

Examining the Impact of Environmental, Social and Governance Scores on Financial Performance of Listed Companies on the German Stock Exchange (XETRA)

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Abstract: As investors' knowledge on sustainability concerns rises, the concept and interest of sustainable investment continue to expand and become increasingly attractive as the global financial market is considered an effective and powerful tool in the process of developing sustainable economies. Although sustainability is not a new concept in the financial market, its recent recognition and wider adoption has increased as consumers, investors, businesses, and world leaders have become more sensitive and concerned about the future of the planet. Hence, this paper re-examines the impact of environmental, social, and governance (ESG) scores on the financial performance of the listed companies on the German Stock Exchange from 2011 to 2021. With a total of 450 listed firms and 4,950 observations sourced from the Refinitiv database, vector autoregressive (PVAR) together with the system-generalized method of moments (system-GMM) and robust panel multiple regression models were employed to examine the impact and causal relationship between ESG scores and corporate financial performance. The results suggest that ESG scores contribute to organizations' financial performance. We found that better ESG ratings increase companies' systematic risk (volatility), which could boost or increase their stocks' returns. The study however did not find Granger causality between ESG scores and the accounting-based financial performance (ROA), but it did for the market-based financial performance (Tobin's Q). It showed that ESG scores negatively Granger cause firms' financial performance. In a nutshell, organizations' financial performance may be improved by having a higher ESG score and performing better in the social dimension. Overall, the evidence supports the idea that a business case exists for sustainability and corporate social responsibility.

Keywords: Environmental Social and Governance Scores, Corporate Financial Performance, Return on Assets, Tobin's Q, System-Generalized Method of Moments, Firm Systematic Risk

1. Introduction

As investors' knowledge of sustainability concerns rises, the concept and interest of sustainable investment continue to expand and become increasingly attractive. The global financial market is considered an effective and powerful tool

in the process of developing sustainable economies [25, 64, 71]. On a global scale, over \$7 trillion worth of annual investment is needed to develop sustainable economies that meet the objectives and goals of the United Nations Sustainable Development Goals (SDG) and the Paris Agreement [35]. The sustainable and responsible investment

markets have been acknowledged as a potential or viable vehicle to help contribute to materializing these transitions [5] due to their massive assets under management (AUM).

The sustainable investment market is a steadily growing market segment [60, 72]. According to Atkinson [10], this growth is roused by investors who integrate diverse social and environmental screens into their investment decision-making or process. Cognitive and normative influences have stimulated the development of the sustainable investment market [32, 44]. Climate change and changes in societal values or ethics may be considered the driving forces behind sustainable investment decisions. The increasing legislations on sustainable investments and double materiality in Europe and other parts of the world emphasize this new market's recognition, acceptance, and growing importance.

Although sustainability is not a new concept in the financial market, its recent recognition and wider adoption has increased as consumers, investors, businesses, and world leaders have become more sensitive and concerned about the future of the planet. The United Nations (UN) Agenda 2030 sustainable development goals (SDG) and the Paris Agreement's (Accord de Paris) target to keep the average global temperature below 2°C by 2030 have been acknowledged as two of the major events that set the trend of sustainability in motion [88, 102]. In Europe alone, it is estimated that an additional €180 billion per year of climate-related investments are required to meet the Paris Agreement [35]. Furthermore, on a global scale, between \$5-7 trillion worth of annual investments are required to meet the targets of the UN Sustainable Development Goals [35]. At a closer look, meeting these targets calls for gargantuan channeling of capital into sustainability-related investments- to decarbonize economies, ensure prosperity, and make the environment a better place. This requires collective effort and transformational change in attitude, investment approaches, and business practices. Goals 12 and 17 of the SDG encourage companies to adopt and integrate sustainable practices into their business models and further highlight the need for multi-stakeholder partnerships to meet the targets of the sustainable goals [93].

Central to this paper are the following questions: Can businesses be more socially and environmentally responsible without sacrificing profit maximization? Can companies do well by doing good? Can businesses do well by adopting the concept of the triple bottom line [21, 77]? Despite the ever-increasing discussions and attention given to these questions in the academic literature, business, and financial worlds, they are hardly new. The shareholder and stakeholder theories have influenced these questions over the last decades. Both theories are normative theories of corporate social responsibility that outline the ethical responsibilities of a business [41]. Though each theory has its roots in business ethics, the underlying assumptions of the two theories differ significantly. According to the shareholder theory, the prime objective of a business is to maximize profit [105], and it criticizes businesses' obligations to society (as this reduces

profitability) [43]. On the other hand, the stakeholder theory which builds on the idea of corporate social responsibility (CSR) asserts that businesses should create value for all stakeholders, not just shareholders [40]. These stakeholders include its customers, investors, employees, communities, and all other players who have a stake in the firm.

The question going forward is: how can one distinguish between a business that only seeks to maximize profits and one that also prioritizes social responsibility and environmental sustainability? According to Andrews *et al.*, [6], corporate sustainability is a strategy that focuses on the ethical, social, environmental, cultural, and economic dimensions of doing business with the goal of creating long-term value for stakeholders [6, 75]. The activities that lead to corporate sustainability can be referred to as corporate social responsibility (CSR) [36, 106], and ESG is a way of measuring corporate social responsibility [8]. According to Refinitiv, a firm's ESG score measures its corporate sustainability performance based on its resource use, innovation, emissions, workforce, human rights, product responsibility, management, shareholders, and CSR strategy [80]. ESG score is, therefore, a measurement of a firm's level of sustainability, which as well considers how well a firm manages its environmental, social, and governance risks [73].

ESG scores measure a firm's resilience to long-term, financially relevant environmental, social, and governance risks [73]. It has grown to become an influential investment strategy, mostly driven by ideals of corporate accountability and social responsibility. ESG investing has become increasingly popular over the past decade [22]. The US Social Investment Forum (SIF) reports that, the total amount of US-domiciled assets managed using sustainable investment strategies increased by 42%, from \$12.0 trillion at the beginning of 2018 to \$17.1 trillion at the beginning of 2020 [97]. This represents one-third of all assets under management. The Global Sustainable Investment Alliance estimated that more than \$30 trillion was invested in applying ESG scores [53]. The growing demand has spurred a proliferation of funds and strategies that integrate ethical considerations into investment approaches (particularly bottom-up ESG integration, top-down ESG integration, best-in-class selection, thematic investing, and active ownership). As such, companies with high ESG scores become the target of these socially responsible or conscious investors (Socially Responsible Investment, SRI). The pressing question is: does it worth the investment for companies to pursue the journey of achieving higher ESG scores? Is there a link or relationship between firms' ESG scores performance and their financial performance? In terms of causality, do ESG scores cause or drive firms' financial profitability?

1.1. Related Literature

Establishing a relationship between corporate social responsibility (CSR), corporate social performance (CSP), ESG Scores and corporate financial performance (CFP) has been a long-standing debate in the financial markets and in management science [22]. The heterogeneity, inconsistency

and ambiguity in these research findings have fueled the debate. Researchers have identified positive, negative, and neutral relationships between ESG scores and financial performance [42, 48, 74, 84, 91]. Moreover, numerous studies have also identified possible causes for the variation in the results [14, 22, 23, 78]. Hence, the purpose of this paper is to contribute and bring clarity to the ESG-CFP literature by investigating the impact and causal relationship between scores of the former and corporate financial performance.

1.2. Environmental, Social and Governance Criteria (ESG)

ESG investing can be defined as an investing approach that prioritizes optimal environmental, social, and governance (ESG) factors [29, 51]. It is widely recognized as sustainable investing—where investments are made taking into account the environment and human welfare, and the economy. It is founded on the increasing conviction that social and environmental elements have an increasing impact on an organization's financial success [21, 42, 91]. Table 1 illustrates varieties of topics that normally fall under ESG in the literature.

Table 1. Common themes under ESG (ADECESG, 2022; Daugaard, 2020).

