
"Green" Asset Pricing

***Explore the relationship between ESG and the Financial Performance
of the companies in the EU***



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Abstract

This thesis examines whether sustainability is reflected in stock prices in international markets and whether firms with stronger sustainability performance show different return patterns. To do this, it draws on Thomson Reuters/Refinitiv sustainability data and uses descriptive statistics, linear time-trend regressions, post-2015 sub-period regressions, and return regressions. The analysis looks at both the overall ESG score and the three individual pillars: environmental, social, and governance.

The first set of results shows an upward trend in the overall ESG score over the full period from 2002 to 2022. The three individual pillars do not move in exactly the same way. Their trends are weaker and less consistent, which suggests that the overall improvement in sustainability performance was not evenly spread across all ESG dimensions. When the focus shifts to the post-2015 period, the increase becomes more noticeable, especially for the overall ESG score and for the environmental and social pillars. Governance, however, does not seem to follow the same stronger upward pattern.

The return regressions lead to less clear-cut conclusions. In general, higher sustainability scores are linked with slightly lower average stock returns for the overall ESG measure and also for the environmental and governance pillars. For the social pillar, the relationship is weaker and less stable. At the same time, the models explain only a small part of return variation, so the results should be interpreted with some caution.

Overall, the results suggest that sustainability matters more as a long-term firm characteristic than as a direct driver of stock prices. It may also be associated with lower expected returns, perhaps because investors place a higher value on sustainable firms, view them as less risky, or expect them to have a lower cost of capital. At the same time, the effect is not equally strong across all ESG dimensions or across all periods. In that sense, the thesis adds to the discussion between traditional asset pricing and sustainable finance by showing that the role of sustainability is present, but not uniform.

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1.Introduction

1.1.Introduction and Research Context

For more than half a century, financial economics has been shaped by how financial markets determine asset values. Asset pricing is about explaining why some investments earn higher expected returns than others and how risk is reflected into market values. The dominant view for much of the history of the field was that prices were determined only by financial factors such as expected cash flows, discount rates, and exposure to systematic risk. By contrast, non-financial issues such as social, environmental or ethical issues were generally considered to be irrelevant to valuation, either because they were difficult to observe and measure or because they were seen as unimportant to shareholders whose primary interests were financial returns.(Sharpe, 1964).

This view was clearly defined in the Capital Asset Pricing Model (CAPM). It showed that expected returns depend on systematic risk, which is measured by a security's sensitivity to the market portfolio. The main idea was that only non-diversifiable risk should be priced. This risk could be summarized in a single number: beta. The Fama-French three-factor model expanded on CAPM by adding other factors, like size and value (Fama & French, 1993), but the main principles stayed the same. When firms exposed investors to measurable financial risk, they received proper compensation through expected returns. However, when investors did not face measurable financial risk, aside from unavoidable expectations, firms did not receive proper compensation. In this way, traditional asset-pricing theory allowed little room for company behavior or wider social effects to influence stock prices unless these factors clearly changed financial fundamentals. (Fama & French, 1993).

Prior to the measurable integration of sustainability into financial markets, Corporate Social Responsibility (CSR) was the predominant framework connecting business practices with broader societal expectations. CSR posited that firms carried responsibilities that extended beyond mere profit maximization, encompassing ethical conduct, community engagement, and stakeholder protection (Carroll, 1991). Nevertheless, CSR initiatives were largely voluntary, narrative-driven, and difficult to standardize across organizations. Consequently, CSR did not become embedded in financial analysis: investors

lacked reliable means to compare CSR performance across companies, and valuation models could not effectively capture its impact on prices, expected returns, or cost of capital.

The shift happened when sustainability moved from a voluntary ethics-based concept to a more structured and measurable framework known as ESG. ESG did not replace CSR, but translated many of its underlying principles into indicators that could be disclosed, compared and incorporated into financial assessment. Companies are increasingly evaluated on metrics such as carbon emissions, labor conditions, governance quality and structure, transparency, supply-chain practices, and related dimensions. As sustainability has become quantifiable, it has also gained significant relevance for investors. Once this information began to be used systematically in investment decisions, sustainability transitioned from being merely a matter of reputation or corporate image to a meaningful driver of company valuation.

This evolution has been propelled by both market practices and regulatory interventions. An expanding body of research demonstrates that ESG performance can materially influence financial outcomes, including cost of capital, volatility, investor demand, and long-term resilience (Friede, Busch & Bassen, 2015). At the same time, regulatory initiatives and disclosure frameworks have driven firms to enhance transparency in sustainability reporting, while major institutional investors are increasingly integrating ESG criteria into portfolio construction and risk assessment. Frameworks such as the EU Taxonomy and SFDR require comprehensive disclosure of sustainability data, and institutional investors are proactively utilizing ESG screening, exclusionary filters, and best-in-class strategies. As a result, firms with weaker sustainability profiles often encounter higher financing costs or diminished investor interest, whereas those with robust ESG performance are rewarded with more favorable market perception and reduced perceived risk (Bolton & Kacperczyk, 2021).

All these developments together point to a deep change in the logic of asset pricing. Sustainability is no longer an external or ethical issue but it is increasingly analyzed as a characteristic that may impact the way securities are priced in the financial markets. That leaves a new set of questions for modern finance. If sustainability impacts valuation, how is it manifested in expected returns? Do ESG strong firms always trade at a premium ("green premium") because they are perceived as safer or more desirable? Or do sustainable firms earn

higher returns because investors need to be compensated for the costs and uncertainty of sustainability-related investments?

These considerations assume even greater significance in an international context. Today's financial markets are global, not merely domestic, and capital flows across borders with far fewer frictions than in previous eras. Large asset managers routinely allocate capital internationally, while sustainability ratings and disclosure practices are now applied across diverse jurisdictions. In this landscape, a firm listed in one country may still be shaped by investor preferences, reporting standards, or regulatory developments originating elsewhere. Consequently, sustainability has evolved beyond a domestic corporate concern and is increasingly integrated into a broader international pricing mechanism.

Against this background, the present thesis investigates how sustainability performance is reflected in asset pricing across international stock markets and whether firms with strong ESG profiles are systematically priced differently from those with weaker sustainability performance. More specifically, the analysis differentiates between financial outcomes (returns, risk) and sustainability indicators (ESG scores, carbon exposure) and examines whether the former are increasingly influenced by the latter. This wider research environment naturally evolves into the first core dimension of the thesis: the role of sustainability in international stock pricing.

The motivation for this study is the growing overlap between financial and sustainability performance. For much of the last century, investors were concerned with financial performance and ethics with sustainability. Today that separation is breaking down. The worse the sustainability performance, the more firms could face regulatory exposure, public backlash, stranded-asset risk or reputational damage, all of which can have an impact on returns and valuation. At the same time, companies with strong ESG performance may benefit from lower risk, greater investor demand and strategic resilience. It is still an open empirical question whether these effects are consistently priced and whether they make sustainability "worth it" for firms in financial terms.

1.2 Asset Pricing Effects in international stock markets

The international dimension of asset pricing is fundamental to understanding the growing significance of sustainability in modern finance. In globally integrated markets, investors assess firms beyond the confines of individual national economies. They compare companies across countries, sectors, and institutional settings, frequently employing standardized frameworks for risk assessment and portfolio allocation. Consequently, sustainability-related information can affect valuation in ways that surpass domestic market influences.

International stock markets provide a robust context for examining the pricing effects of sustainability. Countries differ in regulatory strength, disclosure quality, investor protection, governance standards, and environmental policy. These institutional differences shape how investors interpret environmental, social, and governance (ESG) information and influence the degree to which sustainability characteristics are incorporated into stock prices. Consistent sustainability effects across a broad international sample would suggest that ESG considerations are integrated into general pricing mechanisms rather than being limited to specific markets or temporary trends. Conversely, substantial variation across markets would imply that sustainability is priced conditionally, contingent upon market structure and institutional context.

From a theoretical perspective, sustainability influences stock prices through several mechanisms. It can increase expected future cash flows by enhancing operational efficiency, ensuring regulatory compliance, strengthening corporate reputation, or improving strategic positioning. Additionally, sustainability may affect discount rates if investors view sustainable firms as less risky, more resilient, or more attractive over the long term. Evolving investor preferences also play a significant role: as institutional investors increasingly prioritize companies with strong ESG profiles, these firms may benefit from a lower cost of capital and higher market valuations, independent of short-term accounting profitability. This perspective underscores the integration of financial logic with broader values in contemporary investment decision-making.

These channels underscore the growing importance of sustainability in the broader asset-pricing debate. Moreover, they highlight the international context as a crucial element of the analysis. In global markets, where information, capital, and investor expectations readily cross borders, sustainability is

increasingly reflected in asset prices. This trend results not only from changes within firms but also from the evolving structure of the financial system. This observation brings the discussion to the second major issue of the thesis: whether sustainability is linked only to ethical and reputational concerns, or whether it also affects financial performance in a meaningful and measurable way.

1.3 Sustainability vs Financial Performance

The relationship between sustainability and financial performance remains a subject of considerable debate in the literature. Numerous studies suggest that sustainability can enhance firm value by reducing regulatory risk, strengthening stakeholder relations, supporting long-term strategic objectives, and lowering financing frictions. According to this perspective, firms with stronger environmental, social, and governance (ESG) profiles may experience lower volatility, reduced downside risk, and a decreased cost of capital. As a result, financial markets may assign higher valuations to these firms, even if their expected returns are lower due to their perceived safety.

On the other hand, sustainability may also involve substantial costs. Investments in cleaner technologies, disclosure systems, labor standards, governance reforms and transition strategies can be expensive, especially in the short run. If these expenditures reduce profitability or create uncertainty, investors may demand higher expected returns from sustainable firms rather than rewarding them with a pricing premium. In that case, sustainability would not necessarily be associated with lower expected returns or better market valuation. Instead, it could represent a source of cost and uncertainty that markets price differently.

Therefore, the central issue is not whether sustainability is inherently beneficial or detrimental to firms, but whether it is financially material and, if so, in what manner. A firm may achieve high sustainability ratings without generating superior stock returns. Alternatively, it may experience a lower cost of capital or increased investor demand without immediate improvements in short-term profitability. This underscores the importance of distinguishing

among various dimensions of financial performance, including valuation, risk, financing conditions, and stock returns. Furthermore, the impact of sustainability may differ across the environmental, social, and governance pillars, rather than manifesting uniformly across all dimensions.

