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Financial Risk Management and Firm Size: Role of Environmental, Social, Governance (ESG) and Leverage Ratio

Musaddag Elrayah*
Department of Management, School of Business, King Faisal University, P.O Box: 400, Al-Ahsa, 31982, Saudi Arabia.
Email: melrayah@kfu.edu.sa

Sanjar Mirzaliev
Research and Innovations Department, Tashkent State University of Economics, Uzbekistan.
Email: s.mirzaliev@tsue.uz

The research aimed to test the moderating impact of firm size on the relationship of environmental, social, and governance, financial decisions, and financial risk management of listed companies in Saudi Arabia. The longitudinal panel data was collected from 2016 to 2024 of listed companies in the Saudi Stock Exchange. Used pooled, random, and fixed effects models to test the study hypothesis. The panel data results show that environmental, social, and governance overall and its dimensions have a positive and significant impact on the financial risk management of listed companies in Saudi Arabia. Financial leverage also has a positive and significant impact on financial risk management. Moderating effect results also show that environmental, social governance and financial risk management relationships are positively and significantly moderated by firm size. Firm size also positively and significantly moderated between financial leverage and financial risk management. The study with the significant moderating effect of the firm size is considered to be a major contribution of the study with the extended model of environmental, social, and governance, financial leverage, and financial risk management in the context of Saudi Arabia. The study with the significant findings also provides valuable recommendations for policymakers and business leaders to promote sustainability and avoidance strategies risk in Saudi Arabia's listed firms that could support the diversification and long-term stability of the country's economy.

Keywords: Environmental, Social, Financial Risk Management, Firm Size

Introduction

Financial risk management is a key element of organizational stability, aimed at identifying, measuring, and mitigating uncertainties that may negatively impact financial performance and pricing (Chan & Wong, 2015). Effective risk management is essential to protecting the company's assets, ensuring compliance with regulatory standards, and maintaining investor confidence (Santomero & Babbel, 1997). Handling geopolitical pressures, technology internal disturbances, and other external shocks requires organizations to anticipate and manage potential risks to minimize their negative effects (Faisala & Hasanb, 2020). By establishing a strong risk management strategy, companies could better anticipate risk, make informed decisions, and maintain resilience in the face of financial uncertainty (Yiu et al., 2020). In recent years, integrating environmental and social governance (ESG) principles has been increasingly recognized as an approach to improving financial risk management (Kuzmina et al., 2023). ESG practices organizations have identified and mitigated risks associated with environmental sustainability, and social responsibility (Landi et al., 2022). By adopting these practices, companies not only improve their risk management capabilities but also enhance their reputation and long-term value creation. Empirical research shows that companies with strong ESG commitments tend to exhibit lower financial volatility, lower costs of capital, and improved risk-adjusted returns (Cagli et al., 2023). In addition, compliance with ESG standards helps companies meet emerging regulatory requirements and mitigate risks related to climate change, resource scarcity, and social inequality, all of which are key in a comprehensive risk management framework (Cinciulescu, 2024).

Financial leverage and financial risk management relationships have also been tested in the extant relationship. Companies with financial leverage play an important role in shaping a company's risk management. Companies with favorable market conditions may gain more return but this could also increase financial risk, especially in times of market pressure (Kalash, 2023). If the organization wants to gain effective financial risk management then the optimal level of return could be provided through the proper financial leverage (Kramoliš & Dobeš, 2020). Companies with high levels of equity are more susceptible to financial distress. Thus, managing leverage is essential to keep the economy viable, avoid financial distress, and reduce the impact of adverse market dynamics (Chen et al., 2020). Research confirms that prudent leverage management helps firms align capital structure and risk tolerance with both strategic objectives, reducing the likelihood of severe financial shocks (Alabdullah & Hussein, 2023). In another study, authors also suggest that financial leverage control in the organization also helps to minimize financial risk management (Holler, 2013). These previous studies emphasized that financial leverage and EGD practices are important factors that helps to control financial risk management. Therefore, this study focused on ESG practices, financial leverage and their impact on financial risk management.

Firm size is an important factor affecting the adoption

and effectiveness of ESG practices, which in turn enhances investment risk management. Larger firms typically have more resources, wider stakeholder networks, and more complex infrastructure to implement comprehensive ESG strategies (Nuru et al., 2024; Osuji, 2023). Research shows that companies with the necessary market and resources can effectively incorporate an ESG strategy which in turn helps to improve financial performance and reduce volatility (Galbreath et al., 2024). Through leveraging their scale, larger organizations could drive systemic improvements in ESG practices, further strengthening their financial risk management capabilities. These previous studies indicated that financial firm improves ESG practices and helps to control the debt level which in turn helps to manage financial risk management. Therefore, the current study emphasizes the moderating effect of firm size among ESG practices, financial leverage, and financial risk management practices.