Environment (E)	Social (S)	Governance (G)
Climate change	Working conditions	Business ethics
Greenhouse gas (GHG) emissions	Equal opportunities	Executive pay
Resource depletion	Human rights	Board diversity and structure
Waste and pollution	Employee diversity	Bribery and corruption
Water and energy efficiency	Health and safety	Political lobbying and donations
Biodiversity	Child labor and slavery	Tax strategy
Deforestation	Community engagement	Compliance
	Philanthropy	

The inclusion of ESG factors in investment decisions has been one of the most significant recent advances in the financial markets. Investors of today are beginning to look beyond the financial bottom line [85], to understand firms' value, impact (double materiality), and the long-term sustainable performance of their portfolios [24]. ESG disclosure provides investors with a way to identify and grasp key issues that are not typically captured and accounted for on a traditional balance sheet yet have a critical impact on a business's risks and opportunities [7]. Investors are increasingly adopting ESG, and it is forecasted to continue to play an integral part in investment strategies moving forward. As the market for ESG grows, investors are requesting new tools to evaluate how firms perform from an ESG perspective [8], as a measure to estimate or project the long-term performance of the company (and their portfolios as well) [15, 87]. In order to determine whether there is even a relationship between firms' ESG scores and their financial performance, the following hypotheses are tested in this paper using the overall ESG score:

H₁: There exists a statistically significant positive relationship between the overall ESG scores and the corporate financial performance of the listed firms on the German stock exchange.

H_{1a}: There exists a statistically significant positive relationship between the distinct E-S-G pillar scores and the corporate financial performance of the listed firms on the German stock exchange.

A firm's ESG score is a reflection of how well it is doing in terms of environmental, social, and governance best practices [85]. Jun et al., [65] argue that investors turn to ESG scores for insights into firms' sustainability performance, and describe ESG criteria as the integration and consideration of environmental and social factors, such as income inequality, diversity, and climate change into business strategies and practices. Bandini et al., [12] define

ESG as “extra-financial material information about the challenges and performance of a company on these matters”, and refer to it as key information that allows investors to better measure and assess risks and opportunities, which allows for additional differentiated investment decisions. Gregory [53] estimated that over \$30 trillion in assets under management in 2018 were invested using sustainable strategies that apply ESG scores from data providers. In the US alone, \$17 trillion as shown in Figure 1 in sustainable investments were recorded at the beginning of 2020, an increase of 42%; representing 33% of the \$54 trillion in total US assets under management [97].

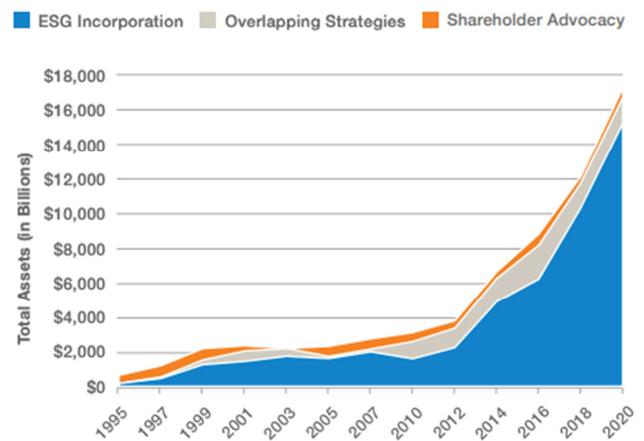


Figure 1. Sustainable Investing in the United States from 1995-2020. Source: US-SIF, 2020.

According to Larcker, et al. [67], due to some unanswered fundamental sustainable business questions that have not been captured by traditional financial analysis although their material financial impacts have been recognized, the authors believe that capital markets are inadequately pricing the cost of ESG criteria on sustainable portfolios. How vulnerable are

firms to climate change? What is the effect of persistently unhappy employees? Investors and portfolio managers alike are turning towards ESG to assess the performance of non-financial metrics on corporates' financial success, especially in the long term. ESG investing is "the consideration of environmental, social and governance factors alongside financial factors in the investment decision-making process" [63]. He postulates that ESG investing ensure and enhance long-term risk-adjusted returns through Thematic investing (investing based on trends or structural shifts, such as social, industrial, and demographic trends). ESG ratings have been acknowledged as a tool to assist investors in taking governance, social, and environmental issues into consideration when making investment decisions [9, 70].

ESG rating agencies are third-party firms that specialize in ESG scoring [34, 52]. Although there are many rating agencies that offer ESG scores, some of the well-known ones are Bloomberg ESG, Data Services, Sustainalytics, S&P Global, Dow Jones Sustainability Index, Thomson Reuters ESG Research Data, MSCI ESG Research, Fitch Ratings, ISS ESG and Moody's Investors Service [34]. These agencies

examine companies and evaluate their performance in terms of corporate sustainability using their own research methodology. ESG rating agencies are becoming an important resource [92], a key reference for businesses, the financial markets, investors, and the academic community when it comes to evaluating a company's sustainability. Given the increasing influence of rating agencies [34], the differences in their rating methodologies, and the different components (criteria) they consider in scoring are key to understanding the level of sustainability of a firm [49].

According to Galbreath [50], investors' spending on ESG ratings from data providers increased from \$200 million to \$500 million between 2014 and 2018. An analysis of the historical development, evolution, expansion, and consolidation of ESG rating agencies and their strategies, as well as their frameworks for evaluation and weighting systems, has previously been addressed in previous research [32, 49]. Considering the remarkable evolution the rating industry has undergone in the last decade, has raised some concerns [34, 49].

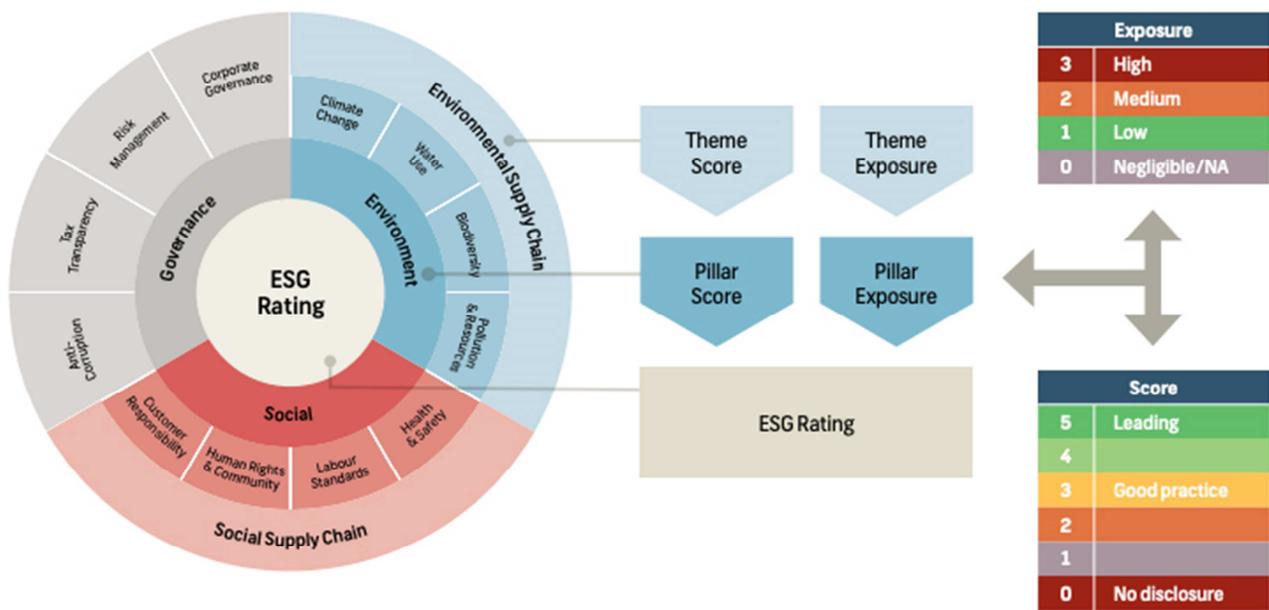


Figure 2. The FTSE ESG ratings framework. Source: (FTSE, 2020).