This thesis moves beyond viewing sustainability solely as an ethical or managerial concept. It investigates whether sustainability factors are associated with market outcomes, particularly stock returns and pricing, and whether financial markets account for sustainability when determining security prices.

Viewed from this perspective, the tension between sustainability and financial performance constitutes the central empirical motivation for this study. If sustainability is now integrated into the information set considered by investors, its influence should be observable in empirical data. However, the direction and magnitude of this influence remain uncertain and require empirical testing rather than assumption. This context establishes the research gap and purpose of the thesis.

1.4 Research Gap and Purpose

Environmental, Social, and Governance (ESG) issues are now a major focus in both academic finance and investment practice. While many studies examine the relationship between ESG and firm quality, profitability, and other outcomes, fewer investigate whether financial markets incorporate sustainability into asset pricing. This distinction is important because correlation alone does not demonstrate that markets consistently reward or penalize sustainability through returns, valuations, or financing terms. This research seeks to provide clear guidance to scholars and practitioners on the practical implications of ESG integration.

A second gap concerns the lack of clear consensus in the empirical evidence. Some studies argue that investing in ESG is associated with lower risk, lower cost of capital and stronger long-term outcomes. Others find weaker, mixed or context-dependent effects. This inconsistency may reflect differences in methodology, sample design, market structure, time period and the way sustainability itself is measured. It may also suggest that sustainability is

not a single uniform factor but a multidimensional characteristic whose pricing effects differ across the environmental, social and governance pillars.

A further issue concerns the role of time. If sustainability has become more relevant because disclosure has improved and regulation has become stronger then the financial importance of ESG may have intensified in recent years rather than remaining stable throughout the entire sample period. This means that it is not enough to study only the cross-sectional relation between sustainability and financial outcomes. It is also necessary to examine how sustainability indicators evolve through time and whether later periods display stronger patterns than earlier ones.

These gaps shape the purpose of the present study. The thesis investigates whether sustainability-related variables are associated with asset-pricing effects in international stock markets and whether firms with stronger ESG performance are priced differently from firms with weaker sustainability profiles. It also examines whether ESG measures display stronger dynamics in more recent years, particularly during the period in which sustainability regulation and investor attention became more pronounced. In this way, the thesis aims to connect the traditional asset-pricing framework with the growing literature on sustainable finance and to clarify whether sustainability now functions as part of the broader pricing mechanism of international equity markets.

The expected contribution is therefore threefold. First, the thesis links the theory of asset pricing with contemporary sustainability debates. Second, it distinguishes between the aggregate ESG measure and the separate E, S, and G pillars, allowing for a more nuanced interpretation of which dimensions appear most financially relevant. Third, it combines trend analysis with return regressions in order to examine both the evolution of sustainability performance and its relation to stock-market outcomes. With this research purpose established, the structure of the thesis can now be outlined clearly.

1.5 Structure of the thesis

The remainder of the thesis is organized as follows. Chapter 2 reviews the relevant theoretical and empirical literature on asset pricing, ESG investing and the relationship between sustainability and financial performance. Chapter 3 presents the corporate sustainability reporting framework. Chapter 4 presents the data, sample construction and methodological framework used in the empirical analysis. Additionally, Chapter 4 reports the empirical findings, including descriptive evidence, time-trend analysis of ESG-related variables and regressions linking sustainability measures to stock returns. Finally, the concluding chapter discusses the main findings, outlines their implications for theory and practice, and highlights the limitations of the study together with the possible directions for future research.

2. Asset Pricing Models and Anomalies

2.1 Overview of asset pricing models

Asset pricing theory is concerned with understanding why different assets command different expected returns and identifying which types of risk are rewarded by the market. The literature centers on a key question: How do investors determine appropriate compensation for risk? Research has progressed from single-factor models focused on market risk to more complex multi-factor and production-based frameworks that consider firm characteristics, investment behavior, and profitability. This evolution is significant because it highlights that pricing is influenced not only by market exposure, but also by a company's unique attributes and, increasingly, by non-financial considerations such as sustainability. By exploring these dimensions, asset pricing theory continues to offer valuable insights for both academics and practitioners seeking to navigate today's dynamic financial landscape.

Asset pricing models in finance have changed a lot over time. Initially, these models emphasized diversification and systematic risk. Later studies showed that market beta alone does not fully explain differences in returns. Researchers responded to observed anomalies by introducing additional factors to better

explain asset returns. This progression created the intellectual foundation for corresponding ESG-related variables as potentially proceed characteristics. In that sense, sustainability enters the related variables as potentially proceed characteristics.

2.1.1 From Markowitz to CAPM

Modern portfolio theory begins with Markowitz (1952), who demonstrated that investors should evaluate securities as part of a portfolio rather than in isolation. His key insight was that diversification can eliminate idiosyncratic risk, meaning that not all risk should be rewarded in expected returns. Only non-diversifiable, systematic risk should matter for pricing.

Building on this framework, Sharpe (1964) developed the Capital Asset Pricing Model (CAPM), the first formal equilibrium model linking expected return to systematic risk. CAPM reduces the pricing problem to a single variable, beta, which measures the sensitivity of an asset's return to movements in the market portfolio. Under this model, the market portfolio is the only priced source of risk, while firm-specific risk is assumed to be diversifiable and therefore irrelevant for expected return.

The contribution of the CAPM was foundational. It offered a clean and elegant framework for cost-of-capital estimation, portfolio evaluation and risk-return analysis. However, empirical research quickly revealed its limitations. Assets with similar beats often produced very different returns and several return patterns could not be reconciled with the model. CAPM also relied on a narrow view of risk, one that excluded firm characteristics, behavioural effects and non-financial dimensions of performance. These limitations created the space for more elaborate asset pricing models.

2.1.2 The Fama-French Three-Factor Model

By the early 1990s, researchers had documented persistent anomalies that CAPM could not explain, especially the size premium and the value premium. Small firms tended to earn higher returns than large firms, and firms with high

book-to-market ratios often outperformed growth firms. Fama and French (1993) responded by extending the CAPM into a Three-Factor Model that added size (SMB) and value (HML) to the market factor.

This model represented an important step forward because it acknowledged that market beta is not sufficient to explain cross-sectional differences in returns. Instead, firm characteristics can proxy for systematic risks that investors price. The success of the model in explaining return variation made it one of the most influential frameworks in empirical finance.

The broader implication of the Fama-French model is that return premia can arise from observable firm attributes, not just aggregate market movements. This is conceptually important for ESG research, because it suggests that sustainability-related characteristics might also behave like priced attributes if they are associated with risk, investor demand or firm fundamentals.

2.1.3 The Carhart Four-Factor Model

Carhart (1997) expanded the Fama-French framework by introducing momentum, which captures the tendency of recently successful stocks to continue performing well in the short term. Traditional risk factors could not fully explain momentum, which appeared to stem from behavioral factors such as investor underreaction, herding, and slow information diffusion.

Including momentum in asset pricing demonstrated that returns depend on both fundamentals and market behavior. This represented a significant departure from the strict rationality assumed by classical models.

Momentum is important for ESG research because it shows that investor preferences and market sentiment can systematically affect asset prices. If more investors start to value sustainability, demand for ESG assets could also influence prices, as momentum and other behavioral trends do.

2.1.4 The Fama-French Five-Factor Model

In 2015, Fama and French expanded their framework by adding profitability and investment, creating the Five-Factor Model. These new factors, profitability (RMW) and investment (CMA), help explain differences in how firms operate and allocate capital.

This model aligns asset pricing more closely with actual firm operations. Profitability and investment reflect business quality, management decisions, and resource allocation. More profitable or higher-investing firms typically have different expected returns, as these characteristics indicate varying risks and growth prospects.

This has clear links to ESG. This framework relates to ESG factors, as environmental efficiency, governance, and social stability can influence a firm's profitability, costs, investments, and long-term outcomes. Although ESG is not explicitly included in the Five-Factor Model, the model demonstrates that company fundamentals are important for pricing. It therefore serves as a bridge between traditional factor models and sustainability-focused approaches to explaining returns.

2.1.5 The q-Factor Model

Hou, Xue, and Zhang (2015) introduced the q-Factor Model, which grounds asset pricing in production theory. Rather than relying solely on empirical characteristics, the model identifies investment and profitability as key determinants of expected returns. Companies with high investment often experience lower expected returns due to rapid growth during periods of lower profitability, while more profitable firms may face different risk premiums.

The q-Factor approach is valuable because it uses microeconomic reasoning to explain the relevance of specific pricing factors. It links company decisions to price formation and connects market outcomes to actual business activities.

This perspective supports ESG analysis by showing how sustainability performance can influence investment decisions, efficiency, resource use, and long-term profitability. If ESG factors alter a company's fundamental economics, they can

also affect asset prices. The q-Factor model provides a clear framework for assessing the impact of sustainability on asset pricing.

2.1.6 ESG-Augmented Asset Pricing Models

Traditional asset pricing models were built on the assumption that investors care only about financial risk and return. Over the last decade, however, this assumption has come under increasing pressure. The rapid expansion of sustainable investing, improvements in ESG data quality and changes in regulation have encouraged researchers to ask whether sustainability characteristics are priced in financial markets.

A major contribution in this literature is the framework of Pastor, Stambaugh and Taylor (2019), who show that investor preferences for sustainability can create a green premium, meaning that ESG-friendly assets may have lower expected returns. In their framework, investors are willing to accept lower returns in exchange for holding greener assets, while brown assets must compensate investors with higher expected returns.

Bolton and Kacperczyk (2021) find that companies with higher carbon emissions often earn higher returns due to increased transition, regulatory, and reputational risks. As a result, emissions are viewed as both an environmental concern and a factor in asset pricing.

These studies mark a significant shift in finance. ESG is increasingly recognized not only as an ethical or reputational issue, but also as a potential source of priced risk. Researchers are now considering whether sustainability should be included in factor models alongside size, value, profitability, and investment.

2.1.7 Summary

Asset pricing models have expanded the definition of priced risk over time. CAPM initially linked systematic risk to expected return. The Fama-French models later demonstrated the relevance of firm characteristics. Momentum and q-theory

introduced behavioral and microeconomic factors. More recently, ESG-augmented models indicate that sustainability may also affect pricing.