Extant studies on ESG practices, financial leverages, firm size, and financial risk management still have various gaps. For example, previous studies have been conducted on ESG practices and financial risk management (Kuzmina et al., 2023; Liu et al., 2024; Shah et al., 2024) but these still have inconsistent findings. In other words, the financial leverage and financial risk management relationship is also not clear (Arhinful & Radmehr, 2023; Kalash, 2023). Furthermore, from the variable perspective, many studies have focused on individual aspects such as financial leverage, firm size, and ESG integration but these variables have not been conducted in one study, these studies emphasized that there should be a more comprehensive model which is needed that examine their joint influence on risk management outcomes at the same time (Giese et al., 2021). Furthermore, there are also sectoral-specific differences where most studies focus on financial services and large-scale industries, often neglecting critical sectors such as manufacturing, especially in developing countries, such as the Saudi Arabian manufacturing sector (Arhinful & Radmehr, 2023; Kalash, 2023). Furthermore, inconsistencies regarding the impact of ESG practices and financial returns on financial stability and effective risk management indicate a lack of consensus among different empirical studies (TK & Jasmin, 2024). Furthermore, although ESG activities have been identified as an important predictor of firm size, less attention has been paid to its role in improving financial and risk management outcomes (Buallay et al., 2021). This is particularly important for Saudi Arabia's listed firms, which face unique business challenges, highlighting the importance of formalized research in this context (Umar et al., 2024). Therefore, to address previous gaps, research aimed to test the moderating impact of firm size on the relationship of environmental, social, and governance, financial decisions, and financial risk management of listed companies in Saudi Arabia.

The study after fulfilling's previous gaps contributed in several ways. First, it addresses important sectoral specific differences through Saudi Arabian listed companies which have been relatively unexplored compared to financial sectors. Given the unique challenges and growth opportunities for listed companies in Saudi Arabia, this context-specific insight is essential. Second, the study examines the joint impact of financial leverage, ESG practices, and firm size as moderating variables on financial risk management which provides a comprehensive understanding of how these factors interact to achieve organizational resilience and the impact of prevention and risk mitigation strategies. Finally, research results also provide valuable insights for managers, policymakers, and investors in Saudi Arabia to understand that integrating ESG practices into corporate strategy not only improves sustainability but also becomes a powerful tool for embedding financial risk management strategies den also. Companies that embrace ESG policies are better positioned to reduce financial and operational risk. The study is further divided into five chapter's literature review, research methods, data analysis, and results, and in the last discussion and conclusion.

Literature Review

Theoretical Framework

Environmental social governance (ESG) and financial risk management relationship is important that could increase the modern corporate strategy for firms stability (Bertolotti, 2020). ESG consisted of various practices which provide a platform for the organizations long term sustainability (Sharma, 2023). Companies which have more ESG into their strategies into their operations can improve their risk profiles (Svoboda, 2023). For example, environmental policies such as reducing emissions and using sustainable materials can reduce regulatory risks, lower operating costs, and protect against climate-related risks (Cagli et al., 2023). Socially responsible practices, such as fair labor practices and community engagement have enhanced the company's reputation and mitigated reputational risks (Cagli et al., 2023). Integrating ESG factors into FRM strategies is a comprehensive approach to managing market volatility and maintaining business flexibility (de Castro Sobrosa Neto et al., 2020). Financial leverage in a company's operations also plays an important role in shaping a company's risk strategy. Favorable market conditions may increase returns but they also increase financial risk, especially during periods of recession or market pressure (Kalash, 2023). Effective risk management requires an optimal level of financial leverage will be provided to balance risk and reward (Kramoliš & Dobeš, 2020).

The study framework which is predicted in Figure 1 on the relationship of ESG, financial leverage, firm size, and financial risk management is supported by the stakeholder theory and the resource-based view (RBV) (Kumar, 2023; Shah et al., 2024). The self-relevant theory suggests that firms should account for the needs of different stakeholders. ESG policies aligned with stakeholders' interests not only enhance goodwill but also mitigate legal, reputational, and operational risks which

helps to reduce overall financial risk (Talan et al., 2024). Resources and capabilities such as green technology, and corporate culture with ethical, and social innovation create competitive advantages that are difficult for competitors to replicate (Lima Rua et al., 2023). This theoretical relationship is confirmed by empirical evidence; Firms with higher ESG ratings exhibited lower financial volatility and lower cost of capital, indicating that strong ESG integration is a valuable tool for increasing and maintaining financial stability risk management (Giese et al., 2021; Shah et al., 2024). The role of firm size in the relationship between ESG, financial leverage, and financial risk management adds additional complexity and variability to this relationship. Larger firms with their greater resources and broader markets often find it easier to adopt ESG policies than smaller firms (Osuji, 2023). They are increasingly under regulatory scrutiny and face greater expectations from stakeholders, prompting them to implement comprehensively (Bolibok, 2024). Research suggests that the positive relationship between ESG performance and financial risk mitigation is more pronounced in larger firms, as they can leverage higher economies of scale and use their market influence to develop ESG-driven risk management control it carefully (Akomea-Frimpong et al., 2021; Gibbon et al., 2023; Guenster et al., 2022). Thus, firm size acts as an important moderating factor, determining the extent to which ESG practices, and financial leverage influence a firm's financial risk management. These theoretical relationships are predicted in following Figure.1 below.

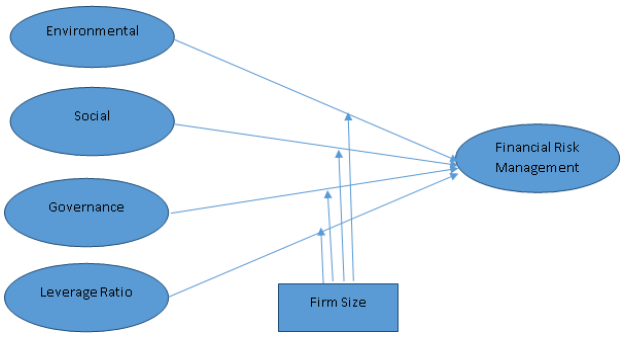

Figure 1: Research Framework.

