lu Zhang. Digesting anomalies: An investment approach. *The Review of Financial Studies*, 28(3):650–705, 2015.

[123] Bruce D Grundy and Spencer J Martin. Understanding the nature of the risks and the source of the rewards to momentum investing. *The Review of Financial Studies*, 14(1):29–78, 2001.

[124] Harrison Hong, Terence Lim, and Jeremy C Stein. Bad news travels slowly: Size, analyst coverage, and the profitability of momentum strategies. *The Journal of Finance*, 55(1):265–295, 2000.

[125] Narasimhan Jegadeesh and Sheridan Titman. Profitability of momentum strategies: An evaluation of alternative explanations. *The Journal of Finance*, 56(2):699–720, 2001.

[126] Pedro Barroso and Pedro Santa-Clara. Momentum has its moments. *Journal of Financial Economics*, 116(1):111–120, 2015.

[127] Narasimhan Jegadeesh and Sheridan Titman. Momentum. *Annu. Rev. Financ. Econ.*, 3(1):493–509, 2011.

[128] Allen Goss and Gordon S Roberts. The impact of corporate social responsibility on the cost of bank loans. *Journal of banking & finance*, 35(7):1794–1810, 2011.

[129] Emirhan Ilhan, Zacharias Sautner, and Grigory Vilkov. Carbon tail risk. *The Review of Financial Studies*, 34(3):1540–1571, 2021.

[130] Lars Peter Hansen and Scott F Richard. The role of conditioning information in deducing testable restrictions implied by dynamic asset pricing models. *Econometrica: Journal of the Econometric Society*, pages 587–613, 1987.

[131] Michael J Brennan and Ashley W Wang. The Mispricing Return Premium. *Review of Financial Studies*, 23(9):3437–3468, 2010.

[132] Juris Dobrick, Christian Klein, and Bernhard Zwergel. Esg as risk factor. *Journal of Asset Management*, 26(1):44–70, 2025.

[133] Jan Mossin. Equilibrium in a capital asset market. *Econometrica: Journal of the econometric society*, pages 768–783, 1966.

[134] Owen A Lamont. Economic tracking portfolios. *Journal of Econometrics*, 105(1):161–184, 2001.

[135] Jules H. van Binsbergen, Xiao Han, and Alejandro Lopez-Lira. Machine learning: The term structure of earnings expectations and conditional biases. *Jacobs Levy Equity Management Center for Quantitative Financial Research Paper*, 2021.

[136] Hui Guo and Robert Savickas. Idiosyncratic volatility, stock market volatility, and expected stock returns. *Journal of Business & Economic Statistics*, 24(1):43–56, 2006.

[137] Jie Cao and Bing Han. Cross section of option returns and idiosyncratic stock volatility. *Journal of Financial Economics*, 108(1):231–249, 2013.

[138] Martijn Cremers, Michael Halling, and David Weinbaum. Aggregate jump and volatility risk in the cross-section of stock returns. *The Journal of Finance*, 70(2):577–614, 2015.

[139] Alex Edmans. The end of esg. *Financial Management*, 52(1):3–17, 2023.

[140] Robert Heinkel, Alan Kraus, and Josef Zechner. The effect of green investment on corporate behavior. *Journal of financial and quantitative analysis*, 36(4):431–449, 2001.

[141] Matthias Horn. The influence of esg ratings on idiosyncratic stock risk: The unrated, the good, the bad, and the sinners. *Schmalenbach Journal of Business Research*, 75(3):415–442, 2023.