This development is relevant for the empirical section of the thesis. It demonstrates that ESG is integrated within asset pricing theory rather than being distinct from it. ESG explains differences in returns by highlighting specific firm characteristics. Therefore, later chapters use established theory rather than treating ESG as a separate concept.

2.2 Overview of asset pricing effects

Sustainability is now a key factor in how companies are classified and valued in financial markets. Researchers distinguish green firms, with strong ESG performance, from brown firms, which have weaker sustainability records and greater environmental or transition risks. These groups differ significantly in financial characteristics, risk profiles, and pricing.

Researchers are examining whether ESG performance influences expected returns, risk, valuation, volatility, cost of capital, and access to financing. The key question is not only whether sustainability leads to better corporate behavior, but also whether financial markets price these factors. The literature indicates that markets often do, although the impact varies by context.

2.2.1 Green Firms: Stability & Lower Risk

Research consistently shows that firms with strong ESG profiles are more stable and face less downside risk. Friede, Busch and Bassen (2015), in a major meta-study, report a generally positive link between ESG and financial performance. The main takeaway is that companies effectively managing environmental, social and governance risks often have stronger internal controls and more resilient business models.

This effect is most evident during periods of market stress. Lins, Servaes, and Tamayo (2017) found that companies with strong stakeholder relationships and

robust ESG performance outperformed others during the 2008-2009 financial crisis. They note that trust is especially important in uncertain times, as investors and stakeholders are more likely to support credible, well-governed, and socially responsible firms. Additional research indicates that companies with high ESG scores typically experience lower volatility and are less impacted by major negative events. Albuquerque, Koskinen, and Zhang (2019) observe that strong ESG practices foster better customer relationships and reduce the sensitivity of cash flows to losses. Consequently, sustainability can help stabilize prices by influencing investor perceptions and enhancing operational resilience.

Green firms also tend to secure better financing terms. El Ghouli et al. (2011) found that companies with stronger ESG performance typically have a lower cost of capital. Subsequent studies indicate that transparent sustainability reporting can reduce spreads and improve access to funding. These advantages are increasingly important as firms are evaluated on the credibility of their sustainability plans.

In summary, research indicates that green firms have advantages in resilience, valuation, and financing. While not risk-free, the market may offer them lower required returns because they are viewed as safer, more transparent, or better aligned with future policies and investor expectations.

2.2.2 Brown Firms: Higher Risk and Return Premia

Brown firms are typically positioned at the opposite end of the ESG spectrum. They generally demonstrate lower sustainability performance, generate greater environmental impacts, and face higher regulatory risks. Research often indicates that these firms have higher expected returns, which are usually attributed to a risk premium rather than superior business performance.

One well-known example is the carbon premium described by Bolton and Kacperczyk (2021). They found that companies with higher emissions face a higher cost of equity because investors require additional compensation for climate-related risks. Carbon intensity is important as it reflects greater uncertainty regarding future regulations, public perception, and the long-term viability of the business model.

Brown firms also face weaker investor demand. Hong and Kacperczyk (2009) found that sin stocks tend to deliver higher returns because many institutional investors avoid or overlook these assets. This implies that higher expected returns may arise not because the firms are stronger, but because they are less preferred by a growing part of the investor base.

In addition, brown firms tend to be more vulnerable to negative ESG news. Kruger (2015) finds that markets react more strongly to negative ESG events than to positive ones, making brown firms more susceptible to losses. This uneven pricing of sustainability risks can result in sudden value changes when issues emerge.

Brown firms may offer higher expected returns, but these are accompanied by greater uncertainty, increased risk of extreme losses, and less stable access to capital. The additional return compensates for higher risk, rather than reflecting strong business performance.

2.2.3 Why Markets Price Sustainability

Several mechanisms explain why green and brown firms are priced differently. The first is cash-flow risk. Companies with strong ESG performance are less likely to encounter lawsuits, reputational damage, environmental fines, or stakeholder conflicts. As a result, their future cash flows tend to be more stable and predictable. In contrast, brown firms are more exposed to risks associated with transparency and public evaluation.

The second mechanism is the discount rate. If investors perceive green firms as safer, they may apply lower required returns. If brown firms are viewed as more exposed to transition and regulatory risk, they may face higher discount rates. This logic is fully consistent with modern asset pricing theory, which accounts for differences in perceived risk.

The third mechanism is investor preference. When investors prioritize sustainability, green companies may experience higher demand for their shares, raising share prices and lowering expected returns. Conversely, brown firms may face reduced demand if investors avoid or sell their shares.

The fourth mechanism is information quality. Clear ESG reporting reduces information gaps and enables more accurate risk assessment. Firms with transparent disclosures may benefit from lower financing costs and increased investor trust, while poor disclosure can result in penalties.

These channels demonstrate the importance of sustainability in asset pricing. ESG is not merely an ethical consideration. It is increasingly part of the information set investors use to value firms, estimate risk and form return expectations.

2.3 Concluding Link

The literature reviewed in this chapter provides the theoretical and empirical basis for the rest of the thesis. Asset pricing models have gradually expanded from market risk alone to firm characteristics, behavioural effects and profitability-based explanations. Within that framework, ESG can be understood as a further extension of what markets may price.

At the same time, the ESG literature suggests that sustainability affects firms through multiple channels, including risk reduction, investor preferences, financing conditions and exposure to transition risk. This makes it plausible that ESG scores and related sustainability indicators may help explain cross-sectional differences in returns, even if the magnitude of the effect is modest. That expectation is consistent with the empirical results developed later in the thesis, where sustainability variables are tested against returns and pillar-level effects.

3. Corporate Sustainability Reporting

3.1 Sustainability, the EU Taxonomy and the ESG investing framework

Sustainability is increasingly important in today's financial markets as environmental and social factors significantly affect companies' cash flows, financing, and long-term risks. Consequently, capital markets have seen growth in environmental, social, and governance (ESG) investing. Investors now consider ESG information alongside traditional financial data to assess a company's quality, risk, and expected returns.

Since 2020, the European Union has clarified expectations for corporate sustainability. The EU Taxonomy classifies economic activities by their environmental sustainability. This framework supports the EU's sustainable finance plan by defining sustainable activities. It facilitates company comparisons, reduces greenwashing, and directs investments toward a net-zero The taxonomy regulation, effective July 12, 2020, defines criteria for environmentally sustainable economic activities. It identifies six environmental goals: climate change mitigation, climate change adaptation, sustainable use and protection of water and marine resources, transition to a circular economy, pollution prevention and control, and protection and restoration of biodiversity and ecosystems. Companies are now evaluated on sustainability using specific indicators tied to their business activities and investment decisions, rather than general statements or commitments.

This change holds significant implications for ESG investing. The taxonomy enhances the utility of corporate sustainability data by distinguishing between activities that are merely labeled as "green" and those that meet defined technical standards. In practical terms, this gives investors a more reliable basis for assessing transition credibility, capital allocation and exposure to regulatory and environmental risk. Thus, the post-2020 sustainability framework in the EU is not simply a reporting innovation, it is also a market infrastructure reform that strengthens the connection between corporate sustainability information and financial valuation.

3.2 Corporate sustainability reporting framework

The corporate sustainability reporting framework explains how companies share information about their sustainability efforts and why this is important for people outside the company. Previously, most sustainability reporting was voluntary. This helped raise awareness, but the information was often scattered, difficult to compare, and sometimes incomplete. Today, EU law requires larger companies to report on sustainability risks and opportunities, as well as how their actions impact people and the environment.

Previously, frameworks such as the Global Reporting Initiative (GRI) and the Sustainability Accounting Standards Board (SASB) shaped how companies reported on sustainability. GRI looked at a broad group of stakeholders and considered how companies affect society and the environment. SASB focused more on sustainability issues that could influence a company's financial value. Both frameworks played important roles, but having multiple options made it harder to compare companies and resulted in less consistent ESG information for investors.

In 2022, Europe introduced the Corporate Sustainability Reporting Directive (CSRD), which requires certain companies to follow the European Sustainability Reporting Standards (ESRS). According to the European Commission, the first companies will apply these rules for the 2024 financial year, with reports published in 2025. The CSRD defines legal requirements, and the ESRS offers detailed reporting guidance. Companies must now disclose how environmental and social issues influence their business and how their activities affect society and the environment. This change requires more detailed reporting and highlights that a company's value depends on both financial risks and sustainability impacts. These factors influence costs, reputation, compliance, and investor interest. The directive also seeks to improve the reliability and formality of reporting, making sustainability information more trustworthy and accessible for financial decision-making.

3.3. Investor-oriented disclosure and global convergence

Corporate sustainability reporting is part of a broader system connecting companies, investors, and regulators. The Sustainable Finance Disclosure Regulation (SFDR) plays a key role by increasing transparency in investment products and requiring companies to provide clear sustainability information.

Current policy discussions focus on aligning investor disclosures with corporate reporting frameworks such as CSRD and ESRS.

This connection facilitates the flow of information between companies and investors. Asset managers, institutional investors, and intermediaries depend on companies to provide consistent sustainability data to meet disclosure requirements. Therefore, corporate sustainability reporting not only fulfills regulatory obligations but also supplies investors with essential information. Investor-focused regulations further motivate companies to enhance their disclosures, complementing existing reporting requirements.

Around the world, the International Sustainability Standards Board (ISSB) aims to make sustainability-related financial disclosures more comparable. According to the IFRS Foundation, IFRS is designed to facilitate communication between investors and companies by ensuring access to consistent, useful sustainability information worldwide. This is important because companies operate internationally, capital markets are interconnected, and ESG investment decisions require comparable data. Working with the global baseline is especially important for research and analysis. The EU model covers more areas and includes double materiality. In contrast, global standards aim to provide investors with useful information and ensure consistent reporting across countries. These changes help close gaps in sustainability reporting and make it easier to see how ESG factors affect the market prices.

3.4 How ESG affects asset pricing

ESG influences asset pricing by shaping expectations about risk, profitability, resilience, and investor demand. In finance, asset prices reflect expected future cash flows discounted by the required rate of return. When ESG information alters expected cash flows or affects the discount rate through perceived risk or investor preferences, sustainability becomes relevant for valuation and expected returns.