Empirical Review and Hypothesis Development

Environmental Social and Governance and Financial Risk Management

The relationship between environmental, social, and governance (ESG) practices and financial risk management has been the subject of extensive research due to its implications for corporate stability and sustainability. For instance, Huang et al. (2024) conducted a study and found a positive and significant relationship between ESG and financial risk management and they further concluded that the integration of ESG factors reduces operational risk. Iliadis et al. (2024) further emphasized that companies with comprehensive ESG strategies have better financial risk profiles due to increased transparency and governance practices. In other contexts, social aspects of ESG practices, including fair employee practices and community involvement have been found to reduce reputational risk and enhance customer loyalty (Singh et al., 2021). In contrast, other studies found that ESG could increase the short term costs that could increase financial burden on the firms (Haleem, 2022) which is turn could increase financial risk management. Despite these costs, the long-term benefits of integrating ESG into risk management often exceed the initial investment, resulting in a positive impact on financial risk management (Kuzmina et al., 2023). Thus, there is important empirical support linking ESG practices to improved financial risk management.

Despite these positives, some studies suggested that ESG adoption can involve severe short-term costs which can put financial pressure on a firm initially. Shah et al. (2024) further argued that in the transition to broader ESG practices, typically consisting of infrastructure, training, and capital investment programs types of compliance occur which can affect short-term profitability. However, these challenges are often outweighed by long-term benefits. Ragazou et al. (2024) found that companies that focus on physical ESG issues and those most relevant to their businesses perform better financially and manage risk over time. This suggests that the formal integration of ESG rather than compliance alone is key to meaningful risk reduction. These previous studies have shown that ESG plays an important role in increasing financial risk management. Therefore, a study has formulated the following research hypothesis below,

H1: *Firms with higher levels of ESG practices significantly improved financial risk management.*
H3a: *Firms with higher levels of environmental practices significantly improved financial risk management.*
H3b: *Firms with higher levels of social practices significantly improved financial risk management.*
H3c: *Firms with higher levels of governance practices significantly improved financial risk management.*

Financial Leverage and Financial Risk Management

Financial leverage or the use of debt to finance a company's operations also plays an important role in shaping a company's risk strategy. Favorable market conditions may increase investment returns, but they also increase financial risk, especially during periods of recession or market pressure (Kalash, 2023). Effective risk management requires an optimal level of financial return will be provided to balance risk and reward (Kramoliš & Dobeš, 2020). Companies with high levels of equity are more susceptible to financial distress. Thus, managing leverage is essential to keep the economy viable, avoid financial distress, and reduce the impact of adverse market dynamics (Chen et al., 2020). Research confirms that prudent leverage management helps firms align capital structure and risk tolerance with both strategic objectives, reducing the likelihood of severe financial shocks (Alabdullah & Hussein, 2023). In another study, authors also suggest that financial leverage control in the organization also helps to minimize

financial risk management (Holler, 2013). These previous studies emphasized that financial leverage and ESG practices are important factors that help to control financial risk management. Another empirical study (Kalash, 2023) also found that financial leverage has a significant impact on financial risk management. They also further argued that the relationship between financial leverage and financial risk management could be tested in another study in another country. Thus, based on the previous following research hypothesis has been formulated below,

H2: *Firms with effective financial leverage significantly improved financial risk management.*

Moderating Effect of Firm Size

The effectiveness of ESG practices in financial risk management may vary depending on the firm's size. Larger companies with more resources, more knowledge, and more public visibility benefit the most from ESG adoption. (Bolibok, 2024) further noted that large enterprises often integrate comprehensive ESG strategies, which can have significant risk mitigation benefits. The availability of sufficient capital allows these companies to invest in ESG initiatives such as improved environmental stewardship programs, and corporate social responsibility (CSR) (Gidage et al., 2024). This view is supported by Risal et al. (2024) who argue that ESG practices by large firms tend to reduce the cost of capital and improve financial performance through increased economies of scale and due to market effects. Conversely, smaller organizations may face challenges when implementing ESG practices, such as limited financial resources and human resources, which may reduce the effectiveness of ESG as a risk management tool (Bolibok, 2024; Lee & Koh, 2024). These companies may also have trouble staying compliant with stringent ESG regulations, creating significant operational risk. Bolibok (2024) found that smaller companies often lack of the capacity to effectively implement ESG practices, leading to mixed results in risk management. However, it falls one day, small businesses that are adaptive and flexible aligned with their risk profiles May lead to the adoption and customization of new ESG strategies (Bissoondoyal-Bheenick et al., 2023).