Shown in Figure 2, ESG score calculated by considering a firm's environmental impact, governance practices, and social responsibilities is measure of a firm's exposure to long-term environmental, governance, and social risks which are often not captured by traditional financial analyses [32]. Energy efficiency, worker safety, and board diversity are a few of these risks, all of which have potentially serious financial repercussions [85, 87]. A firm with a good ESG score manages its ESG risks better than its peers, whereas a company with a bad ESG score has a larger exposure to unmanaged ESG risks on average. Financial analysis and ESG evaluations and scores can work together to provide investors with a better picture of a company's long-term

prospects or potential [1, 23]. Moreover, ESG score and its data allow investors to understand a firm's exposure to risk, and management of ESG-related issues in multiple dimensions [32]. The authors posit that ESG score comprises of an overall (aggregate) score that breaks down into underlying pillar scores (sub-scores) and themes which are built on numerous individual indicator assessments that are peculiar to each firm's unique circumstances. As shown in Figure 3 the sub-scores and themes are built on over 100 individual indicator measures [80], that are applied to each firm's unique context or circumstances. ESG scores are normally ranked per percentile or its letter grades equivalent [46, 73, 80].

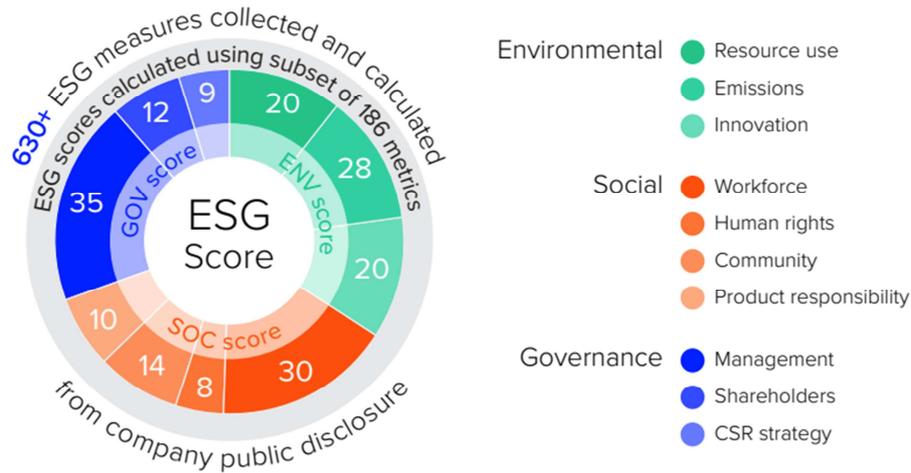


Figure 3. Environmental, social, and governance scores framework from Refinitiv. Source: (Refinitiv, 2022).

As interest in ESG criteria grows, investors need a mechanism to objectively assess a company's ESG performance. Hence, when selecting and evaluating asset or portfolio managers, institutional and retail investors are increasingly assessing how far they integrate ESG criteria into their processes. Companies that score highly on ESG criteria are thought to be better at predicting future risks and opportunities, more inclined to long-term strategic thinking, and more focused on long-term wealth development [7, 92]. The scores enable investors to select and identify where the greatest ESG exposures exist in a portfolio by identifying securities with the highest exposures and poorest ratings [1]. As a result, investors may wish to further analyze such securities, engage with the firms, or even exclude such securities from their portfolios [46, 73]. Conventional exposure analysis and ESG scores can be used alongside to provide a comprehensive and complementary perspective on risks [85].

ESG rating agencies provide a comprehensive data set for research and analysis for identifying and evaluating the risk and return relationships of various ESG factors [22]. In that regard, companies in understanding their ESG scores embark on a journey to continuously improve them year-over-year in view to attracting ESG-conscious investors [9]. As a result, ESG ratings serve as an extremely useful internal benchmarking tool for guiding decision-making and improving sustainability performance [32].

It is assumed that a high ESG score has the potential to increase a firm's wealth or value by means of increasing cash flows (i.e., corporate financial performance) and or a reduction in the cost of capital [79]. Hence, in light of the fact that risk plays a significant role in determining the cost of capital, environmental, social and governance factors can have an impact on shareholder value if it affects firm risk [18]. Therefore, integrating ESG factors into investment decisions or business strategies fits into the overall concept of risk management.

The impact of ESG on firm risk as a significant determinant of corporate financial performance is an intriguing part of the academic literature that this paper also seeks to investigate. Despite the recognition of ESG factors

in risk mitigation [18], only a small part of the literature has addressed the link between ESG and its risk mitigation factors on corporate financial performance [17, 77]. The paper aims to fill this research gap by examining the impact of firms' ESG scores on systematic market risk (Beta) using data provided by the Thomas Reuters Refinitiv database. Beta measures the volatility of a portfolio or a security compared to the market as a whole [95]. It gives insights into an individual's stock's returns against those of the market as a whole [96]. Investors can determine whether a stock moves in the same direction as the market by using the beta. Additionally, it reveals how risky or volatile a stock is in comparison to the rest of the market [69].

A security is considered to be theoretically less volatile than the market if its beta value is less than 1.0 [69, 95]. This means that including this stock or security in a portfolio makes it less risky or volatile than the same portfolio without the stock. On the other hand, a beta value that is more than 1.0 indicates that the stock or security's price is theoretically more volatile than the market [69, 95]. Betas that are higher than the market benchmark are typically found in small-cap and technology stocks [96]. This implies that including such stocks in a portfolio will raise the portfolio's risk while also possibly raising its expected return [33]. Lastly, a beta value of negative means that the stock is inversely correlated to the market [69]. In response, this paper therefore proposes the following hypothesis:

H₂: There exists a statistically significant positive relationship between the overall ESG scores and the betas of the listed firms on the German stock exchange.

1.3. ESG and Corporate Financial Performance Nexus

The pressure from the government, non-profit organizations, and green consumers has increased the attention and focus of businesses and researchers on the pursuit of sustainability. As a result, numerous studies have investigated the relationship between a firm's sustainability practices and their financial performance [27, 62, 86, 91]. The findings have been inconclusive, confusing, and

sometimes ambiguous [42]. Some of these studies have found a significant positive relationship between ESG-CFP, stating that a firm’s engagement in CSR improves its financial performance. Several studies have found a significant and negative relationship between ESG-CFP, stating that a firm’s engagement in CSR weakens its financial performance [27, 62, 86, 91]. Still, other studies have identified no significant relationship between ESG-CFP, explaining that a firm’s participation in CSR has no effect or does not influence its financial performance [89]. In view of the above ambiguities, this paper aside from investigating the relationship between ESG scores and CFP, further dives deeper to understand the causality between ESG scores and CFP. Is it ESG scores that cause financial performance, or vice versa? Therefore, we further propose that:

H₃: ESG scores positively cause (causality) financial performance.

2. Materials and Methods

The data, variables considered, and techniques utilized to produce the desired outcomes are addressed in this section.

2.1. Database and Sample Selection

Both the financial and ESG data were collected from the Thomas Reuters Refinitiv database (2011-2021). Refinitiv’s ESG scores are made to measure a firm’s relative ESG performance, commitment, and effectiveness based on information provided by the company. This addresses ten

major topics, including emissions and the environment. The scores are based on ten main themes categorized under the Environmental Pillar (resource use, emissions, and product innovation), the Social Pillar (workforce, human rights, community and product responsibility), and the Governance Pillar (Management, Shareholders, and Corporate Social Responsibility, CSR strategy). Their combined ESG score measures and illustrates the sustainability level of a company. Measured in percentile (or grades from D- to A+) (see Figure 4), the combined ESG score is the sum total of a company’s Environmental, Social, and With minimal transparency and company biases, the Refinitiv ESG scores are based on the relative performance of environmental, social, and governance factors that are material to the particular company, industry, and its country of incorporation.

The listed firms on the German Stock Exchange (XETRA), GSE, were the primary focus of this paper. The panel data was compiled from the above mentioned database because of its most comprehensive ESG scores, which covers over 80% of the global market capitalization across over 630 different ESG metrics [80]. It consists of 450 listed companies with 4,950 observations across the 11 industrial sectors of the GSE from 2011 to 2021. The German Stock Exchange platform Xetra was chosen for this study because of its high traded volume. Xetra holds a 60% market share in Europe for listings on the *Deutscher Aktienindex*- the German Stock Exchange, DAX [103]. Hence, Xetra was selected as the universe for this paper because of its significant market dominance across Europe.