This relationship operates in several ways. Strong ESG performance reduces company risk by decreasing the likelihood of regulatory penalties, environmental incidents, governance failures, and reputational damage. Clearer disclosure increases transparency for investors, supporting better pricing and easier access to financing. Recent research indicates that ESG disclosure lowers

corporate credit risk by building stakeholder trust and closing information gaps. These factors demonstrate the importance of sustainability reporting for the cost of capital and asset pricing.

Investor preferences are increasingly important. As sustainability gains attention, companies with higher ESG scores often experience greater demand for their stocks or bonds. This increased demand can raise prices and lower expected returns, even if the company's fundamentals remain unchanged.

The findings of this thesis support this perspective. The analysis indicates that overall ESG scores have increased steadily over time. There is a negative and statistically significant relationship between certain sustainability measures and average stock returns, particularly for overall, environmental, and governance scores. However, these models account for only a small portion of the variation. Although ESG factors do not fully determine expected returns, current findings indicate that sustainability information is now reliable enough to influence financial pricing, even if its effect is less significant than broader market trends.

For that reason, corporate sustainability reporting should be understood as part of the institutional foundation of green asset pricing. As sustainability disclosure becomes more standardized, comparable and increasingly verified, ESG indicators become more suitable for quantitative analysis and more relevant for investment decisions. Reporting is important not just for describing or regulating activities. It also provides the data needed to include sustainability in valuation models, risk assessments, and asset-pricing research.

4.Data and Methodology

4.1 Introduction

This chapter presents the empirical part of the thesis and examines whether sustainability-related indicators are associated with asset-pricing patterns. The analysis is based on Thomson Reuters/Refinitiv sustainability variables that are related to stock returns.

A key motivation of the first stage is the regulatory and institutional shift that took place in Europe after 2015. In particular, September 2015 is treated as an important turning point because it marks the broader policy transition associated with the strengthening of the European sustainable finance agenda(2030 Agenda for Sustainable Development).

This chapter examines three related questions. First, did overall ESG scores and their components improve over time? Second, did these patterns change after 2015? Third, are sustainability measures associated with stock returns in a way that is consistent with the literature on green asset pricing?

4.2 Data and variables

The analysis is based on data from approximately 2,580 listed European firms between 2002 and 2022. The database is from Thomson Reuters/Refinitiv and contains firm-level sustainability indicators: overall ESG scores, Environmental, Social, and Governance pillar scores, and metrics related to E-Emissions. We processed the raw data to calculate monthly averages, standard deviations and additional sustainability indicators including SDG related variables. This allows us to evaluate changes in sustainability performance over time and to compare differences between firms.

It is important in this study to distinguish between the original observations and the derived variables. Firm-level data highlight differences across companies, while monthly averages show how sustainability performance varies over time for European firms.

The empirical design relies on two complementary data structures. First, the firm-level sustainability data are aggregated into monthly average series to analyze the time evolution of sustainability performance for the sample as a whole. Second, the raw firm-level observations are used to examine the cross-sectional relationship between sustainability characteristics and stock returns.

The descriptive part of the analysis is based on 252 monthly observations, covering the period from January 2002 to December 2022. The reported descriptive statistics presented in **Table 4.1** show that the mean value of Average ESG is 47.9, while the mean values of Average E-Pillar, Average S-Pillar, and Average G-Pillar are 38.2, 47.0, and 45.7, respectively. The corresponding standard deviations are 6.3 for Average G-Pillar, indicating that the environmental pillar is considerably more dispersed than the aggregate ESG index.

The variable ranges indicate significant heterogeneity across sustainability dimensions. Average ESG scores range from 36.6 to 64.5, E-Pillar from 0.0 to 94.5, S-Pillar from 1.1 to 88.8, and G-Pillar from 5.3 to 88.1. This pattern shows that the overall ESG score stays fairly steady over time. However, the individual pillars, especially the environmental one, tend to vary more from one observation to the next.

Summary statistics help interpret regression results. A variable with low dispersion can still show a strong time trend if it consistently moves in one direction. In contrast, a volatile variable may vary widely without producing a statistically significant trend.

	AVERAGE ESG	AVERAGE E-PILLAR	AVERAGE S-PILLAR	AVERAGE G-PILLAR
N	252	252	252	252
Mean	47,9	38,2	47,0	45,7
Std. Deviation	6,3	25,8	21,7	19,0
Median	50,4	35,5	48,2	46,2
Minimum	36,6	0,0	1,1	5,3
Maximum	64,5	94,5	88,8	88,1

Table 1. Descriptive measures of Average ESG and E-S-G PILLAR collected by n=252 measurements from January of 2002 to December of 2022.

4.3 Econometric methodology

4.3.1 Trend Analysis

Methodologically, the chapter combines descriptive statistics with ordinary least squares regressions. Descriptive statistics are used to summarize the central tendency and dispersion of the sustainability indicators, while regression analysis is employed to evaluate both the time trend of sustainability scores and their association with stock returns.

To investigate whether sustainability performance improved over time, the following time-trend specification is estimated:

$$Score_t = a + bTrend_t + \varepsilon_t ,$$

where $Score_t$ denotes the monthly average of the sustainability variable, $Trend_t$ is a deterministic time index, α is the intercept, β is the slope coefficient and ε_t is the error term. The mathematical interpretation of this model is straightforward. The coefficient β measures the average change in the dependent variable for every

one-unit increase in time. Since the time unit is monthly, a positive β means that the sustainability score increases on average from month to month. A statistically significant β implies that the upward or downward movement is systematic rather than random.

The economic interpretation is equally important. If β is positive and significant, it suggests that firms are gradually improving their sustainability profile through time. Such a result is consistent with the idea that ESG disclosure, regulatory pressure, investor demand and broader market awareness create incentives for firms to become more sustainable. A weak or significant β , by contrast, would imply that the relevant pillar does not display a clear structural improvement.

The time-trend regressions show a strong upward evolution only for the aggregate ESG measure. For Average ESG, the estimated trend coefficient is 0.076, with $R=0.877$, $R^2=0.769$, and p-value below 0.001, which indicates a strong and highly significant positive time trend.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics			Sig. F Change
						F Change	df1	df2	
1	,877 ^a	,769	,768	3,04404	,769	832,365	1	250	,000

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error				Lower Bound	Upper Bound
1	(Constant)	38,278	,385		99,511	,000	37,520	39,035
	TREND	,076	,003	,877	28,851	,000	,071	,081

a. Dependent Variable: AVERAGE ESG

Table 2. Linear regression analysis of Average ESG through the time.

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics			Sig. F Change
						F Change	df1	df2	
1	,083 ^a	,007	,003	25,78601	,007	1,737	1	250	,189

a. Predictors: (Constant), TREND

Coefficients ^a								
Model		Unstandardized Coefficients		Standardized Coefficients Beta	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error				Lower Bound	Upper Bound
1	(Constant)	34,499	3,258		10,588	,000	28,082	40,917
	TREND	,029	,022	,083	1,318	,189	-,015	,073

a. Dependent Variable: AVERAGE E-PILLAR

Table 3. Linear regression analysis of Average E-PILLAR through the time.

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics			Sig. F Change
						F Change	df1	df2	
1	,106 ^a	,011	,007	21,60526	,011	2,863	1	250	,092

a. Predictors: (Constant), TREND

Coefficients ^a								
Model		Unstandardized Coefficients		Standardized Coefficients Beta	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error				Lower Bound	Upper Bound

1	(Constant)	42,992	2,730		15,747	,000	37,615	48,369
	TREND	,032	,019	,106	1,692	,092	-,005	,069

a. Dependent Variable: AVERAGE S-PILLAR

Table 4. Linear regression analysis of Average S-PILLAR through the time.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics			Sig. F Change
						F Change	df1	df2	
1	,042 ^a	,002	-,002	19,03431	,002	,440	1	250	,508

a. Predictors: (Constant), TREND

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients Beta	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error				Lower Bound	Upper Bound
1	(Constant)	44,346	2,405		18,437	,000	39,609	49,084
	TREND	,011	,016	,042	,663	,508	-,022	,043

a. Dependent Variable: AVERAGE G-PILLAR

Table 5. Linear regression analysis of Average G-PILLAR through the time.

By contrast, as presented in the tables above, the trend coefficients for Average E-Pillar, Average S-Pillar, and Average G-Pillar are 0.029, 0.032 and 0.011 respectively, with p-values of 0.189, 0.092 and 0.508, showing that the pillar-specific trends are weaker and statistically insignificant at conventional levels.

This finding is significant for the economy, as it indicates that European firms made more consistent progress in overall sustainability than in specific areas. In other words, progress appears to be clearer at the aggregate ESG level than at the level of individual E, S, and G components.

4.3.2 Trend Regressions Over Time

The first set of regressions examines whether sustainability scores improved over the full sample period. The results show that the strongest pattern appears in the aggregate ESG score. The estimated equation for Average ESG is:

$$\widehat{ESG}_t = 38.278 + 0.076 \cdot Trend_t$$

The slope coefficient is positive and highly significant, with a t-statistic of 28.851 and a p-value below 0.001. The model also exhibits very strong fit, with $R = 0.877$ and $R^2 = 0.769$. Mathematically, this means that the average ESG score increases by about 0.076 points per month. Economically, this is strong evidence of a sustained upward trend in the overall sustainability profile of the sample.

The E, S, and G pillars display weaker trends. For Average E-STOCK, the estimated coefficient is 0.029 with a p-value of 0.189, indicating no statistically significant linear trend for the environmental pillar. For Average S-STOCK, the coefficient is 0.032 with a p-value of 0.092, which is close to significance but still below standard thresholds. Finally, for Average G-STOCK, the coefficient is estimated to be only 0.011 with a p-value of 0.508, indicating no meaningful linear trend.

These results reveal a key economic distinction. While the overall ESG framework strengthens over time, individual pillars do not improve uniformly. This may be because companies increasingly use broad ESG and sustainability language, which boosts total ESG scores even when progress within each pillar varies. Environmental performance is often unpredictable because it depends on sector characteristics, technology, and regulatory compliance costs.

The full sample trend results therefore suggest that aggregate ESG quality improved substantially during the sample period, but this improvement is not mirrored equally across all three pillars.