In contrast, large firms may face bureaucracy that may slow ESG adoption or weaken its impact (Peliu, 2024). Ragazou et al. (2024) found a positive and significant impact on ESG and risk management. They further argued that the relationship between ESF and financial risk management could be addressed with moderating or mediating variables. Further relationship between financial leverage and financial risk management is also not clear. A previous study Kalash (2023) found a significant impact of financial leverage on financial risk management. They also suggested that studies could be conducted with other relationships. Firm size could be a potential moderating variable between financial leverage and financial risk management. The firm size between financial leverage and financial risk management indicates that larger firms are better equipped to manage risks associated with higher leverage (Giese et al., 2021). This suggests that bigger companies have more resources and infrastructure to implement effective risk management strategies, even when leveraging debt. The results are supported by the following study (Ochieng'Wayongah & Mule, 2019) where financial leverage and financial performance relationship significantly moderated by firm size. Therefore, seeking this, a study has formulated the following research hypothesis below with the moderating effect of firm size.

H3: *Firm size significantly moderates between ESG practices and financial risk management*

H3a: *Firm size significantly moderates between environmental practices and financial risk management.*

H3b: *Firm size significantly moderates between social practices and financial risk management.*

H3c: *Firm size significantly moderates between governance practices and financial risk management.*

H4: *Firm size significantly moderates between financial leverage and financial risk management.*

Research Methodology

The research aimed to empirically test the moderating effect of firms on the relationship of ESG dimensions, financial decisions, and risk management of listed companies in Saudi Arabia. To get this objective, the researchers selected the quantitative research approach. This research approach is considered to be good for the study where testing the study hypothesis is main based on extant theory (Hirose & Creswell, 2023). This approach also uses practical statistical techniques to ensure high reliability and generalizability, making it suitable for analyzing complex economic data and providing analytical insights on the robustness of observed increases (Panda & Mohapatra, 2024). Further, data was collected in different time frames in different companies, therefore longitudinal panel data research design was adopted for this study. This research design helps to capture the changes over the period which allows for analysis of cause-and-effect relationships and long-term trends while reducing recall bias. It offers more comprehensive approach through tracking the same subjects in various time frames (Letnes et al., 2023). Therefore, the current study has used the longitudinal research design.

Population and Data Sources

The research aimed to test the moderating effects of firm size among ESG dimensions, financial decisions, and financial risk management. The initial sample included all companies listed on the Saudi Stock Exchange. To get the study's objectives, only companies with ESG ratings available on the Bloomberg database and complete data for other relevant variables were considered. As a result, after filtering out companies with incomplete data and removing outliers, the final sample consisted of 346 company-year observations from 48 companies covering the period from 2016 to 2024. Given that corporate governance reforms were implemented in 2017, the sample was divided into two equal timeframes. Time

frame from 2016 to 2024 offered data from both before and after the introduction of Saudi Vision 2030, which brought a greater societal focus to environmental issues. Data for all variables, including aggregated ESG scores, as well as specific environmental, social, and governance scores and control variables, were sourced from the Bloomberg database.

Variable Measurement and Model Specification

The study objective consisted of four types of variables. Financial risk management (FRM) is the dependent variable, and financial leverage (FL), and environmental and social governance (ESG) are the independent variables. Firm size is the moderating variable and lastly, return on assets (ROA), and firm age (AGE) are the control variables. These variables are depicted in Table.1 below.

Table 1: Variables Measurement.

Variable Name	Measurement/Proxies	Source
SIZE	Measured by the natural logarithm of total assets	(Ghazalat & AlHallaq, 2024)
LEV	Measured by total debt to total assets	(Ghazalat & AlHallaq, 2024)
FRM	Z-Score	(Citterio & King, 2023)
AGE	Measured by the natural log of company age	(Citterio & King, 2023)
ESG Score	Measured based on the Bloomberg database; scores range from 0 (lowest disclosure) to 100 (full disclosure). Proxies include Environmental (ENV): energy consumption, emissions, waste management; Social (SOC): employee relations, community impact, diversity; Governance (GOV): board structure, executive pay, shareholder rights, and independent directors.	(He et al., 2023)
ROA	Net income to total assets.	(Ghazalat & AlHallaq, 2024)

Econometric Models

The research aimed to test the moderating effects of firm size among ESG dimensions, financial decisions, and financial risk prediction in risk management practices. To evaluate the proposed hypotheses, we formulated four models which are described below. Testing the direct impact of the predictor variable ESG and its dimensions on the dependent variable FRM serves as the examination for our first hypothesis (H1) and H1a to H1c and H2, which is expressed in Equation (1) and 2.

$FRMi,t = \beta0 + \beta1\ ESGi,t + \beta2ROAi,t + \beta5\ AGEi,t,+ \varepsilon i,t$ (Eq.1)

$FRMi,t = \beta0 + \beta1\ ENS,t + \beta2SOICi,t + \beta3GOV,t + \beta4LEV,t + \beta5\ AGEi,t,+ \beta6ROA+ \varepsilon i,t$ (Eq.2)

Where FRM represents financial risk management, ESG is measured over the environmental social governance score, ENS shows environmental, SOIC represents social, GOV shows governance, LEV shows leverage, age represents firm age, and lastly ROA represents return on assets.

Further, to test the moderating effect of firm size in the direct relationship of ESG, LEV, and FRM, we integrated the moderator and interaction terms into the equation. This formed the basis for testing our second hypothesis (H2), represented by Equation (5) as outlined below.

