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THE EFFECT OF AI-DRIVEN ESG RATINGS ON FIRM VALUATION: A CROSS-COUNTRY STUDY

Dr Faheem Qazi
Assistant Professor
Department of Business Administration
Greenwich University
dr.fahimqazi@greenwich.edu.pk

Abstract

Local disparities in various traditional rating agencies have raised concerns about the reliability of environmental, social, and governance (ESG) ratings, which in turn have made investors and policymakers wary. This paper examines the effects of AI-enhanced ESG ratings on the valuation of firms in an international context, addressing issues of subjectivity and the lack of comparability in sustainability ratings. It aimed to determine whether AI-enhanced ESG ratings are a more accurate predictor of a firm's market value. A quantitative methodology was employed, and information was gathered from 350 companies in the USA, the UK, Germany, and other countries. To ensure proportional sampling, a stratified sampling technique was employed to select industries (manufacturing, services, and technology/IT) and firm sizes (less than 500, 500-5000, and more than 5000 employees). Valued assessments, as measured by the Tobin Q, recorded the firm's valuation, whereas ESG evaluations, facilitated by AI scoring frameworks, helped in assigning ESG ratings. The obtained reliability scores were adjusted for the high degree of internal consistency (Cronbach's alpha: 0.892 for ESG ratings and 0.867 for firm valuation). Regression analysis indicated that the explanation of the difference in 38.7% of the firm valuation by the ESG ratings was a significant one ($R^2 = 0.387$), and a strong positive effect was observed ($\beta = 0.622$, $p < 0.001$). It is proposed that AI-based ESG ratings enhance the relevance of valuation and recommend better disclosure. AI ratings should be utilized in decision-making, and harmonized standards of reporting should be established across countries to achieve comparability.

Keywords: AI-based ESG Ratings, Firm Valuation, Sustainable Finance, Cross-country Analysis, Corporate Governance.

Introduction

Over the past few years, the issue of environmental, social, and governance (ESG) factors has come into sharp focus as part of making informed investment decisions and developing effective corporate financial policies. As the world has become more focused on sustainability and corporations witness the desire of stakeholders to discover the level of corporate transparency, ESG ratings have turned into meaningful measures of corporate performance as opposed to conventional financial indicators (Friede, Busch, and Bassen, 2015; Li, Gong, and Tang, 2023). It is a growing realization among investors, regulators, and firms that ESG performance is not only an indicator of corporate responsibility but also carries significant implications for firm valuation and long-term competition (Fatemi, Glaum, & Kaiser, 2018).

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The adoption of innovative technologies has transformed the methods of gathering, processing, and publishing ESG information. Specifically, algorithmic and robotic rating designs have enhanced the objectivity and scalability of ESG ratings, enabling comparisons across more countries (Drempetic, Klein, and Zwergel, 2020). As companies thrive in a more global and competitive business environment, it has become necessary to understand how the relationship between ESG ratings and firm valuation varies across different institutional settings.

Although the impact of ESG reporting disclosures on the financial performance of the firms in question has been previously examined, the tendency towards an increasingly sophisticated system of rating triggers a substantial demand to re-evaluate the stability of the ESG valuation linkages and their cross-municipal reliability (Velte, 2023). This paper fills this gap by examining the effects of algorithmically improved ESG ratings on firm valuation in various countries, providing both theoretical and practical implications of such ratings for global investors.

Rationale

The reason the study has been conducted is due to two broad concerns: (1) the increasing dependence of ESG ratings by investors, policymakers, and firms, and (2) the paucity of empirical literature regarding how systematically constructed ratings impact firm valuation in various institutional settings. The available literature reveals both positive and negative findings-in some studies, there are positive results as ESG performance raises the firm value with the research on the factors that contribute to the given effect as improved reputation and reduced risk (Broadstock, Chan, Cheng, and Wang, 2021), meanwhile, in other studies, individuals are unable to point to the inconsistent and incongruent results of poor rating options that can distort the measurements of valuation (Berg, Kolbel, and Rigobon, 2022).

Furthermore, with the shift that ESG has started to make towards a regulatory structure in most jurisdictions, a standardized and scalable rating system is a necessity (Sila & Cek, 2017). Accordingly, learning about whether the systematic derivation of ESG scores has meaningful effects on valuation in any of the countries can inform corporate strategies, notify global investors, and facilitate regulatory harmonization.