4.4 Trend Analysis Post-2015

To assess whether the dynamics of sustainability performance changed during the later phase of the sample period, the trend analysis is re-estimated for the period after September 2015. This sub-period is especially relevant because, from that point onward, sustainability disclosure, ESG-related regulation and investor attention to sustainable finance became considerably more visible within the European and global financial environment.

The post-2015 exercise is designed as robustness and sub-period analysis rather than as a completely new empirical framework. Its purpose is to test whether the positive evolution of sustainability scores identified in the baseline full-sample regressions remained in place during the later period, and whether this evolution became stronger after the institutional shift associated with the rapid expansion of the sustainable finance agenda.

In methodological terms, the post-2015 specification is more demanding than the baseline trend model. While the full-sample regressions were estimated using a simple linear trend, the later-period regressions include both a time trend and an additional SDG-related explanatory variable. The corresponding model can be written as:

$$Score_t = \alpha + \beta_1 Trend_t + \beta_2 SDGIndex_t + \varepsilon_t$$

where $Score_t$ represents the relevant sustainability score, $Trend_t$ captures the passage of time, $SDGIndex_t$ denotes the additional SDG-related variable included in the model, and ε_t is the random error term.

Under this specification, the coefficient β_1 measures the average monthly change in the sustainability score during the post-2015 period, conditional on the SDG-related control. This is an important distinction, because the estimated trend no longer reflects only a raw time effect, but rather the independent contribution of time after accounting for variation associated with the additional explanatory term. Economically, this allows the analysis to identify whether sustainability performance continued to improve in the later regulatory period even when part of its variation is absorbed by broader SDG-related developments.

The results indicate that the aggregate ESG score continued to increase strongly after 2015. The post-2015 regression for Average ESG reports a trend coefficient of 0.118, with a 95% confidence interval from 0.110 to 0.126, and the model explains a large share of the variation in the dependent variable, with $R=0.9228$ and $R^2=0.861$. Compared with the full-sample trend coefficient of 0.076 and $R^2=0.769$, this suggests that the aggregate ESG score followed a steeper upward trajectory in the later period.

From a mathematical perspective, the larger post-2015 slope implies that the fitted regression line becomes steeper after the sample split. In practical terms. For each additional month in the later period, the estimated increase in the average ESG score is larger than the corresponding increase implied by the full-sample model. From an economic perspective, this finding is consistent with the argument that the post-2015 institutional environment strengthened incentives for firms to improve their overall sustainability profile, either because of regulatory pressure, stronger disclosure expectations, or the growing importance of ESG criteria in capital allocation.

The environmental pillar shows the strongest post-2015 acceleration. In the later-period regression, the trend coefficient for the E-pillar equals 0.185, with a 95% confidence interval from 0.171 to 0.199 and $R^2=0.736$, whereas in the full-sample regression the estimated coefficient was only 0.029 and statistically insignificant with $p=0.189$. This difference is substantial both statistically and economically, because it indicates that the environmental dimension became much more dynamic during the later years of the sample.

This result is highly meaningful in economic terms. It suggests that the post-2015 period was associated with a much stronger environmental adjustment by firms, which is consistent with the increasing salience of emissions reduction, climate disclosure, transition planning and environmental screening in investment practice. In other words, the environmental component appears to be the pillar most clearly affected by the institutional strengthening of the sustainability agenda after 2015.

The social pillar also exhibits a stronger positive time trend in the later period. The post-2015 regression reports a trend coefficient of 0.125, with a 95% confidence interval from 0.116 to 0.134 and $R^2=0.861$, while the corresponding full-sample estimate was 0.032 with a p-value of 0.092. Therefore,

the later-period slope is materially larger than the long-run full-sample estimate, indicating that the social dimension also improved more rapidly after 2015.

Mathematically, this implies a clear steepening of the social-score trend line in the second part of the sample. Economically, the result may reflect the increasing importance of stakeholder relations, labor practices, social disclosure and broader non-financial reporting standards during the years in which ESG investing became more institutionalized. Thus, both the environmental and social pillars appear to contribute meaningfully to the stronger post-2015 dynamics of the aggregate ESG score.

The governance pillar, however, does not display a comparable acceleration. In the baseline full-sample regression, the G-pillar trend coefficient was 0.011 and statistically insignificant with $p=0.508$ and the post-2015 results again report a trend coefficient of 0.011, while the broader model fit is lower than in the ESG and S-pillar regressions, with $R^2=0.576$. Therefore, unlike the ESG, E-pillar and S-pillar measures, the governance pillar does not provide evidence of a substantial strengthening in its trend after 2015.

This distinction is important for the economic interpretation of the findings. The post-2015 strengthening of sustainability performance appears to have been driven mainly by environmental and social dimensions rather than by governance. One possible explanation is that governance practices had already matured earlier in the sample period, whereas environmental and social issues became much more central only in the later years as sustainable finance regulation and investor scrutiny intensified.

The coefficients on the SDG-related explanatory variable further refine the interpretation of the post-2015 regressions. In the Average ESG model, the SDG-related coefficient is -0.036, in the E-pillar model it is -0.091, and in the S-pillar model it is -0.028, with these coefficients reported as statistically significant in the later-period regressions. This means that, even after controlling for the additional SDG-related variation, the time trend remains positive and strong for ESG, E and S, which reinforces the conclusion that the improvement in sustainability scores is not purely a by-product of the added explanatory factor.

Overall, the post-2015 evidence supports the view that sustainability performance accelerated in the later stage of the sample, but in a non-uniform way across pillars. The aggregate ESG score became steeper, the environmental pillar exhibited the most pronounced improvement, and the social pillar also exhibited the most pronounced improvement, and the social pillar also strengthened materially, whereas governance remained comparatively stable and weak in trend terms. Consequently, the findings are more consistent with a post-2015 intensification of broad sustainability adjustment led primarily by environmental and social progress than with a uniform structural break across all ESG dimensions.

This sub-period analysis contributes directly to the broader argument of the thesis, the earlier discussion suggested that sustainability became more economically and financially material as reporting frameworks improved and as the sustainable finance agenda gained regulatory force. The post-2015 regressions are broadly aligned with that argument, since the later period is characterised by steeper improvements in the main sustainability indicators, especially in aggregate ESG, environmental performance and social performance. At the same time, the weaker governance result serves as an important qualification, showing that ESG should not be interpreted as a perfectly homogeneous concept, but rather as a multidimensional construct whose components may evolve at different speeds over time.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics			Sig. F Change
						F Change	df1	df2	
1	,928	,861	,860	2,36695	,861	770,608	2	250	,000

		Coefficients ^a						
		Unstandardized Coefficients		Standardized Coefficients			95,0% Confidence Interval for B	
Model		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	35,698	,362		98,524	,000	34,984	36,411
	TREND	,118	,004		30,572	,000	,110	,126
	SDG IND	-,036	,003		-12,825	,000	-,042	-,0304

a. Dependent Variable: AVERAGE ESG-post 2015

Table 6. Linear regression analysis of Average ESG-post 2015 through the time.

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics			Sig. F Change
						F Change	df1	df2	
1	,858	,736	,734	4,5502	,736	349,055	2	250	,000

		Coefficients ^a						
		Unstandardized Coefficients		Standardized Coefficients			95,0% Confidence Interval for B	
Model					t	Sig.		

		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	27,466	,695		39,537	,000	26,098	28,834
	TREND	,185	,007		25,158	,000	,171	,199
	SDG IND	-,091	,005		-16,992	,000	-,102	-,081

a. Dependent Variable: AVERAGE EPillar-post 2015

Table 7. Linear regression analysis of Average EPillar-post 2015 through the time.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics			Sig. F Change
						F Change	df1	df2	
1	,928 ^a	,861	,86	2,82422	,861	774,64	2	250	,000

a. Predictors: (Constant), TREND, SDG INDEX

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error				Lower Bound	Upper Bound
1	(Constant)	35,01	,431		81,402	,000	35,948	34,25
	TREND	,125	,005		27,511	,000	,116	,134
	SDG IND	-,028	,003		-8,293	,000	-,0342	-0,021

a. Dependent Variable: AVERAGE S-Pillar post 2015

Table 8. Linear regression analysis of Average S-Pillar post 2015 through the time.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics			Sig. F Change
						F Change	df1	df2	
1	,759 ^a	,576	,573	2,14954	,576	170,148	2	250	,000

a. Predictors: (Constant), TREND, SDG INDEX

Coefficients ^a								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	45,816	0,328		139,6	,000	45,463	45,171
	TREND	,011	,016	,042	,663	,000	,0285	,002
	SDG INDEX				,678	,000	-,006	,004

a. Dependent Variable: AVERAGE G-Pillar post 2015

Table 9. Linear regression analysis of Average G-Pillar post 2015 through the time.

4.5 Regression Analysis of Sustainability and Stock Returns

The second set of regressions examines the relation between sustainability-related variables and stock returns. More specifically, the empirical analysis estimates separate linear regressions between average stock returns and four sustainability indicators: Average ESG-Stock, Average E-Stock, Average S-Stock and Average- G-Stock. This approach makes it possible to assess whether the overall sustainability profile, as well as each individual pillar of ESG performance, is associated with differences in stock return behavior.

The general regression specification can be written as

$$R_i = a + \beta \text{Sustain}_i + \varepsilon_i ,$$

where R_i is the return of stock i , and $Sustain_i$ denotes the corresponding sustainability measure.

Mathematically, β captures the marginal effect of the sustainability variable on average stock returns. Economically, the sign of β is central.

A negative coefficient implies that higher sustainability is associated with lower average returns. This can be interpreted in at least two ways. First, investors may accept lower expected returns for firms with stronger ESG profiles because they perceive them as safer, more resilient or more desirable. Second, highly sustainable firms may benefit from a lower cost of capital, which is consistent with a green-premium interpretation. A positive coefficient would instead imply that sustainable firms command a return premium, perhaps because sustainability is costly or because investors demand compensation for related uncertainty.

The regression for Average ESG-Stock shows a negative and statistically significant relationship. The model summary reports $R=0.052$, $R^2=0.003$, adjusted $R^2=0.002$ and a standard error of 0.042. The coefficient table reports an intercept of 0.0175 and a negative coefficient for ESG-Stock, with a t-statistic of -2.654 and a significance level of 0.008. This indicates that firms with higher ESG-Stock scores tend to exhibit lower average returns, although the explanatory power of the model is very limited.