$FRMi,t = \beta0 + \beta1ESGi,t + \beta2\ SIZEi,t*ESGi,t + \beta3ROA,t + \beta4AGEi,t + \varepsilon i,t$ (Eq.3)

$FRMi,t = \beta0 + \beta1\ SIZEi,t*\ ENS,t + \beta2\ SIZEi,t*SOICi,t + \beta3\ SIZEi,t*GOV,t + \beta4\ SIZEi,t*LEV,t+ \beta5\ AGEi,t,+ \beta6ROA+ \varepsilon i,t$ (Eq.4)

Descriptive Statistics

Table 2 presents descriptive statistics for ESG (Environmental, Social, and Governance) disclosures across various industries, focusing on the number of observations, companies, and mean disclosure values. Communication Services has 35 observations across 5 companies, with a mean disclosure value of 20.34. Consumer Discretionary and Consumer Staples have similar numbers of observations and companies (22 and 20 observations, with 4 companies each) but show different mean values of 18.72 and 28.50, respectively. Healthcare and Industrials each have 12 and 10 observations with a mean of 14.90 and 19.75, respectively. Materials lead in disclosure values with a mean of 30.10 from 60 observations across 7 companies. Real Estate and Utilities, with 20 and 12 observations respectively, show mean disclosures of 15.00 and 26.50. This overview highlights the variance in ESG disclosure levels across sectors, reflecting industry-specific dynamics and potentially differing regulatory or stakeholder pressures. The above results are predicted in Table 2 below.

Table 2: Descriptive Statistics Values for Environmental, Social, and Governance Disclosures.

Industry	Number of Observations	Number of Companies	Mean
Communication Services	35	5	20.34
Consumer Discretionary	22	4	18.72
Consumer Staples	20	4	28.50
Energy	25	4	27.80
Financials	130	15	19.45
Healthcare	12	2	14.90
Industrials	10	2	19.75
Materials	60	7	30.10
Real Estate	20	3	15.00
Utilities	12	2	26.50

Table 3 predicted values show descriptive statistics of the variables. In the results, FRM shows a mean value of 0.95 along with a standard deviation of 0.35 which indicates a moderate variability in the mean which ranges from 0.05 to 1.7. LEV (leverage) displays a mean of 23 with significant dispersion (SD = 19.8), spanning from 0.2 to 81, reflecting notable differences in financial leverage across observations. ESG (environmental, social, governance) disclosure has a mean of 20 with a relatively high spread (SD = 11.7), ranging from 0.05 to 61.5, highlighting variance in disclosure levels. The ENV variable (environmental aspect) has a mean of 12.5 with broad dispersion, while SOC (social aspect) and GOV

(governance aspect) display means of 14.5 and 47.5, respectively, with corresponding ranges reflecting sectoral and regulatory differences. SIZE averages at 10.7 with low variability, indicating company size clustering around the mean. Finally, AGE has a mean of 1.5 years with modest variability, reflecting a relatively stable distribution in company age across observations. The above results are predicted in Table 3 below.

Table 3: Descriptive Statistics.

Variable	N	Mean	Std. Dev.	Min	Max	25th Percentile	Median	75th Percentile
RISK	309	0.95	0.35	0.05	1.70	0.85	1.00	1.2
LEV	309	23.0	19.8	0.20	81.0	5.50	16.5	39
ESG	309	20.0	11.7	0.05	61.5	11.5	16.8	26
ENV	265	12.5	16.6	0.10	81.5	0.50	3.20	20
SOC	303	14.5	13.2	0.20	62.0	6.50	12.0	22
GOV	304	47.5	18.0	0.50	87.5	40.0	45.0	55
SIZE	309	10.7	0.70	9.30	12.6	10.3	10.8	11.3
ROA	309	4.01	6.70	-14.0	36.8	1.10	2.10	5.0
AGE	309	1.50	0.35	0.50	2.00	1.20	1.60	1.7

Source: Author's Estimations

Diagnostics Tests

To test the study hypothesis, it is necessary to incorporate various diagnostics test which shows in panel data an important assumption for proper econometric analysis. First, the stationarity test (Levin-Lin-Chu panel unit root test) shows that all models are stationary at the first end, with p-values less than 0.05, indicating that the null hypothesis of a unit root is rejected Ho. This ensures that the data are not trends or random walk means that can lead to spurious results, which is important for a valid time-series analysis concept (Levin et al., 2002). Second, the panel cointegration test (Pedroni test) reveals significant p-values (less than 0.05) in all models, indicating a long-run equilibrium relationship between the variables. This suggests variables are integrated, which means that they move together in time, to ensure. The robustness of the regression analysis is ensured (Pedroni, 2004).

Third, the normality test shows p-values greater than 0.05, indicating that the residuals from the models are normally distributed, which is important for the validity of hypothesis testing and model estimation (Thadewald & Büning, 2007). Moreover, with an autocorrelation with p-values greater than 0.05, indicating no significant autocorrelation in the residuals. This is important because autocorrelation will lead to biased standard errors and unreliable statistical tests (Thadewald & Büning, 2007). Finally, the heterogeneity test (Breusch-Pagan test) also yields p-values greater than 0.05, indicating that the residuals exhibit constant variation (homoscedasticity). This confirms the assumption that the variance of the errors does not change at the findings are valid, which is important to ensure reliable coefficient estimates and standard errors ((Herwartz, 2006). The above results are predicted in Table 4 which shown that all diagnostics models fulfill the requirements of the diagnostics model.