Problem Statement

Although ESG ratings are becoming a common part of both investment and corporate decision-making, the grading mechanisms and their impact on company valuation do not yield the same results for all countries and businesses. Past studies have concentrated on single-market or conventional disclosure-based ESG ratings but have not filled the results gap with a cross-country perspective on the impact of standardized and systematic ESG scores on firm value. Such a difference produces uncertainty for investors worldwide and policymakers, as they use these ratings in the context of capital allocation and regulatory systems. The extent to which algorithmically created ESG ratings can effectively influence firm valuation in various institutional settings is unclear unless there is empirical evidence of their impact.

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Research Question

1. What are the advantages of capitalization in firm valuation in countries using mechanized ESG ratings?

Research Objectives

- To assess the market in various countries in connection with the ESG rating and firms' valuation.

Theoretical Framework

Numerous financial and corporate governance theories can be used to base the relationship between ESG ratings and firm valuation.

First, there is the Stakeholder Theory, which argues that companies should add benefits not only to shareholders but also to other stakeholders, such as employees, customers, communities, and regulators (Freeman, Harrison, Wicks, Parmar, and De Colle, 2010). Implementing these sustainability aspects into corporate decisions enhances their legitimacy and overall sustainability, which can be indicated by increased firm valuation (Velte, 2023).

Second, there is another foundation in Signaling Theory. Good ESG scores represent a reputable indication of a company's commitment to sustainability and risk management, and thus they attract investors and minimize the cost of capital (Spence, 2002; Fatemi, Glaum, and Kaiser, 2018). Companies that adopt high levels of ESG are viewed as less susceptible to regulatory penalties, reputational damage, or environmental risks, which in turn can increase the value of their companies.

Lastly, it is the Resource-Based View (RBV), which asserts that when firms have strong ESG practices, they create intangible resources in the form of brand reputation, stakeholder trust, and employee commitment disproportionately; they generate sustainable competitive advantages and greater valuation (Hart, 1995; Broadstock, Chan, Cheng, and Wang, 2021).

A combination of these theories suggests that a systematic production of ESG ratings may have a desirable systemic effect on firm value, decreasing informational asymmetry, establishing reputational capital, and aligning corporations with various sustainability standards of the global economy.

Study Hypothesis

H_1: AI-driven ESG rating has a positive and significant impact on firm valuation when it comes to cross-country.

Conceptual Framework

The conceptual model is presented below and shows the hypothesized relationship between ESG ratings and the valuation of firms:

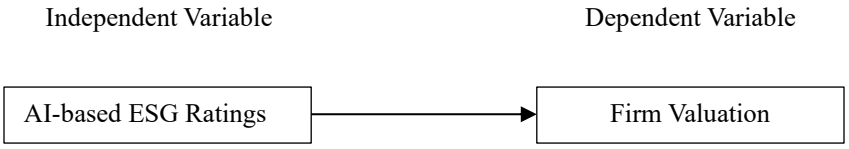


Figure 01: Conceptual Framework

Literature Review

ESG and Firm Valuation

The connection between ESG performance and a firm's valuation has been a subject of considerable research, with most results indicating a positive correlation. A meta-analysis conducted across 2,000 studies by Friede, Busch, and Bassen (2015) concluded that, in most cases, ESG factors have a positive correlation with a corporation's financial performance. The reasons attributed to this relationship include better risk management, increased investor confidence, and long-term sustainability benefits. Fatemi, Glaum, and Kaiser (2018) demonstrated that companies adhering to their ESG principles exhibit more prominent valuations, particularly when these valuations are announced publicly to capital markets. On the same note, Velte (2023) emphasized that ESG performance enhances firm value by increasing reputation and stakeholder congruence; however, differences in rating methodologies can sometimes lead to misleading results.

Rating Methodologies and Divergence Issues.

Still, drawing a positive trend, irregularities with ESG ratings are also a burning issue. Research has shown that various rating agencies are likely to issue divergent ESG ratings for the same firms, as some are based on minor methodologies (Berg, Kolbel, and Rigobon, 2022). Such a difference undermines shareholder trust and complicates the conduct of cross-national comparisons of firm sustainability performance. Drempetic, Klein, and Zwergel (2020) discovered that the size of firms significantly impacts ESG scores, such that the larger they are, the higher their rating becomes, as they can afford to disclose rather than adopt better sustainability practices. These contradictions highlight the importance of standardized and systematic methods for evaluating ESG.

Cross-Country Perspectives

The effectiveness of ESG ratings on firm valuation may vary across different institutional and cultural settings. The Turkish firms considered by Sila and Cek (2017)

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documented the potential of ESG practices in impacting firm performance; however, varying ESG improvement in magnitude occurred in the understudied firms based on governance systems and regulatory conditions. The study by Broadstock, Chan, Cheng, and Wang (2021) on Chinese companies during the COVID-19 pandemic found that ESG performance functioned as a buffer against market shocks, thereby improving the valuation of firms. Li, Gong, and Tang (2023) furthered this line of investigation to emerging markets by demonstrating that investor attention mediates the relationship between ESG performance, thereby speculating that the efficacy of ESG initiatives is culture- and economically conditioned. These works require cross-country studies to be conducted, providing heterogeneity in the effects of ESG ratings on firm values.