Score range	Grade	Description
0.0 <= score <= 0.083333	D -	'D' score indicates poor relative ESG performance and insufficient degree of transparency in reporting material ESG data publicly.
0.083333 < score <= 0.166666	D	
0.166666 < score <= 0.250000	D +	
0.250000 < score <= 0.333333	C -	'C' score indicates satisfactory relative ESG performance and moderate degree of transparency in reporting material ESG data publicly.
0.333333 < score <= 0.416666	C	
0.416666 < score <= 0.500000	C +	
0.500000 < score <= 0.583333	B -	'B' score indicates good relative ESG performance and above-average degree of transparency in reporting material ESG data publicly.
0.583333 < score <= 0.666666	B	
0.666666 < score <= 0.750000	B +	
0.750000 < score <= 0.833333	A -	'A' score indicates excellent relative ESG performance and high degree of transparency in reporting material ESG data publicly.
0.833333 < score <= 0.916666	A	
0.916666 < score <= 1	A +	

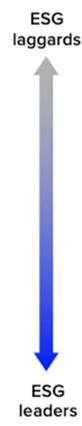


Figure 4. Refinitiv’s ESG scoring range.

2.2. Refinitiv ESG Scoring Methodology

Refinitiv ESG ratings integrate and take into consideration industry materiality and business size (market cap) biases, reflecting the underlying ESG data methodology and providing a transparent, data-driven evaluation of companies’ relative ESG performance and capability. The ESG scoring system used by Refinitiv adheres to a number of important calculating principles. Moreover, an overall ESGC score is

also calculated which discounts the ESG score for news controversies that materially impact companies. The underlying metrics are granular enough to distinguish between firms that have limited reporting, and or who lack transparency, and firms that 'walk the walk' and become market leaders in their fields.

According to Refinitiv model in Figure 5, consists of two overall ESG scores namely; ESG score (a measure of firms’ ESG performance based on verifiable reported public data) and ESGC score (comprising of the ESG score and ESG

controversies (score) to provide a comprehensive assessment of firms' sustainability conduct and impact over time).

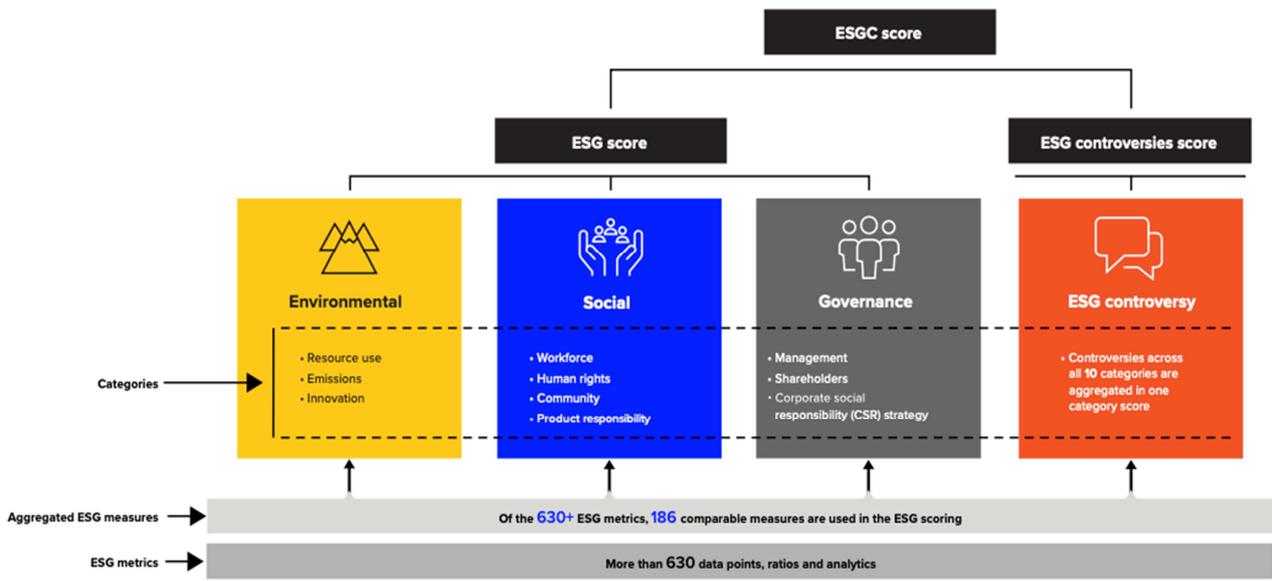


Figure 5. Compositions of Refinitiv's ESG score methodology. Source: (Refinitiv, 2022).

The ESG combined (ESGC) score is used for this thesis since it is the only factor that considers a company's involvement in controversies when calculating its sustainable performance score. Accordingly, if a corporation is embroiled in ESG controversies, the overall ESG combined score will be a weighted average of the ESG score and the ESG controversies score for that year. The ESG controversy score is assessed based on topics like fines, lawsuits, and ongoing legislation settlements or disputes. The particular

firm gets penalized in the year of the scandal, which lowers their total ESG combined score, ESGC.

The scores are calculated using a percentile rank scoring approach which is based on the ten category scores (see Figure 5) and the ESG controversies score. According to Refinitiv [80], the percentile is based on the following three factors; firms which are worse than the current one, firms with the same value and firms with a value at all. These three factors are mathematically computed as:

$$Score = \frac{no.of\ companies\ with\ a\ worst\ value + \frac{no.of\ companies\ with\ the\ same\ value\ in\ the\ current\ one}{2}}{no.of\ companies\ with\ a\ value}$$

According to Refinitiv, this approach is more robust and not sensitive to outliers. The TRBC industry group is used as the baseline in calculating the Environmental, Social, and Controversies scores.

2.3. Research Design

A quantitative analysis seemed to be the most appropriate approach given that the goal of this paper to look into the relationship between ESG scores and corporate financial performance [16]. In essence, the paper aims to investigate whether sustainable investments (that is if firms with higher ESG scores) improve their financial performance.

A multi-dimensional method, using panel data was used to investigate the relationship between ESG and corporate financial performance in this research. When compared to cross-sectional and time-series data, panel data typically have more degrees of freedom and sample variation, which increases the efficiency of the estimators [58]. The authors further argue that panel data is more suited to capturing the complexity in general and specific human behaviors. Finally, Bouslah et al., [20] showed that panel data results can be more generalized since its multi-dimensional method reduces

the effects of potential temporal errors that could affect the data. Furthermore, a panel data approach is a more suitable method as it provides insights into the long-term effect of this relationship [16, 20]. A multi-dimensional panel data approach is therefore employed in this study to investigate the relationship between ESG and corporate financial performance.

The study employs the ordinary least square multiple regression (OLS) model and the panel vector autoregression (PVAR) methods along with a system-generalized method of moment (System-GMM) to investigate the correlation and dynamic causal relationship, primarily between ESG scores and corporate financial performance.

In this paper, multiple regression was utilized to investigate the relationship between ESG scores and corporate financial performance. Our motivation for employing this tool in our analysis was by using independent variables whose values are known to predict the value of the single dependent value [76, 94]. Moreover, this model removes bias by accounting for the correlation between the dependent variable and propensity scores [83]. The regression equation for this paper is expressed as;

$$Y = a + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_n X_n + \epsilon_i$$

Where Y is the dependent variable, a is the intercept, X_1, \dots, X_n are the n independent variables, and ϵ_i is the stochastic error term. In calculating the weights, $a, \beta_1, \dots, \beta_n$, regression analysis ensures maximal prediction of the dependent variable from the set of independent variables through the least squares estimation.

In satisfying the conditions for regression analysis, the model's linearity, independence of residuals, multicollinearity, homoscedasticity, and autocorrelation were checked [76, 82, 94]. Finally, the Granger causality test was also conducted to establish the direction of causality between ESG score and CFP.