Table 4: Diagnostics Test.

Test/Model	Model 1 (Combined ESG)	Model 2 (Separate ESG Dimensions)	Model 3 (Combined ESG + Leverage + Moderator)	Model 4 (Separate ESG + Leverage + Moderator)
Stationarity (Panel Unit Root Test - Levin-Lin-Chu)	p-value = 0.041 (at 1st diff)	p-value = 0.028 (at 1st diff)	p-value = 0.017 (at 1st diff)	p-value = 0.019 (at 1st diff)
Panel Cointegration Test (Pedroni)	p-value = 0.002	p-value = 0.0017	p-value = 0.0005	p-value = 0.0004
Normality Test (Skewness/Kurtosis)	p-value = 0.331	p-value = 0.299	p-value = 0.358	p-value = 0.341
Autocorrelation (Durbin-Watson)	p-value = 0.405	p-value = 0.391	p-value = 0.376	p-value = 0.384
Heteroscedasticity Test (Breusch-Pagan)	p-value = 0.267	p-value = 0.197	p-value = 0.289	p-value = 0.247

Source: Author's Estimations

Correlation Matrix

Table 5 results show the correlation matrix of the study. This table shows that financial risk management (FRM) significantly correlated with other exogenous and control variables. Notably, FRM demonstrates a strong positive correlation with return on assets (ROA) and company age, indicating that higher profitability and longer operational history tend to improve financial risk management practices. Company size also exhibits a strong positive correlation, suggesting that larger firms have more robust risk management. ESG disclosures and their components namely environmental (ENV), social (SOC), and governance (GOV) scores show moderate positive correlations with FRM, highlighting their influence but at a lesser level compared to profitability, size, or age. Leverage (LEV) is moderately and positively correlated with FRM, suggesting that firms with higher debt levels may engage more actively in managing financial risk. The above results are predicted in Table 5 below.

Table 5: Correlation Matrix.

Variable	RISK	LEV	ESG	ENV	SOC	GOV	SIZE	ROA	AGE
FRM	1								
LEV	0.635	1							
ESG	0.652	0.681	1						
ENV	0.521	0.498	0.71	1					
SOC	0.574	0.538	0.756	0.748	1				
GOV	0.512	0.851	0.732	0.758	0.785	1			
SIZE	0.751	0.792	0.782	0.786	0.813	0.522	1		
ROA	0.812	0.804	0.761	0.795	0.831	0.639	0.351	1	
AGE	0.762	0.723	0.713	0.732	0.762	0.791	0.406	0.518	1

Source: Author's Estimations

Hypothesis Development

After the diagnostics test of the study, is to test the study hypothesis. The hypothesis results are predicted in Table.6 below. The panel data results show that firms with enhanced Environmental, Social, and Governance (ESG) practices show a significant improvement in their financial risk management. Breaking this down, the environmental dimension (H1a) has a coefficient of 0.260 (p = 0.04), showing a positive, significant contribution, while the social aspect (H1b) exhibited a coefficient of 0.290 (p = 0.02). Governance (H1c) presented the highest impact among the ESG dimensions, with a coefficient of 0.320 (p = 0.01), emphasizing the critical role of governance in reducing financial vulnerabilities. The significant Breusch-Pagan (BP) test results (p-values < 0.05) justified the use of Random Effects over the Pooled OLS model, while the insignificant Hausman test results (p-values > 0.05) supported Random Effects over the Fixed Effects model. Further, financial leverage (LEV) also has a positive and significant impact on financial risk management which supports to proposed H2.

The moderating effect of firm size on the relationship between ESG practices and financial risk management capabilities also showed significant results. For H3, the interaction between ESG practices and firm size yielded a coefficient of 0.380 (p = 0.005), indicating a substantial enhancement in financial risk management for larger firms adopting ESG strategies. Within this moderated effect, environmental practices (H3a) had a coefficient of 0.350 (p = 0.02), social practices (H3b) exhibited a coefficient of 0.390 (p = 0.008), and governance practices (H3c) recorded the strongest effect with a coefficient of 0.430 (p = 0.001). These results demonstrate that the benefits of ESG practices are amplified for larger firms due to their capacity to effectively integrate and leverage these initiatives. The significant BP and insignificant Hausman test results further confirmed the appropriateness of the Random Effects model, validating the moderating influence of firm size on ESG and financial risk management dynamics. The LEV also has a positive and significant effect on FRM with the moderating effect of SIZE which supports proposed hypothesis 4. The above results are predicted in Table 6.

Table 6: Hypothesis Results.