The ESG Rating Technological Advancements.

Computational techniques for analyzing ESG evaluation have advanced significantly in recent years, enhancing the reliability of data and improving comparability. This gives way to such systematic methodologies that are easier to transmit and scale, especially in cross-country studies. Indeed, the feasibility of automated rating methods minimizes subjective bias (Drempetic et al., 2020); however, they also warn about the array of risks associated with an excessive focus on volume instead of quality of disclosure. Research also suggests that the efficiency of markets can be enhanced with the aid of algorithmically improved ESG ratings, which reduce the level of information asymmetry between investors and companies (Berg et al., 2022).

Although the beneficial effects of ESG on a firm's valuation can be supported by evidence, several gaps remain. First, there is a lack of studies that capture cross-country differences in ESG valuation linkages, as most focus on a single-country setting (Velte, 2023). Second, ESG ratings generate uncertainty among investors due to methodological inconsistencies (Berg et al., 2022). Third, there are limited studies to systematically investigate ESG ratings, which may provide a more effective comparison of countries. The responses to these gaps are vital in understanding the extent to which standardized ESG ratings can educate firm valuation in subsequent firms across different settings and institutions.

Research Methodology

Research Design

The research design of this study is quantitative and cross-sectional, aiming to investigate the impact of systemically produced ESG ratings on the valuation of firms across several countries. The qualitative method is suitable for this purpose, as the hypothesis to be evaluated is the necessity of proving the statistical correlation between ESG ratings and firm valuation (Creswell & Creswell, 2018). By adopting a cross-country design, it is possible to compare firms operating in various institutional, regulatory, and cultural settings and gain insight into the effectiveness of ESG-valuation linkages on generalization (Berg, Kolbel, and Rigobon, 2022).

Population and Sample

The sample population of the current study will comprise publicly listed companies in both developed and emerging sectors, from which ESG ratings are obtained. These 350 firms would belong to five countries: the United States, the United Kingdom, Germany, Pakistan, and other developing countries. The choice of such countries was made to ensure diversity in terms of regulatory frameworks, ESG disclosure standards, and market maturity (Li, Gong, and Tang, 2023).

A purposive sampling method is employed, targeting firms with available ESG ratings data from reputable rating agencies and financial performance data (Velte, 2023). The strategy ensures the reliability of the data and facilitates comparisons between firms.

Data Sources

To conduct the proposed study, secondary data is utilized, which is obtained:

- ESG Ratings: Rating agencies, including MSCI, Refinitiv, and Sustainalytics, employ standardized techniques; therefore, the elements that comprise their algorithmic tools are considered a rating (Drempetric, Klein, & Zwergel, 2020).

- The firm's valuation indicators are obtained through market-based indicators (e.g., the Q of Tobin, market-to-book ratio), which are sourced from Bloomberg, Thomson Reuters Eikon, and annual firm reports (Fatemi, Glaum, and Kaiser, 2018).

- Demographics: Other variables gathered at the firm level include country of origin, industry sector, and firm size, providing descriptive information and control variables.

Measurement of Variables

- Independent variable (IV): ESG Ratings. This is an algorithmically derived ESG score (scale: 0-100), aggregated across the environmental, social, and governance dimensions.

- Dependent Variable (DV): Firm Valuation - To demonstrate the value of a company, the researchers employ the comprehensive metric that is Tobin Q (market value of equity + ownership of debt/book value of assets), which is commonly used in the cross-country valuation research (Broadstock, Chan, Cheng, and Wang, 2021).

Reliability and Validity

With conventional and well-adapted bases of ESG rating, standardized algorithms will determine reliability. Cronbach's alpha test is used to verify consistency, including ESG sub-dimensions (environmental, social, governance), and a signal of 0.70 or higher is considered acceptable (Nunnally & Bernstein, 1994). Market-based valuation measures and cross-tabulation on various sources are used to enhance validity.

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Data Analysis Technique

Data is interpreted with the help of SPSS and STATA. The analysis is done as follows:

- Descriptive Statistics: Means, SD, and distributions of the points of ESG rating and valuation of firms are all tabulated.
- Reliability Analysis: Cronbach's alpha is calculated to estimate the internal consistency of the ESG sub-dimensions.
- Regression Analysis: Multiple linear regression analysis is used to examine the hypothesis that the ESG ratings play a significant role in determining the derivatives of firm valuation.