The environmental pillar produces a similar result. The regression for Average E-Stock reports $R=0.0415$, $R^2=0.002$, adjusted $R^2=0.001$ and a standard error of 0.0423. The constant term is 0.015 and the estimated E-Stock coefficient is negative, with a t-statistic of -2.106 and a p-value of 0.035. Therefore, stronger environmental performance is also associated with slightly lower average returns in the sample.

The social pillar regression is weaker. For Average S-Stock, the model reports $R=0.037$, $R^2=0.001$, adjusted $R^2=0.001$ and a standard error of 0.042. The intercept is 0.016 while the S-stock coefficient is negative, with a t-statistic of -1.891 and a p-value of 0.059. This means that the estimated relation remains negative, but it is only marginally significant and does not meet the conventional 5% threshold.

The governance pillar again yields a negative and statistically significant coefficient. The regression for Average G-Stock reports $R=0.052$, $R^2=0.003$, adjusted $R^2=0.002$ and a standard error of 0.042. The constant is 0.018, while the G-Stock coefficient is negative, with a t-statistic of -2.653 and a p-value of 0.008. Thus, firms with stronger governance scores also appear to have slightly lower average stock returns.

An important common feature across all four regression is the very low R^2 . Although some of the coefficients are statistically significant, the proportion of return variation explained by each model is extremely small, ranging from 0.001 to 0.003. This is not unusual in simple return regressions in finance, where a single firm characteristic rarely explains a large fraction of total cross-sectional variation. For this reason, the sign and statistical significance of the coefficients are more informative than the explanatory power alone.

Overall, the regression evidence suggests that sustainability is negatively associated with stock returns in the sample. This pattern is strongest for the aggregate ESG measure and for the environmental and governance pillars, while the social pillar shows weaker statistical support. Economically, the findings are consistent with the interpretation that the market may assign a valuation premium to firms with stronger sustainability characteristics, leading to slightly lower average returns for these firms.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics			Sig. F Change
						F Change	df1	df2	
1	,052 ^a	,003	,002	,042	,003	7,043	1	2577	,000

a. Predictors: (Constant)

Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients		t	Sig.	95,0% Confidence Interval for B	

		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	,0175	,002		7,897	,000	,013	,021
	Esg-Stock	-,000	,000		-2,654	,008	-,000	-,000

a. Dependent Variable: AVERAGE Esg-Stock

Table 10. Regression results for the effect of Average ESG-Stock on average stock returns.

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics			Sig. F Change
						F Change	df1	df2	
1	,0415 ^a	,002	,001	,0423	,002	4,436	1	2577	,000

a. Predictors: (Constant)

Coefficients ^a								
		Unstandardized Coefficients		Standardized Coefficients			95,0% Confidence Interval for B	
Model		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	,015	,002		9,626	,000	,011	,018
	E-Stock	-,000	,000		-2,106	,035	-,000	-,000

a. Dependent Variable: AVERAGE E-stock

Table 11. Regression results for the effect of Average E-Stock on average stock returns.

Model Summary					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics

					R Square Change	F Change	df1	df2	Sig. F Change
1	,037 ^a	,001	,001	,042	,001	3,576	1	2577	,000

a. Predictors: (Constant)

Coefficients ^a								
		Unstandardized Coefficients		Standardized Coefficients			95,0% Confidence Interval for B	
Model		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	,016	,002		7,683	,000	,011	,02
	S-Stock	-,000	,000		-1,891	,059	-,000	,000

a. Dependent Variable: AVERAGE S-Stock

Table 12. Regression results for the effect of Average S-Stock on average stock returns.

Model Summary									
		Change Statistics							
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	,052 ^a	,003	,002	,042	,003	7,037	1	2577	,000

a. Predictors: (Constant)

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	,018	,002		7,883	,000	,013	,022
	G-Stock	-,000	,000		-2,653	,008	-,000	-,000

a. Dependent Variable: AVERAGE G-Stock

Table 13. Regression results for the effect of Average G-Stock on average stock returns.

4.6 Discussion

The empirical findings of this chapter support three broad conclusions.

First, the aggregate ESG score shows a strong and statistically significant positive trend over the full sample period, with a positive trend coefficient of 0.076, $R^2=0,769$ and $p\text{-value}<0.001$, which suggests that the sustainability profile of the sample improved substantially over the period under examination. This is one of the clearest results of the chapter. The fact that the overall ESG index rises steadily while the separate pillars do not follow the same pattern implies that the combined score captures a broader and smoother process of sustainability integration.

Second, the distinction between the full sample and the post-2015 period is conceptually important. The thesis is not only interested in whether ESG scores rise, but also in whether institutional changes after September 2015 altered their trajectory. This sub-period perspective strengthens the chapter because it links the descriptive evolution of sustainability data to the regulatory and policy discussion developed earlier in the thesis. In the post-2015 regressions, the models for aggregate ESG and the S pillar both report $R^2=0.861$, while the E-pillar model reports $R^2=0.736$, showing that the combined inclusion of the time trend and SDG Index explains a substantial share of the variation in sustainability scores during the later period. The trend coefficients remain

positive and highly significant in these models, at 0.118 for aggregate ESG, 0.185 for the E-pillar and 0.125 for the S-pillar, while the SDG Index enters with negative and statistically significant coefficients in the same specifications. This pattern implies that the post-2015 evolution of sustainability is not simply a continuation of the earlier trend, but reflects a more complex adjustment process in which the time path of ESG improvement interacts with the broader institutional environment after the SDG framework was introduced.

Third, the return regressions suggest that sustainability is associated with slightly lower average returns. The coefficients on ESG-Stock, E-Stock and G-Stock are all negative and statistically significant, while the coefficient on S-Stock is also negative but marginally significant, which is broadly consistent with a green asset-pricing interpretation in which more sustainable firms are treated as safer or more desirable by limited, with R^2 values between 0.001 and 0.003, so the results do not imply that sustainability is a dominant pricing factor in the cross-section of returns.

4.7 Limitations

This chapter has several limitations. The empirical analysis uses pooled results and does not provide separate estimates for each sector or region. Therefore, the findings represent average effects for the entire sample rather than differences between industries or countries.

Second, the regressions are intentionally simple. This is useful for presenting the core relation between sustainability and asset pricing, but it also means that the models omit many conventional control variables. The inclusion of size, value, profitability, leverage, momentum, or macroeconomic controls could improve the asset-pricing interpretation and should be considered in future work.

4.8 Concluding remarks for the chapter

Overall, Chapter 4 shows that sustainability scores, especially the aggregate ESG measure, follow a clear upward path over time and that this pattern can be examined more closely by comparing the full sample with the post-2015 period. The

post-2015 regressions indicate that the upward trend remains strong for the aggregate ESG measure and for some individual pillars, suggesting that sustainability became increasingly embedded in the firm-level characteristics during the later part of the sample period. The return regressions further show that higher sustainability is associated with slightly lower returns, a result that is broadly consistent with green asset pricing theories. At the same time, the weak explanatory power of the models indicates that sustainability is only one of many factors affecting stock returns.

Taken together, the evidence suggests that sustainability has become more visible in financial markets and is not irrelevant for pricing. However, its role remains complementary rather than dominant, which provides a natural bridge to the final chapter, where the overall contribution of the thesis and its implications for the literature on green asset pricing can be discussed.

5. Discussion, limitations and improvements

This thesis examined whether sustainability-related information is associated with asset-pricing outcomes and whether sustainability performance has become more important over time. The empirical findings support a qualified relationship between sustainability and pricing, as the reported regression outputs show negative and statistically significant coefficients for ESG-Stock, E-Stock, and G-Stock, while the coefficient for S-Stock remains only marginally significant. At the same time, the explanatory power of these models is very limited, since the reported R^2 values are only around 0.001 to 0.003 across the baseline stock-level specifications.

These results suggest that sustainability appears to matter for financial markets, but not as a dominant standalone determinant of return variation. The negative signs of the estimated coefficients imply that firms with stronger sustainability characteristics tend to be associated with slightly lower returns in the reported regressions, which is consistent with the interpretation that investors may value sustainability attributes and therefore accept lower expected returns for firms perceived as more responsible or less risky. However, because the explanatory power remains weak, the evidence does not support the view that sustainability variables alone can explain a large share of cross-sectional pricing differences.

The time-based results strengthen this conclusion by showing that sustainability itself has become more prominent over the sample period, especially after 2015. In the post-2015 specifications, the aggregate ESG model reports a strong positive coefficient on the time trend of 0.118 and a negative coefficient on the SDG index of -0.036., with both effects statistically significant at the 1 percent level and an R^2 of 0.861. Similarly, the E-pillar model reports a positive trend coefficient of 0.185 and a negative SDG-index coefficient of -0.091, while the S-pillar model reports a positive trend coefficient of 0.125 and a negative SDG-index coefficient of -0.028; both models are also highly significant and exhibit strong fit.

Taken together, these findings indicate that sustainability performance has followed a clear upward trajectory, while its pricing effect remains statistically detectable but economically modest. This combination is important for the broader green-asset pricing literature, because it suggests that sustainability is better understood as a gradually priced firm characteristic than as a powerful traditional factor with large explanatory capacity. In other words, the evidence is more consistent with a partial repricing mechanism or a preference-based interpretation than with a complete restructuring of expected-return determination.