2.4. Models' Variables Definition and Description

The components of firm financial performance are of central importance to management research because explaining variation in firm performance is a key subject in the study of organization [62, 100]. The relationship between accounting-based (such as return on assets (ROA), return on equity (ROE), and return on sales (ROS)) and market-based measures (such as Tobin's Q and market returns) has significant implications

for organizational research [13], since it concerns whether firms' financial performance should (or can) be treated as a one-dimensional construct or not [11, 62, 81, 100]. For a comprehensive understanding of the impact of ESG on firm financial performance, this study considers both the accounting-based and market-based measures as indicators of firm financial performance (dependent variables). In theory, accounting-based measurements reflect past or short-term financial performance, whereas market-based indicators are reflections of future or long-term financial performance [100]. ROA and Tobin's Q are employed as independent variables in this study as recommended by some previous studies [2, 26, 56, 98].

Moreover, the total Environmental, Social, and Governance (ESG) score and its component pillar scores (Environmental, E Score, Social, S Score, and Governance, G Score) are regarded as the primary independent variables. According to related literature in this field, Total Assets, Price-to-Cash Flows, Book Value Per Share, and Total Debts are major financial variables that affect the performance of stock returns and are thus, identified as control variables in this study [13, 98]. Table 2 below shows the summary of the regression variables.

Table 2. Summary of regression variables.

Dependent variable	Independent variables	Control variable
Return on Assets (ROA)	ESG score	Total Assets
Tobin's Q	E score	Total Debts
	S score	Book Value Per Share
	G score	

The panel data regression model for the studies is given as:

$$RA = \alpha + \beta_1 ESG + \beta_2 TA + \beta_3 BV + \beta_4 TD + \epsilon \tag{1}$$

$$RA = \alpha + \beta_1 E + \beta_2 S + \beta_3 G + \beta_4 TA + \beta_5 BV + \beta_6 TD + \epsilon \tag{2}$$

$$TQ = \alpha + \beta_1 ESG + \beta_2 TA + \beta_3 BV + \beta_4 TD + \epsilon \tag{3}$$

$$TQ = \alpha + \beta_1 E + \beta_2 S + \beta_3 G + \beta_4 TA + \beta_5 BV + \beta_6 TD + \epsilon \tag{4}$$

Where RA is the return on assets, ESG is the Environmental, Social, and Governance scores, TA represents Total Assets, BV is Book Value Per Share, TD is Total Debts, α the y-intercept, β is the coefficient of the respective independent variables, and ϵ is the stochastic error term. Table 3 illustrates the definition and description of the variables.

Table 3. Definition and Description of regression variables.

Definition/Description of variables	
Return on Assets (RA)	Return on assets (ROA) is a measure of how efficiently a company uses the assets it owns to generate profits. ROA = (Net Profit / Total Assets) x 100
Tobin's Q (TQ)	Tobin's Q is the ratio between the market value of physical assets and their replacement value or cost. TQ = Total Asset Value of Firm / Total Market Value of Firm, or TQ = Equity Book Value / Equity Market Value
Environmental Social and Governance (ESG) scores	ESG scores indicate a firm's aggregated environmental, social and corporate governance pillars scores.
Total Assets (TA)	Total assets refer to the sum of the book values of all assets owned by a firm. The value of a company's total assets is obtained after accounting for depreciation associated with the assets.
Book Value Per Share (BV)	Book value per share (BVPS) is the ratio of equity available to common shareholders divided by the number of outstanding shares. This figure represents the minimum value of a company's equity and measures the book value of a firm on a per-share basis.
Total Debts	Total debt is the sum of all balance sheet liabilities that represent principle balances held in exchange for interest paid.

This research also adopts the dynamic panel vector autoregression (PVAR) methodology to investigate the relationship between ESG scores and corporate financial performance. The dynamic nature solves the issues of serial correlation and endogeneity of the explanatory variables. The system-GMM approach will be applied since it produces efficient estimators [19, 70]. The PVAR combines the conventional VAR method, which treats all system variables as endogenous, and with the panel data method, which allows unobserved individual variations [1, 69]. System-GMM transforms equation (5) into first differences and uses the lagged values of the endogenous variables as instruments that create efficient regression estimates.

Following [1, 6], the first-order PVAR model which is used to determine the ideal lag for the model selection as shown in (5).

$$Z_{it} = \mu_i + \Phi(I) Z_{it-1} + v_i + \theta_t + \varepsilon_i \quad (5)$$

Where $i = 1, 2, 3, \dots, N, t = 1, 2, 3, \dots, T, Z_{it}$ represents the dependent variables, Z_{it} is the independent variables, $\Phi(I)$ is the lag operator of the endogenous covariates, v is an individual specific effect, θ is fixed time effect and ε is the stochastic error term. Following [1], the first difference equation which addresses the country-specific fixed and time effects is given by equation (6).

$$\Delta Z_{it} = \Delta \mu_i + \Phi(I) \Delta Z_{it-1} + \Delta v_i + \Delta \theta_t + \Delta \varepsilon_i \quad (6)$$

Δ as the difference operator, this study estimates the PVAR by using the robust system-GMM estimator developed by [19] and also tests the Granger causality between ESG scores and corporate financial performance. Unlike the conventional VAR, the system-GMM PVAR

expands the estimation sample and improves the consistency and robustness of the results [1].

2.5. Robustness Measures

Numerous robustness checks were carried out to guarantee that the relationships identified by this study are efficient, reliable, and unaffected by spurious relationships. The Gauss Markov assumptions that make Ordinary Least Squares (OLS) the best linear unbiased estimators (BLUE) were used to diagnose the variables and the regression estimations [45].

The assumptions of normality, multicollinearity, and heteroscedasticity were tested to ensure the efficiency of the regression estimates [54]. The assumption of normality was tested using the Jarque-Bera test. The Jarque-Bera test is a goodness-of-fit test that determines if sample data have skewness and kurtosis that are close to those of a normal distribution. The Variance Inflation Factor (VIF) and the White test were utilized to identify and address the presence of multicollinearity and heteroscedasticity respectively.

3. Analysis and Results

3.1. Descriptive and Summary Statistics

Table 4 presents an overview of the descriptive statistics of listed companies on the German Stock Exchange (Xetra) from 2011 to 2021. With a total of 450 firms and 4,950 observations, the Industrial, Information Technology, and Consumer Discretionary industry sectors represent the top-ranked industries with the highest frequencies of firms, representing 88, 85, and 59 firms respectively.