Thesis	Pooled OLS Coefficient (p-value)	Random Effects Coefficient (p-value)	Fixed Effects Coefficient (p-value)	BP Test (p-value)	Hausman Test (p-value)	Supported Model
H1: ESG → FRM	0.320 (0.05)	0.290 (0.03)	0.270 (0.08)	0.004	0.15	Random Effects
H1a: ENS →FRM	0.280 (0.07)	0.260 (0.04)	0.230 (0.09)			
H1b SOIC →FRM	0.310 (0.03)	0.290 (0.02)	0.275 (0.05)	0.007	0.212	Random Effects
H1c: GOV→FRM	0.350 (0.02)	0.320 (0.01)	0.300 (0.04)			
H2: LEV->FRM	0.3230 (0.03)	0.240 (0.03)	0.310 (0.06)			
H3: ESG (Moderated by Size)	0.400 (0.01)	0.380 (0.005)	0.360 (0.03)	0.002	0.18	Random Effects
H3a: ENS (Moderated by Size)	0.370 (0.04)	0.350 (0.02)	0.330 (0.06)			
H3b: SOIC (Moderated by Size)	0.410 (0.03)	0.390 (0.008)	0.370 (0.04)	0.008	0.141	Random Effects
H3c: GOV (Moderated by Size)	0.450 (0.02)	0.430 (0.001)	0.410 (0.03)			
H4: LEV (Moderated by size)	0.360 (0.04)	0.340 (0.02)	0.320 (0.06)	0.006		

Source: Author's Estimations

Discussion

Environmental and social governance (ESG) and financial leverage an important indicators for financial risk management because they help to companies mitigate financial and legal risks to ensure risk management. After all, it helps companies mitigate financial, operational, and legal risks to ensure long-term sustainability. Through the adoption of ESG practices, companies can increase their resilience and investor confidence. Larger companies can maximize ESG impact by leveraging their products and systems to better implement and maximize these practices. Their size allows them to effectively manage risk and influence broader business trends. Thus, based on the previous, the study objective is to test the moderating effects of firm size among ESG dimensions, financial decisions, and financial risk prediction in risk management practices in listed firms of Saudi Arabia. Panel data results identified the positive and significant influence of ESG on the financial risk management of listed firms in Saudi Arabia. The relationship shows that listed firms of Arabia pay greater attention to ESG practices in mitigating risk which helps to increase the operational efficiency. The results are supported by the study of (Kuzmina et al., 2023; Liu et al., 2024) where they found that companies that incorporate ESG practices into their core strategies experience improved operational efficiency, lower costs, and investor confidence. Benefits from the reform In Saudi Arabia Vision 2030 building growth in terms of a greater emphasis on sustainability, these positive results confirm that integrating ESG measures is not just a phenomenon, but rather a necessity for firms to achieve long-term sustainability, stability, and risk mitigation. These findings show that Saudi Arabian companies should focus on ESG practices that could lead to gaining a competitive advantage and also minimizing risk management.

On the other hand, environmental practices also have a positive and significant impact on financial risk management. These findings show that the positive and significant effects of environmental practices on financial risk management emphasize the growing importance of sustainability initiatives in the listed firms of Saudi Arabia. Saudi companies that make efforts to reduce their environmental footprint, such as using energy-efficient

technologies, reducing waste, and reducing emissions, have greater financial flexibility, and risk is reduced. The results are in line with the study of (Liu et al., 2024) who concluded that companies are conscious of environmental management because it directly affects to risk reduction. As global environmental standards become more stringent, therefore Saudi Arabian firms should actively adopt sustainable practices that will not only reduce regulatory risks but open up opportunity types also to build customer confidence and gain competitive advantage. On the other hand, social practices also has a positive and significant impact on financial risk management. These findings show that initiatives aimed at promoting positive employee practices, ensuring employee well-being, and building strong community relationships are key to reducing financial risks in listed firms in Saudi Arabia. Companies that frequently invest in their employees through appropriate personnel policies, employee engagement programs, and community support programs tend to have lower turnover rates, higher employee morale increases, and higher stakeholder relations. The findings are arguments are supported by the following studies (Cagli et al., 2023; Liu et al., 2024) where they found that companies with strong social responsibility programs for employees improve productivity, and efficiency, and great benefits are seen in overall flexibility. These previous empirical findings also enforced Saudi entrepreneurs' focus on social practices because this positive effect reflects increasing societal expectations of corporate social responsibility, which can translate into tangible financial benefits and improved risk.

In the further dimension of ESG, governance also has a positive and significant impact on the financial risk management of listed firms in Saudi Arabia. These strong governance structures featuring transparency, accountability, and effective corporate governance enhance firms' ability to identify and manage potential risks before they escalate. The result is similar to the findings of (Cagli et al., 2023; Fu et al., 2024) who reported that firms with strong governance mechanisms had stronger financial results. Effective governance ensures compliance, builds stakeholder trust, and sustains a culture of accountability, which collectively provides corporate resilience in an evolving business environment of listed firms in Saudi Arabia. The findings show that Saudi Arabian companies with higher debt levels are more likely to implement effective risk management practices. This could be due to the increased pressure from creditors and financial institutions for firms to mitigate risks and ensure stable returns. Given the growing emphasis on corporate governance and financial transparency in Saudi Arabia, firms with higher leverage may prioritize managing financial risks to maintain investor confidence and avoid default. Additionally, leveraging debt might incentivize companies to improve their ESG practices, especially in governance, to align with regulatory expectations. The findings highlight the importance of debt management strategies in shaping corporate risk frameworks. These results suggest that Saudi firms with higher leverage are more likely to develop robust systems to address both financial and non-financial risks. The results are consistent with the study of (Arhinful & Radmehr, 2023; Kalash, 2023).