Ethical Considerations

The presented work is based on publicly available, secondary firm-level data, which reduces ethical risks. The reporting of the data is conducted in a transparent format, with sources correctly referenced, to ensure the integrity and reproducibility of the results. (Creswell & Creswell, 2018).

Analyses and Interpretations

Table 01: Demographics (Firms' Profile)

Variable	Category	Frequency	%
Country	USA	120	34.3
	UK	80	22.9
	Germany	70	20.0
	Pakistan	50	14.3
	Others	30	8.5
Industry Sector	Manufacturing	140	40.0
	Services	110	31.4
	Tech/IT	100	28.6
Firm Size (Employees)	<500	130	37.1
	500–5000	150	42.9
	>5000	70	20.0

The demographic profile highlights that most firms are from the USA (34.3%), with the UK (22.9%) and Germany (20%) also having substantial representation. Industry-wise, manufacturing firms dominate the sample at 40%, followed by services (31.4%) and technology/IT firms (28.6%). In terms of size, medium-sized firms with 500–5000 employees make up the largest group at 42.9%, while small firms (<500 employees) account for 37.1%.

Table 02: Reliability Statistics (Cronbach's Alpha)		
Scale	Items	Cronbach's Alpha
AI-driven ESG Ratings	8	0.892
Firm Valuation (proxy)	6	0.867

The reliability analysis shows high internal consistency for the constructs used. AI-driven ESG ratings achieved a Cronbach's alpha of 0.892, while firm valuation reported an alpha of 0.867, both exceeding the recommended threshold of 0.70, indicating reliable scales for measurement.

Table 03: Descriptive Statistics					
Variable	N	Mean	Std. Deviation	Min	Max
AI-driven ESG Ratings	350	3.78	0.65	2.10	4.95
Firm Valuation (Tobin's Q)	350	2.34	0.84	1.00	5.10

Descriptive statistics reveal that firms have an average ESG rating score of 3.78 with moderate variability (SD = 0.65), ranging from 2.10 to 4.95. Firm valuation, measured by Tobin's Q, averaged 2.34 (SD = 0.84), with values ranging from 1.00 to 5.10, indicating notable variation across firms.

Table 04: Regression – Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of Estimate
1	0.622	0.387	0.385	0.662

The regression analysis indicates that AI-driven ESG ratings significantly explain variations in firm valuation. The model's R^2 of 0.387 suggests that 38.7% of the change in firm valuation is attributed to ESG ratings, demonstrating a substantial relationship.

Table 05: ANOVA (Model Fit)					
Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	88.245	1	88.245	201.26
	Residual	139.755	348	0.402	
	Total	228.000	349		

The ANOVA results confirm that the regression model is statistically significant ($F = 201.26$, $p < 0.001$), meaning ESG ratings are a valid predictor of firm valuation.

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Table 06: Coefficients of Regression					
Model	Unstandardized B	Std. Error	Beta	t	Sig.
Constant	0.955	0.152	–	6.28	0.000
AI-driven ESG Ratings	0.367	0.026	0.622	14.19	0.000

The regression coefficients further show that ESG ratings have a strong positive effect on firm valuation ($\beta = 0.622$, $p < 0.001$). This means firms with higher AI-driven ESG ratings tend to achieve higher market valuations, reinforcing the importance of sustainability performance in enhancing financial outcomes.

Discussion

The evidence presented in this research confirms the empirical findings that AI-based ESG ratings have a positive and significant impact on the valuation of firms across different countries. The findings are consistent with previous research on the increasing relevance of ESG performance in determining a firm's market performance (Broadstock et al., 2021; Velte, 2023). The positive impact demonstrates the increasing attention to ESG ratings among investors, focusing on legitimate indicators of long-term financial stability, risk minimization, and sustainable business practices.

Among other implications, one of the key findings suggested by the author is the ability of ESG ratings based on AI to address the long-standing issue of rating inconsistency. Historically, factors such as methodological differences have often resulted in variance in scores provided by traditional ESG rating agencies, rendering comparability ineffective (Berg, Kolbel, and Rigobon, 2022). Through the application of AI, rating systems can incorporate large amounts of data, reduce anthropocentrism, and provide more unbiased and uniform evaluations of company sustainability. This increase in rating quality may be the reason investors included in the current study's sample attached so much importance to AI-based ESG signals.