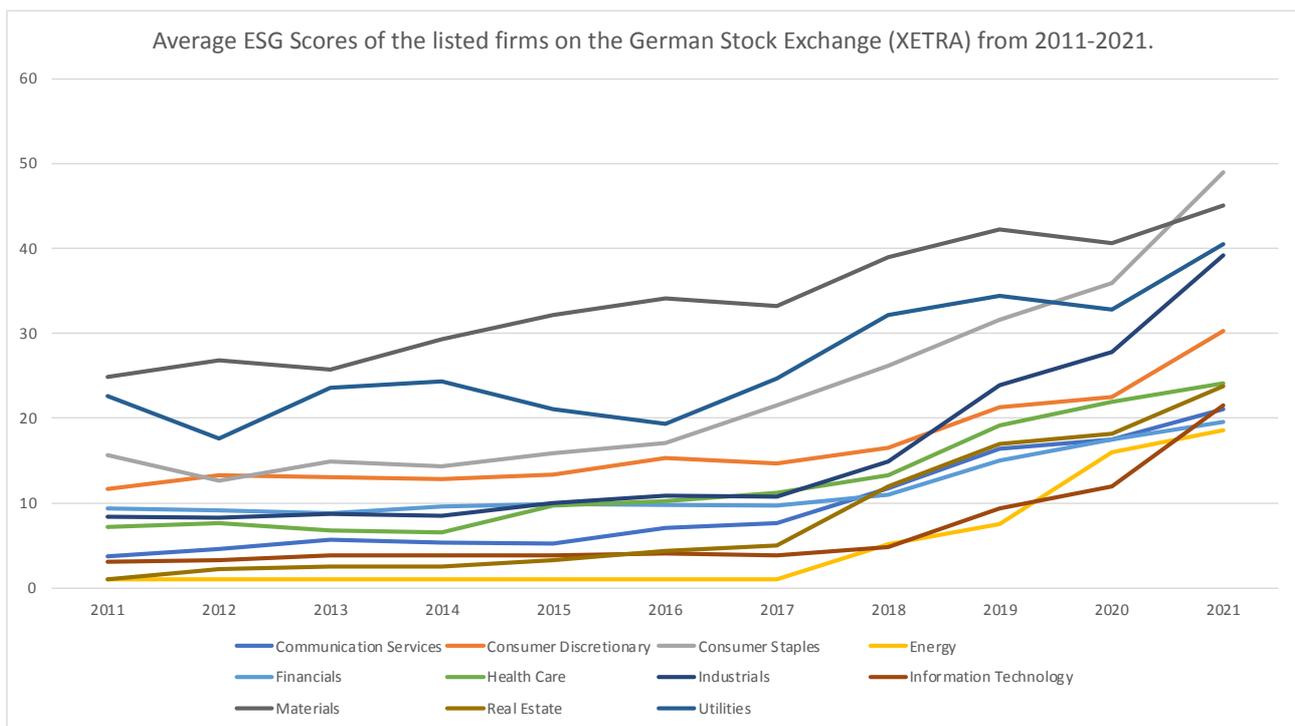


Figure 6. The evolution of ESG scores of the listed companies on the GSE from 2011 to 2021.

Table 4. Summary statistics of the industrial sectors on the German Stock Exchange.

Industry Sectors the German Stock Exchange, Xetra	No. of firms	Freq.	Percent	Cum.
Communication Services	31	341	6.89	6.89
Consumer Discretionary	59	649	13.11	20.00
Consumer Staples	11	121	2.44	22.44
Energy	7	77	1.56	24.00
Financials	55	605	12.22	36.22
Health Care	48	528	10.67	46.89
Industrials	88	968	19.56	66.44
Information Technology	85	935	18.89	85.33
Materials	21	231	4.67	90.00
Real Estate	37	407	8.22	98.22
Utilities	8	88	1.78	100.00
Total	450	4950	100	

Figure 6 shows the evolution of the average ESG scores of the 11 industrial sectors of the German Stock Exchange (GSE) from 2011 to 2021. The average ESG score for the Consumer Staples sector rose from 14.8 in 2011 to become an industry leader in 2021 with an average score of 48.8. With a total revenue of 20.7 billion EUR (2021), Henkel AG & Co. KGaA had the highest ESG average score of 73.7 from 2011 to 2021 followed by Beiersdorf AG with an average ESG score of 59.5.

The Material sector which has been the industry leader from 2011 to 2020 had an average ESG score of 44.7 in 2021. Heidelberg Cement AG recorded the highest average ESG score of 70.6 in the Material sector from 2011 to 2021. Followed by BasfSe with an average ESG score of 68.4%, the energy sector has consecutively recorded the lowest average ESG over the period with 4.0 in 2021. In a nutshell, the industry has recorded a 2.3% growth in average ESG scores from 2011 (of 98.956) to 2021 (of 327.491).

The summary statistics of the ESG and financial variables used in this study are presented in Table 5. The table indicates the total number of observations used for this study, their mean, standard deviation, and the minimum and the

maximum number of observations. The table indicates that the listed firms have an average Tobin's Q or Q ratio of 0.999. A low Q ratio between 0 and 1 means that the cost to replace a company's assets is greater than the value of its stock. This means that the stock is undervalued. On the other hand, a high Q ratio (greater than 1) implies that a firm's stock is more expensive than the replacement cost of its assets, which means that the stock (or market) is overvalued. In this case, the market's Q ratio of 0.999 implies that the companies are undervalued suggesting that the market looks attractive to investors, potential purchasers, or corporate raiders, as they may want to purchase firms instead of creating similar companies. This would likely result in increased interest in the firms, which would increase their stock prices and increase its Tobin's Q ratio. The correlation test also indicates that both the total ESG scores and its pillar scores have significant and negative relationship between the independent (financial) variables, return on assets (ROA) and Tobin's Q [30, 89]. However, as found in the appendix, the ESG variables resulted significant and positive correlations between total assets (TA) and book value per share (BV).

Table 5. Summary statistics of regression variables.

Variable	Obs.	Mean	Std. Dev.	Min	Max
ROA	4,950	.0181477	.073807	-1.1399	1.12439
TQ	4,950	.9994972	3.274939	0	177.8022
ESG Score	4,950	13.32012	23.73813	1	92.75507
E Score	4,950	13.2573	25.78059	1	98.31469
S Score	4,950	15.18925	27.64224	1	98.24187
G Score	4,950	13.52111	24.85359	1	96.86117
Total Debt	4,950	3.24e+09	2.05e+10	0	26.92618
Book Value Per Share	4,950	13.18895	37.57828	-76.25214	921.3256
Total Assets	4,950	1.71e+10	1.15e+11	0	2.80e+12
Market Risk (Beta)	4,950	.3642754	.5062403	-4.275566	4.527875

3.2. Robustness Tests

To ensure the accuracy of the estimates, the model's normality, multicollinearity, and heteroscedasticity test were checked. Robust standard errors were used to estimate all the models to address the possibility of heteroscedasticity. Transforming the data into natural logs to ensure its normal distribution [102], the presence of multicollinearity was also accounted for and addressed using the Variance Inflation

Factor (VIF) [3, 38, 39, 47]. The eigenvalue stability condition after estimating the parameters of the panel autoregression was also checked. Gregory [55] showed that if the modulus of each individual eigenvalue of the estimated model or matrix is less than one, the estimated panel VAR is considered stable. Therein, since each eigenvalue's modulus is strictly less than 1, the estimates for this paper met the eigenvalue stability requirement as shown in Figure 7 and Table in the appendix.

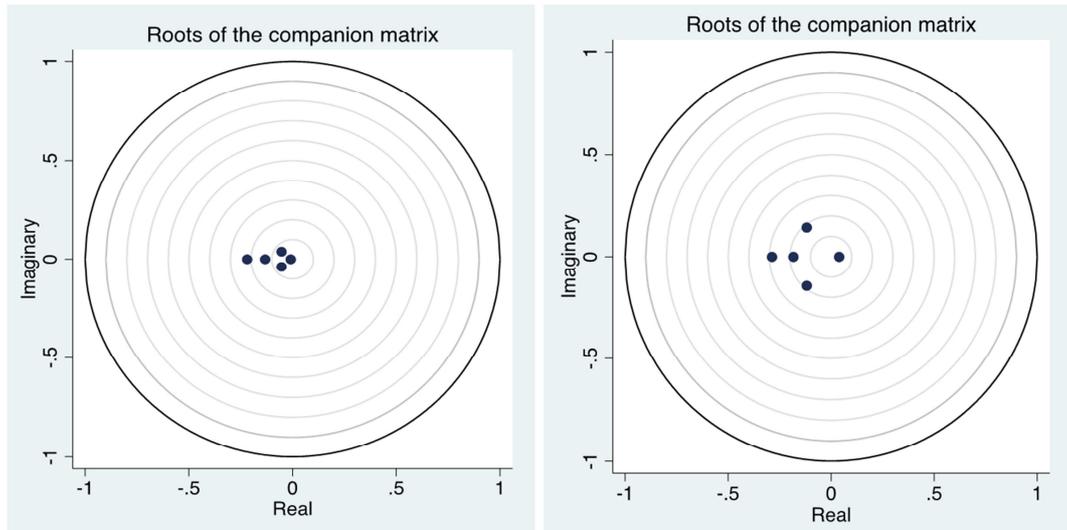


Figure 7. Stability of Return on assets PVAR (Left) and Tobin's Q PVAR (Right).

3.3. Regression Results

The study used different robust multiple (panel) regression models, to investigate: the impact of ESG scores on corporate financial performance (CFP), the impact of ESG scores on market risk (Beta), and the causality between ESG and CFP (using the PVAR Granger causality test). It is worth noting that both accounting-based (ROA) financial performance and market-based (Tobin's Q) financial performance were also examined.