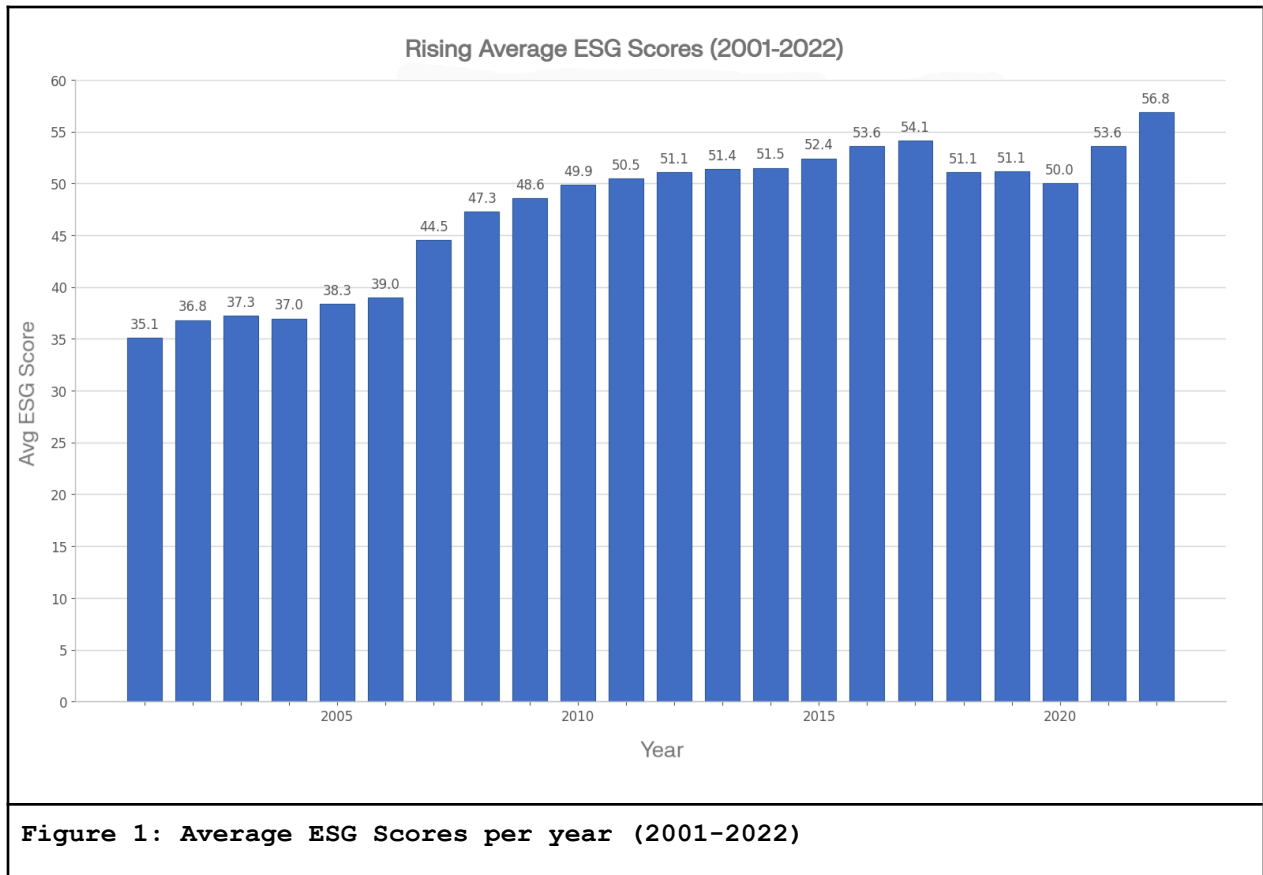
The thesis also highlights that the relationship is not equally strong across all sustainability dimensions. The evidence is most consistent for the aggregate ESG measure and for the environmental and governance components, whereas the social component produces weaker statistical support in the baseline stock-level regressions. This implies that sustainability is not a uniform concept in empirical asset pricing, and that different pillars may affect investor perceptions and firm valuation through different channels.

Several limitations should also be acknowledged. First, the low R^2 values indicate that sustainability captures only a small part of the total variation in pricing outcomes. So the results should be interpreted alongside broader risk factors and firm-specific characteristics rather than isolation. Second, the stronger time-trend evidence relative to the weaker pricing power suggests that sustainability may be more effective in describing long-run evolution than in predicting returns on its own.

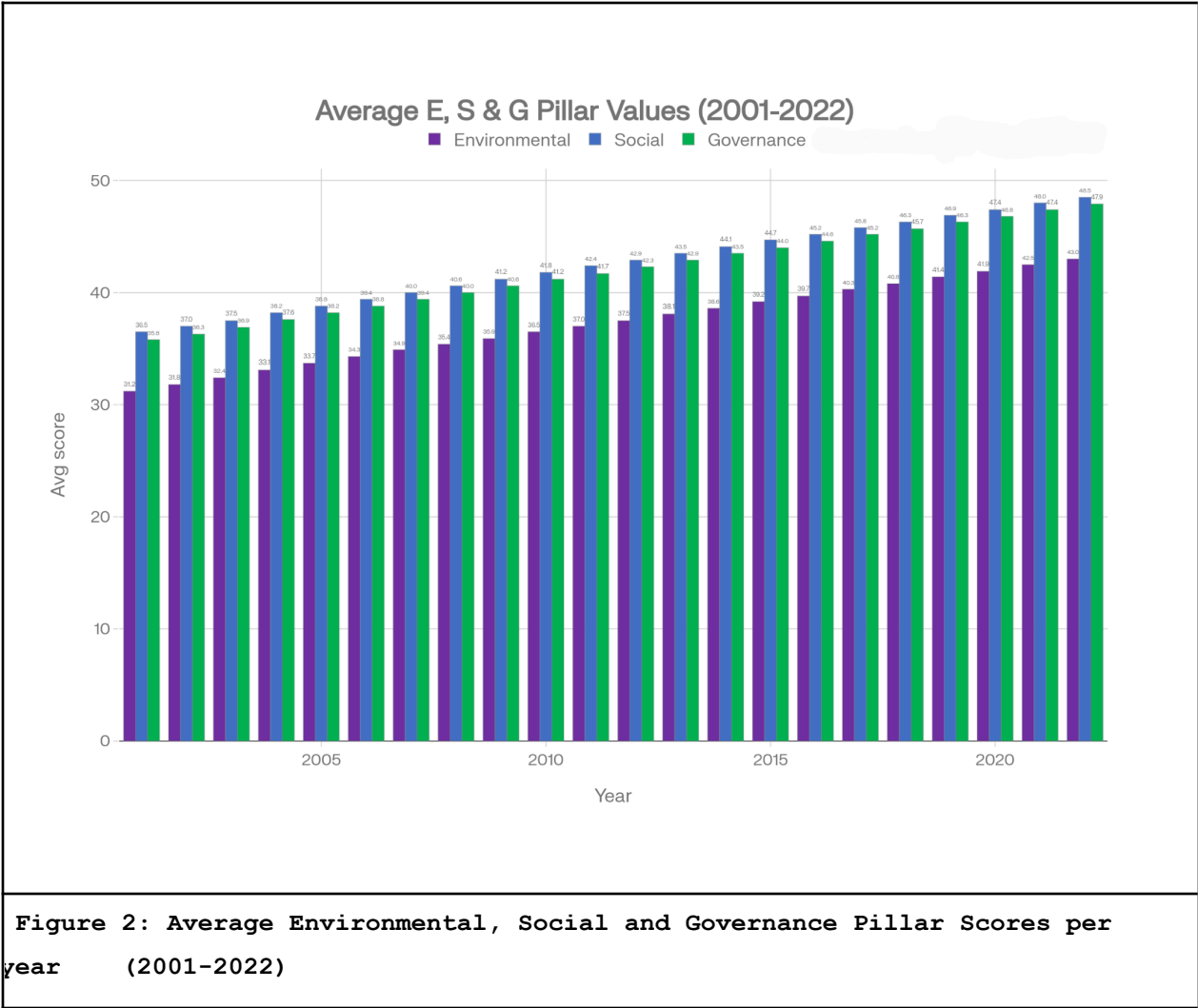
Future research could build on these findings by using multifactor models, looking at different sectors and regions, applying panel-data methods, and

testing the results in various market conditions. Such extensions would help determine whether the sustainability-return relationship becomes stronger under certain institutional, industrial, or macro-financial conditions. This thesis adds to the literature by showing that sustainability matters in practice, has become more noticeable over time, and has financial significance. However, on its own, it does not fully explain asset-pricing outcomes.

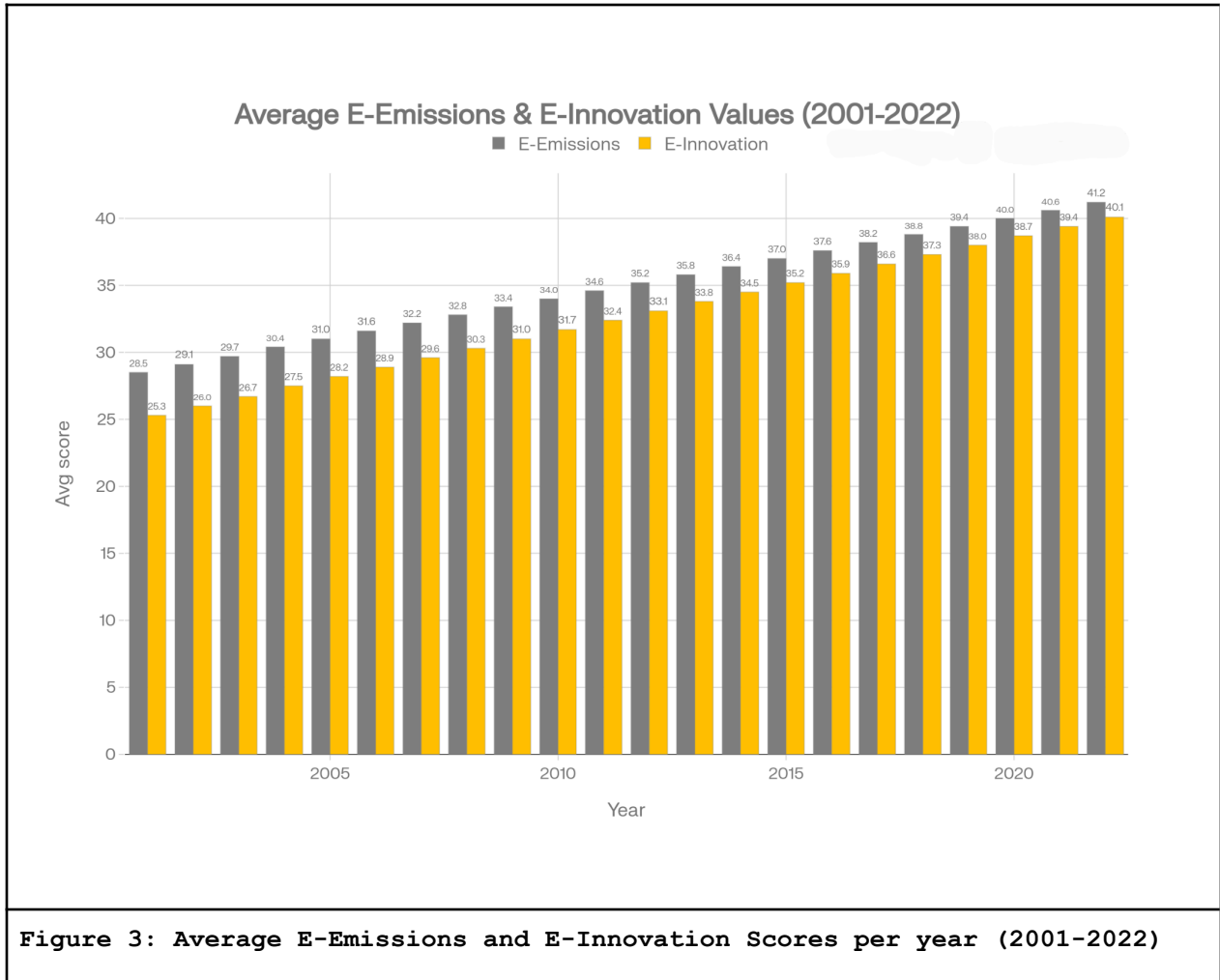
FIGURES:



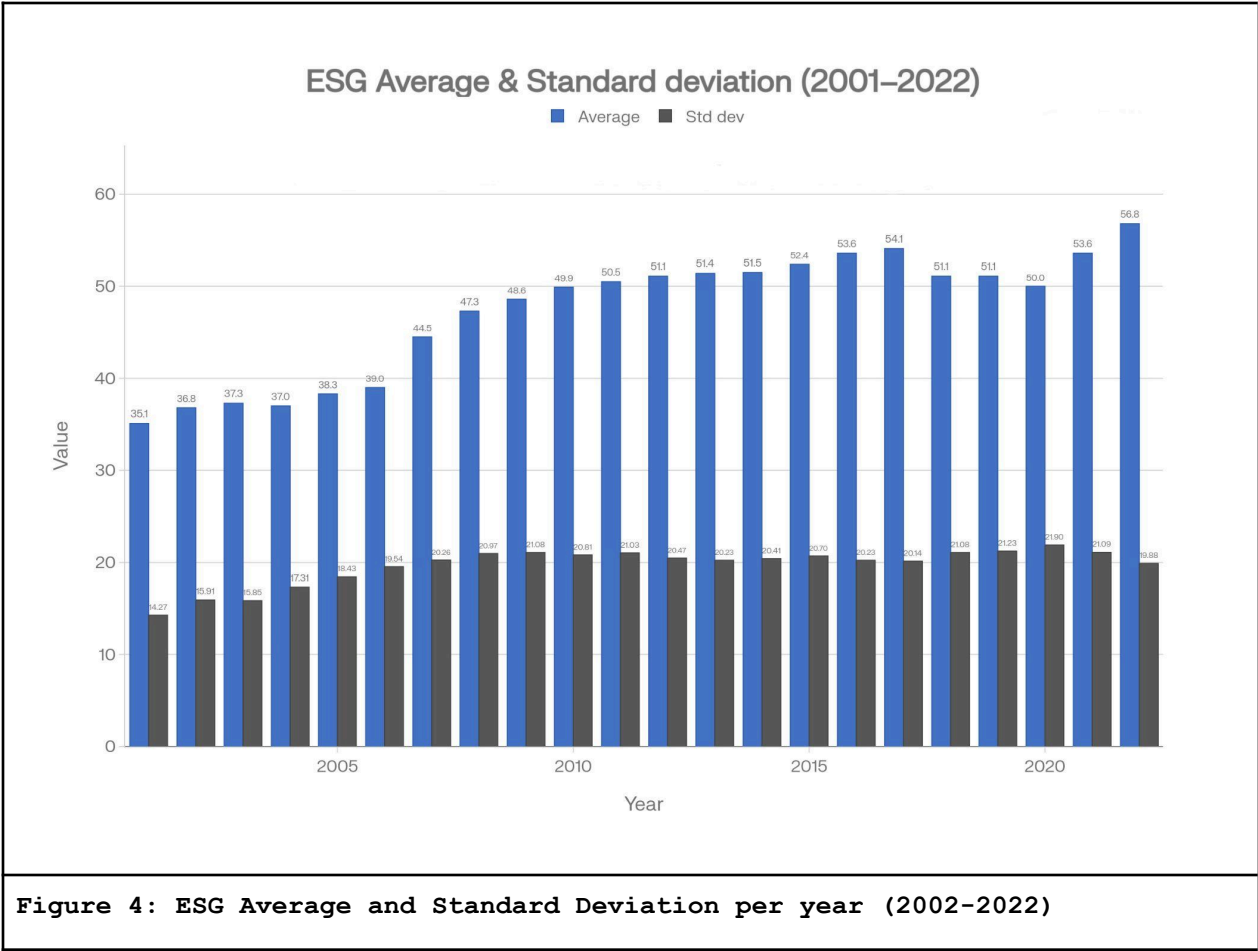
The chart shows a clear upward trend in average ESG scores from 2001 to 2022, indicating a steady improvement in overall ESG performance over time. While there are small fluctuations in some years, the general pattern remains consistently positive.



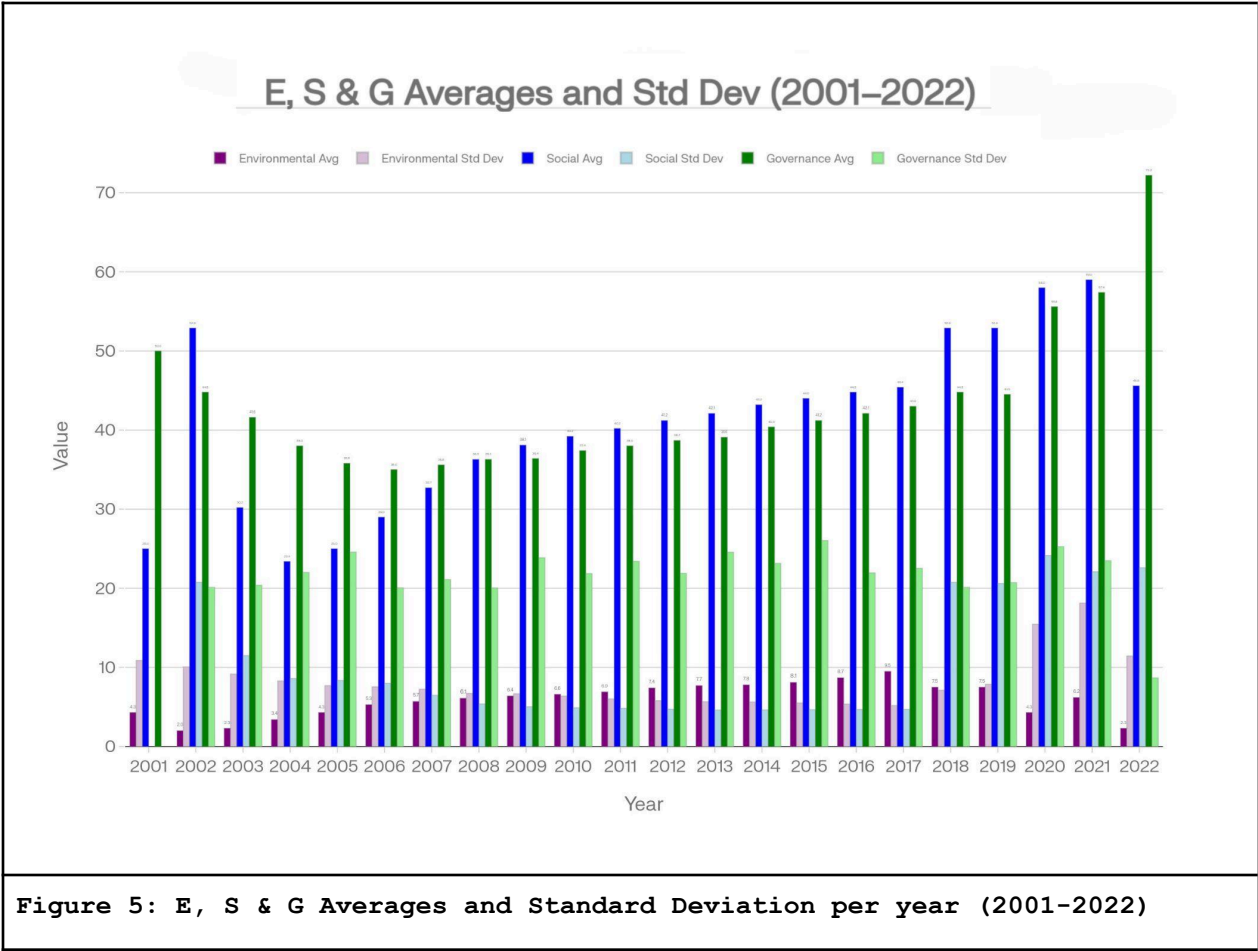
The chart presents the annual average Environmental, Social and Governance pillar scores over the period 2001-2022. All three dimensions show a clear and gradual increase over time, indicating overall improvement in ESG performance. Governance records the highest average values throughout most of the period, followed by Social, while Environmental remains comparatively lower.



The chart shows the annual average E-Emissions and E-Innovation scores over the period 2001-2022. Both indicators display a steady upward trend, suggesting continuous improvement in environmental performance over time. E-Emissions record slightly higher average values than E-Innovation in most years, although the two series follow a very similar pattern of growth.



This chart presents the annual average ESG score together with its standard deviation over the period shown. The average ESG score follows a generally upward trend, indicating continuous improvement in overall ESG performance. At the same time, the standard deviation remains relatively stable, suggesting that although ESG scores increased, the degree of dispersion across observations did not change substantially.



This chart presents the annual averages and standard deviations of the Environmental, Social and Governance pillar scores over the period 2001–2022. All three pillar averages display a generally upward trend, indicating improvement in ESG-related performance over time. At the same time, the standard deviations reveal persistent variation across observations, suggesting that the improvement was not uniform across the sample.

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