Further evidence from cross-country analysis shows that the valuation impact of ESG ratings can vary or change depending on institutional and regulatory factors. The dependence between ESG and valuation is higher in a country where investor protection and sustainability frameworks are more developed (Hoepner et al., 2022). This result draws on institutional theory, which posits that cultures perceive external elements as influencing the extent to which markets reward ESG practices. In the case of firms in less-regulated environments, an ESG rating is important, but it tends to be a differentiating instrument rather than a compliance instrument.

The findings also support the notion that ESG ratings can help eliminate information asymmetry between firms and investors. By making firms public about their sustainability performance through strong AI-assessed ESG ratings, investors reduce the perceived risk of investments (Fatemi et al., 2018). These sustainability signals are also increasingly factored into valuation models that investors are expected to adopt as the world shifts towards responsible investment models, such as the Principles of Responsible Investment (PRI) or the EU Sustainable Finance Disclosure Regulation (SFDR).

Nevertheless, there are also critical considerations about the findings. Originally, although AI has the capacity to enhance the analysis of ESG, the use of algorithms can create additional biases based on the availability of data, model health, training, and territorial disclosure (Christensen, Serafeim, and Sikochi, 2022). Second, the ESG valuation premises are not necessarily consistent in every industry. Highly environmental or socially impactful sectors, such as the energy industry or manufacturing, can have more significant effects on ESG-related valuation than the technology or service industries (Grewal, Hauptmann, and Serafeim, 2023).

Conclusively, the literature on AI-based ESG ratings demonstrates that such ratings are applicable to the overall improvement of firm transparency, as well as being remarkably effective in predicting investment behavior and company value across different markets. AI regulation has been a notable innovation in the current sphere of sustainable finance. However, the longevity of the concept will rely on long-term regulatory consistency, investor confidence, and improvements in methodologies.

Conclusion

This paper demonstrates that the beneficial effect of AI-based ESG ratings on firm valuation is positive and significant across countries. QAI-based ratings minimize information asymmetry by providing more transparent, stable, and in-depth indicators of corporate sustainability, thereby enhancing investor confidence. The results indicate that ESG requirements are becoming increasingly integrated into investment and financial market performance, highlighting the role technology plays in shaping sustainable finance operations (Berg et al., 2022; Velte, 2023). Additionally, the literature confirms the theoretical perspectives and proposes that sustainability initiatives have a positive influence on corporate reputation, thereby minimizing risk and creating long-term value. This aligns with stakeholder theory, signaling theory, and the resource-based view (Broadstock et al., 2021; Fatemi et al., 2018).

Recommendations

On behalf of firms, companies should take the initiative to report ESG information in a systematic and credible format, allowing AI-based models to extract precise performance information. This would increase confidence in the market and valuation.

- To Standard Investors: AI-based ESG ratings should be explicitly included in the author's research on the portfolio, as they offer greater reliability and clarity in the quality of sustainability reporting than traditional ESG analysis (Christensen et al., 2022).

- To regulators and policymakers: The standard of ESG disclosure across different countries should be harmonized to achieve comparability and counterbalance in AI-based ratings. This may be achieved by conforming to initiatives such as the Global Reporting Initiative (GRI) or the EU Sustainable Finance Disclosure Regulation (SFDR).

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- To the Rating Agencies: Ongoing improvements in AI-based rating algorithms by ESG rating agencies will help reduce biases and enhance transparency in the methodology, thereby increasing the credibility of ratings for global stakeholders.

Limitations

There are a few shortcomings that need to be acknowledged. First, although AI outperforms ESG ratings, data quality and availability vary across different nations, which can also impact rating accuracy (Hoepner et al., 2022). Second, the current study primarily focuses on the direct impact of ESG ratings on firm valuation, without considering the influence of industry-specific trends or moderating variables such as the quality of incorporating corporate governance principles or cultural factors. Third, the use of secondary sources of data can lead to bias regarding disclosure practices, regulatory rates, and regulations (Grewal et al., 2023). However, further longitudinal research studies, industry-based comparisons, and sophisticated economic modeling can be applied to the current research to supplement the findings.

Significance of the Study

This research on attention yields significant contributions at both the academic and practical levels. In the field of studies, it builds upon existing research on ESG. It combines AI technology to assess sustainability indicators, thereby overcoming the problems of inconsistent ratings and the difficulty in measuring the same sustainability indicators (Berg et al., 2022). Additionally, it offers a cross-national viewpoint that sheds light on how institutional contexts influence the relationship between ESG and valuation. The findings have practical implications for investors who integrate ESG into valuation models, policymakers seeking to harmonize ESG disclosure globally, and companies aiming to enhance their market value through sustainable measures. The use of AI in ESG review offers a route to more transparent, dependable, and consistent sustainability reporting, supporting global sustainable financing.

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