3.4. Regression Results of ESG-CFP Link

Table 6. Regression output investigating the impact of ESG scores on CFP.

Independent variables	Dependent variables	
	Model 1 (ROA)	Model 2 (Tobin's Q)
ESG Score	.1316985 *	.2376158 *
	(.0157681)	(.0144785)
E Score **	-.0942853 *	-.1432742 *
	(.0432311)	(.0337002)
S Score **	.1644868 *	.4220051 *
	(.0726071)	(.0603117)
G Score**	.0524279	-.0655919
	(.0644075)	(.0526852)
Total Debts	-.0686653 *	-.0889766 *
	(.0179408)	(.0145815)
Book Value Per Share	.0817154 *	-.0052151
	(.029862)	(.0234544)
Total Assets	-.1657615 *	-.2500099 *
	(.0284173)	(.0244316)

Heteroskedasticity robust standard errors in parenthesis,*p-value <0.05. **Variables estimated separately with the other independent variables and without the total ESG score.

Model 1 of Table 6 reports the relationship between ESG scores and corporate financial performance (return on assets, ROA). The ESG score's regression coefficient of 0.132 indicates a positive relationship between it and CFP. With a p-value of less than 0.05, this shows that there exists a statistically significant relationship between ESG scores and

CFP. This means that a unit increase in ESG scores will increase ROA by 0.132 units. The remaining independent variables were all statistically significant at 5% significance level. The table shows a negative relationship between Debts and Total Assets and ROA. The table shows that a unit increase in debts and total assets will decrease return on assets by 0.067 and 0.166 respectively. There is, however, a statistically positive relationship between book value per share and ROA. A one unit increase in book value per share increases returns on assets by 0.082. Regarding the ESG pillar scores of Model 1, aside from the Government score, all the other independent variables were statistically significant at 5%. A unit increase in Environmental score reduces ROA by 0.094. Also, a unit increase in the Social score increases ROA by 0.164. Despite a positive relationship between the Government score and ROA, the result was statistically insignificant at 5%.

In the same way, Model 2 of Table 6 presents the findings of the relationship between ESG scores and CFP (Tobin's Q). Like the ROA, the table shows a positive and statistically significant relationship between the firms' ESG scores and their financial performance. It shows that a unit performance increase in ESG scores will increase Tobin's Q by 0.238. Aside from Book-value per share, all the other independent variables were statistically significant. The table shows a statistically significant negative relationship between Debts, Total Assets and Tobin's Q. Aside from the Government score and Book value per share, all the other variables were statistically significant. A unit increase in the Environmental score reduces Tobin's Q by 0.143. On the contrary, a unit increases in the Social pillar score increases Tobin's Q by 0.422. Although statistically insignificant, there was a negative relationship between the Government score and Tobin's Q.

Insofar, the empirical results from the multivariate regression analysis support the study's main hypothesis (H₁) which states "There exists a statistically significant positive

relationship between the overall ESG scores and the corporate financial performance of the listed firms on the German stock exchange”. The overall ESG score from Table 6 in Model 1 and Model 2 shows a positive and statistically significant relationship between ESG scores and corporate financial performance (return on assets) and market-based financial performance (Tobin’s Q). Further analysis indicates that there is weak support for hypothesis H_{1a} which states that “There exists a statistically significant positive relationship between the distinct ESG pillar scores and the corporate financial performance of the listed firms on the German stock exchange”. Aside from the Social score that showed a positive and statistically significant relationship between both financial performance measures, the rest of the pillar scores showed mixed findings as presented in Table 6.

3.5. ESG and Systematic Market Risk (Beta) Link

Table 7 below presents the regression output investigating the relationship between ESG scores and beta- which measures the volatility of a security, portfolio, or stock compared to the total market. The table shows that at the 5% statistically significant level, there exists a positive relationship between ESG and beta. It states that a unit increase in ESG will increase beta by 0.089. This means that ESG scores increase the volatility of stocks in the market. Which indicate that adding high-performing ESG score stocks to a portfolio will increase the portfolio’s risk, which may also increase its expected return. Aside from the Government score, all the other independent variables were statistically insignificant at 5% significance level. The table shows that a unit increase in Government score will increase beta by 0.098.

3.6. System-GMM Pvar Causality Results

Table 8 presents the causal relationship between return on assets (ROA), Tobin’s Q, ESG scores, total debts, book value per share, and total assets. The results from Panel A of Table 8 show that financial performance measured by ROA does not cause ESG scores and vice versa. However, book value

per share Granger causes both financial performance and total assets. A one-unit increase in book value per share increases ROA by 0.27 and total assets by 0.155. On the other hand, Panel B of Table 8 shows the causal relationships between market-based financial performance (Tobin’s Q), ESG scores, total debts, book value, and total assets. The results show that ESG scores Granger cause financial performance (Tobin’s Q). In a way that, a unit increase in ESG scores decreases Tobin’s Q by 0.314. However, Tobin’s Q does not Granger cause ESG score performance. ESG score however Granger causes book value per share. Thus, book value per share will increase by 0.146 when ESG scores improve by a unit. However, book value per share does not Granger cause ESG score. Total debts and total assets both Granger cause ESG scores. A one-unit increase in total debts and total assets increases ESG scores by 0.06 and 0.009 respectively.

Insofar, hypothesis 3 which states that “ESG scores positively cause (causality) financial performance” is not supported. Since ESG scores do not positively Granger cause any of the financial performance.

Table 7. ESG-beta link regression output.

	Dependent variable
	Beta
ESG score	.0886738 * (.0113883)
E score **	-.0138639 (.0249314)
S score **	.0073573 (.0399314)
G score **	.0983078 * (.0374105)
Total debts	.0036246 (.0119434)
Book value per share	.0035489 (.0161295)
Total assets	.0084985 (.1998503)

Heteroskedasticity robust standard errors in parenthesis. * p-value < 0.05. ** Variables estimated separately with the other independent variables and without the total ESG score.

Table 8. Estimated causality results from the dynamic panel system-GMM.

Panel A: ROA	Dependent variables				
	ROA	ESG Score	Total debts	Book value per share	Total assets
ROA		.0379596 (.0360163)	-.017373 (.0268824)	.0352996 (.146026)	.2015752 (.2114974)
ESG Score	.0606122 (.0538058)		-.0352211 (.0520534)	.1031821 (.1598255)	-.0941502 (.2753782)
Total debts	.0393176 (.0340797)	.0205143 (.0238999)		.1678004 (.1243006)	.0889969 (.2329332)
Book value per share	.0268791 * (.0118353)	.0179099 (.0092853)	-.0093321 (.0082948)		.1553317 * (.0604318)
Total assets	-.0084513 (.0092796)	.0029936 (.0080723)	-.006823 (.0060943)	.0010368 (.0295748)	
Panel B: Tobin’s Q		ESG Score	Total debts	Book value per share	Total assets
Tobin’s Q		0174103 (.0162508)	-.0111176 (.0152065)	-.0927102 * (.0422385)	-.3906436 * (.1153117)
ESG Score	-.3136894 * (.0739317)		-.0454039 (.0415625)	.1457614 * (.0533793)	.082217 (.2447583)

Panel A: ROA	Dependent variables					
	Independent variables	ROA	ESG Score	Total debts	Book value per share	Total assets
Total debts		-1.580889 *	.0619743 *		-.0152144	.5721241 *
		(.0646357)	(.0282503)		(.0622603)	(.1802001)
Book value per share		.0785673	-.0151468	-.000691		.2269902
		(.0258931)	(.0086933)	(.0139363)		(.090062)
Total assets		.0494033	.0087966 *	.0088968	.0256757	
		(.0135477)	(.006411)	(.0073261)	(.0145404)	

* Heteroskedasticity robust standard errors in parenthesis. * p-value < 0.05.