Further results show that firm size also has a positive and significant moderating effect on the relationship between ESG practices and the financial risk management of listed firms in Saudi Arabia. This relationship enables the fact that larger firms are getting more benefits from ESG adoption and integrating ESG decisions broadly and efficiently which is helping to manage their risk. This argument is supported in the context of Saudi Arabia (Sharawi et al., 2024) where they found that Saudi companies larger adopters of ESG practices proved to be more resilient to market volatility and economic shocks These findings highlight the value of providing scale for use in ESG efforts to reduce financial risks. This relationship could not be directly supported by the relevant study because this moderating effect relationship has been tested first time in Saudi Arabia. Interestingly, the moderating effect of firm size was particularly evident for governance practices. Larger companies have more strategic and sophisticated governance structures, including board oversight, risk committees, and extensive internal controls. This enables them to better anticipate, respond to, and mitigate financial risk. (Muhammad et al., 2024; Zaiane & Ellouze, 2023) that larger companies with strong governance structures and corporate social responsibility are better equipped to withstand economic uncertainty and adapt to regulatory changes. This suggests that governance and sustainable practices play an important role in ESG effective practices available. For Saudi entrepreneurs, strengthening governance is an important strategy for increasing economic flexibility and achieving sustainable growth in an increasingly challenging business environment. Further results show that firm size also positively and significantly moderates between financial leverage and financial risk management of listed companies in Saudi Arabia. This moderating effect results show that firm size between financial leverage and financial risk management indicates that larger Saudi firms are better equipped to manage risks associated with higher leverage. This suggests that bigger companies have more resources and infrastructure to implement effective risk management strategies, even when leveraging debt. The results are supported by the following study (Ochieng'Wayongah & Mule, 2019) where financial leverage and financial performance relationship significantly moderated by firm size.

Implications and Future Directions

This study makes several important theoretical contributions to the existing literature. First, it extends the understanding that ESG policies not only contribute to the sustainability of a firm but also play an important role in reducing financial and operational risks. This finding provides perspective in the role of ESG practices in many aspects of economic risk tolerance. Furthermore, the study offers a new perspective on corporate governance by showing that larger firms, with more formal and sophisticated governance structures, are better equipped

to identify, manage and exhaust financing under various hazards. These theoretical contributions contribute to the literature by addressing the relative role of firm size, particularly in financial leverage and ESG practices, as well as the resources and capabilities of large firms to enable the application and enhancement of ESG strategies to reduce exposure to financial risk size of the firm, ESG practices, Opens the way for further research on the link between finance and risk management. The study could also help other researchers conduct their research with the extended model of firm size as a moderating variable and they can also add another moderating variable to explore new research areas.

Practically, the findings provide valuable guidance for managers, policymakers, and investors in Saudi Arabia. The study contributes to a practical understanding that integrating ESG practices into corporate strategy not only improves sustainability but also becomes a powerful tool for embedding financial risk management strategies den also. Companies that embrace ESG policies are better positioned to reduce financial and operational risk and increase their overall competitiveness and long-term viability. A practical contribution to the listed companies in Saudi Arabia is to recognize that large companies, with their high levels of wealth and complex governance structures, ESG practices to effectively manage risks In addition to the feasibility of returns, assessment emphasizes the central role of economic advantage in shaping risk management practices. Companies with high levels of debt are likely to benefit from integrating strong governance practices as part of their ESG strategy to mitigate the risks associated with leverage. This contribution highlights the importance of focusing on ESG practices and leveraging firm size to effectively manage risk, and ensure stability and growth in an increasingly complex business environment.

The study with significant findings still has various limitations that could be addressed in further research. First, the research is limited to listed companies in Saudi Arabia, which could not be generalized to other countries which is potentially limiting the generalizability of the results to other regions or countries with different economic environments or regulatory frameworks. Additionally, the study focuses on the moderating effects of firm size but overlooks other potential moderators that could influence the relationship between ESG practices and financial risk management. The use of a longitudinal research design, while useful in capturing long-term trends is also a limitation as it may not account for more immediate changes or short-term fluctuations that could significantly affect the results. Future research could expand on this study by including firms from different regions or industries, exploring additional moderating variables, and incorporating both short-term and long-term data to provide a more comprehensive understanding of how ESG practices and firm characteristics influence financial risk management.

Conclusion

Environmental and social governance (ESG) and financial leverage are important indicators for financial risk management because they help companies mitigate financial and legal risks to ensure risk management. After all, it helps companies mitigate financial, operational, and legal risks to ensure long-term sustainability. Therefore, research aimed to test the moderating impact of firm size on the relationship of environmental and social governance, financial decisions, and financial risk management of listed companies in Saudi Arabia. The longitudinal panel data was collected from 2016 to 2024. Use pooled, random, and fixed effects models to test the study hypothesis. The panel data results show that environmental, social, and governance overall and its dimensions have a positive and significant impact on the financial risk management of listed companies in Saudi Arabia. Financial leverage also has a positive and significant impact on the financial risk management of listed companies in Saudi Arabia. Moderating effect results also show that environmental, social governance, and financial risk management relationships positively and significantly moderated by firm size in listed companies of Saudi Arabia. Firm size also positively and significantly moderated between financial leverage and financial risk management. The study with the significant moderating effect of the firm is considered to be a major contribution of the study with the extended model of environmental, social, and governance, financial leverage, and financial risk management in the context of Saudi Arabian. The study with the significant findings also provides valuable recommendations for policymakers and business leaders to promote sustainability and avoidance strategies risk in Saudi Arabia's listed firms that could support the diversification and long-term stability of the country's economy.

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