4. Discussions

Previously, empirical studies on the ESG-CFP relationship have been inclusive and mixed. According to Freeman [42], in majority of cases, statistically significant positive outcomes are observed regarding the impact of total ESG scores on firms' financial performance. The findings of this paper are not different as a positive and statistically significant relationship was found between the total ESG scores and the various financial performance measures. Our findings are consistent with those of [27, 60, 84, 90], who established that in the advancement of time, the positive impact of ESG scores on financial performance gradually begins to offset the cost of ESG investment which eventually increases firms' financial performance.

Moving forward, the environmental score (E) showed a statistically significant but negative relationship between both ROA and Tobin's Q. This component comprises a firm's performance regarding climate change, natural resources, level of greenhouse gas emissions, pollution and waste, and environmental opportunities. The findings suggest that environmental aspects somewhat have negative on firms' financial performance. A possible explanation could be the high upfront infrastructure and investment costs required by companies to acquire and install pollution-controlling technologies which could have a huge dent on firms' financial balance sheets. This finding might also be explained by the fact that waste disposal costs are higher as a result of stricter rules and/or the fact that businesses may frequently run the danger of failing to comply with the law and face legal actions which could be expensive. The regression with the Government score, G did not show any significant results with both financial measures. This finding contradicts the report that the G component contributes to firms' value creation [37, 56].

The only positive and statistically significant component score finding with both financial measures was the Social score, S. This component (S) assesses how firms treat their employees and their communities. Working conditions, employee relations, organizational diversity, employee equality and justice, human rights, inclusion, product responsibility, and community health and safety are some of the key points. The findings suggest that it's a win-win situation when companies take the effort to better the working conditions of their employees and as well improve the communities they operate. This finding is consistent with the findings of [98, 105].

Previous studies provide limited evidence on the

relationship between ESG scores and firms' systematic market risk (beta) [87], which this paper sort to bridge. The findings show that total ESG scores increase the volatility (beta) of the listed firms. This means that adding stocks with better ESG scores to a portfolio might increase the portfolio's risk, which might also increase its expected return. In contrast, securities or portfolios with less volatility are less risky and award lower returns. Hence, as the saying goes, the higher the risk the higher the returns. However, it is worth noting that, in reality, financial returns are not always normally distributed. Therefore, what a stock's beta may suggest about its potential future movement should always be taken with caution [58, 65]. It is of interest to point out that, the Government score, G showed statistically significant and positive relations with the beta. However, both the Environment score, E and Social score, S were statistically insignificant at the chosen 5% significance level.

Furthermore, the Granger causality test was as well introduced to investigate the direction of causality between ESG scores and corporate financial performance. The results suggest that return of assets, ROA does not Granger cause ESG scores, and vice versa. The second-panel model showed that ESG scores Granger cause Tobin's Q, and their relationship is negative.

5. Implications of the Study

This paper contributes to the emerging field of how sustainability and corporate social responsibility affect firms' financial performance. Specifically, by focusing on how ESG scores (a proxy for firms' sustainability performance) affect the financial performance of German-listed firms. Practically, this paper highlights how to integrate ESG data into financial portfolios. The results provide further and deeper knowledge on how to further incorporate ESG data into investment decisions. This will be of interest to investors in general, and particularly to socially responsible investors. Thus, the paper could provide motivation for portfolio managers of SRI funds to expand their strategies without losing focus on ESG criteria with ambiguity issues concerning ESG-CFP findings over the years being addressed.

On the other hand, only the effect of ESG Scores on the financial performance of firms listed on the German Stock Exchange is being studied. Hence, these findings might not represent or apply to all areas because of the firms' selection criteria and the various methodological approaches and baselines used by different rating agencies in calculating ESG scores.

6. Conclusion

In light of the increasing awareness among investors and academic researchers regarding firms' ESG performance and corporate financial performance nexus, this study explores the link between ESG scores and corporate financial performance by focusing on the listed firms on the German Stock Exchange, Xetra from the year 2011 to 2021. Previous empirical findings on this subject have been inconclusive and mixed. This paper takes the matter a step further by first investigating the relationship between ESG scores and corporate financial performance. Grounding on the fact that volatility plays a crucial part in stock returns (their financial performance), the study further examines the role of ESG scores on stock volatility. The causality between ESG and corporate financial performance is as well investigated in the research.

With a total of 450 listed firms and 4,950 observations sourced from the Refinitiv database, vector autoregressive (PVAR) together with the system-generalized method of moments (system-GMM) and robust panel multiple regression models were employed to examine the impact and causal relationship between ESG scores and corporate financial performance. The results suggest that ESG scores contribute to organizations' financial performance. We found that better ESG ratings increase companies' systematic risk

(volatility), which could boost or increase their stocks' returns. The study however did not find Granger causality between ESG scores and the accounting-based financial performance (ROA), but it did for the market-based financial performance (Tobin's Q). It showed that ESG scores negatively Granger cause firms' financial performance. In a nutshell, organizations' financial performance may be improved by having a higher ESG score and performing better in the social dimension. Overall, the evidence supports the idea that a business case exists for sustainability and corporate social responsibility.

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Conflicts of Interest

The authors declare no conflict of interest.

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Appendix

Table A1. Correlation matrix between the total ESG scores and the other variables.

	ROA	TQ	ESG	T. Debt	BV	T Assets
ROA	1.0000					
TQ	0.6688*	1.0000				
ESG	-0.1058*	-0.1174*	1.0000			
T. Debt	-0.3134*	-0.3935*	0.5859*	1.0000		
BV	-0.1324*	-0.2857*	0.3767*	0.4484*	1.0000	
T. Assets	-0.3337*	-0.4579*	0.6675*	0.8596*	0.5879*	1.0000

*p ≤ 0.05

Table A2. Correlation matrix between the ESG pillar scores and the other variables.

	ROA	TQ	E Score	S Score	G Score	Debt	BV	TA
ROA	1.000							
TQ	0.669*	1.000						
E Score	-0.141*	-0.157*	1.000					
S Score	-0.106*	-0.117*	0.967*	1.000				
G Score	-0.108*	-0.122*	0.9550*	0.9861*	1.000			
Debt	-0.313*	-0.394*	0.599*	0.590*	0.588*	1.000		
BV	-0.132*	-0.286*	0.385*	0.378*	0.375*	0.448*	1.000	
TA	-0.334*	-0.458*	0.678*	0.670*	0.668*	0.860*	0.588*	1.000

*p ≤ 0.05

Table A3. Variance inflation factor (VIF) of the regression variables.

Variables	ROA		Tobin's Q	
	VIF	1/VIF	VIF	1/VIF
Total Assets	6.15	0.162594	6.35	0.157357
Total Debt	4.18	0.223049	4.46	0.224326
Book Value	1.82	0.549441	2.03	0.492541
ESG	1.52	0.658048	1.55	0.646935
Mean VIF	3.49		3.60	

Table A4. Return on assets PVAR stability table. Source: Author's calculation.

Eigenvalue		
Real	Imaginary	Modulus
-.2190349	0	.2190349
-.1322748	0	.1322748
-.0532543	-.0387222	.065844
-.0532543	.0387222	.065844
-.0089799	0	.0089799

Table A5. Tobin's Q PVAR stability table.

Eigenvalue		
Real	Imaginary	Modulus
-.2871545	0	.2871545
-.1185983	.1434348	.1861158
-.1185983	-.1434348	.1861158
-.1833846	0	.1833846
.0386973	0	.0386973

Table A6. ESG criteria of major index providers. Source: Refinitiv, MSCI, Bloomberg, FTSE; OECD assessment.

Pillar	Thomas Reuters	MSCI	Bloomberg
Environmental	Resource use	Climate change	Carbon emissions
	Emissions	Natural resources	Climate change effects
	Innovation	Pollution & Waste	Pollution
		Environmental opportunities	Waste disposal
Social	Workforce	Human capital	Renewable energy
	Human rights	Product liability	Resource depletion
	Community	Stakeholder opposition	Supply chain
	Product responsibility	Social opportunities	Discrimination
			Political contributions
Governance	Management	Corporate governance	Diversity
	Shareholders	Corporate behaviour	Human rights
	CSR strategy		Community relations
			Cumulative voting
			Executive compensation
			Shareholders' right
Key metrics and submetrics	186	34	Takeover defence Staggered boards Independent directors >120

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