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Sustainability Practices and Financial Performance: Evidence from BIST Electricity Index

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ABSTRACT: Amidst the backdrop of heightened market risks associated with transitioning to a lower-carbon economy, this study pioneers an examination of the correlation between sustainability and financial performance within Turkish energy market generator and retailer companies. In this study, the sustainability performance, exposure to market risks and effects on the financial performance of sub-sectors of companies listed in the BIST Electricity index were analyzed using panel data regression. The findings reveal a nuanced relationship between sustainability factors and financial performance, underscoring the imperative for electricity sector companies to prioritize sustainability initiatives not only for ethical reasons but also as a strategic imperative for long-term financial success and stakeholder value creation. Finally, the possibility of impending regulatory changes underscores the importance of early adoption of sustainability practices to mitigate potential financial liabilities and navigate future market risks effectively.

Keywords: Esg; Esg performance; Sustainability; Corporate financial performance; Panel data regression; Electricity sector

1. Introduction

1.1. Research Background

As underscored during COP 26, there is a pressing need for international financial institutions to play a proactive role in facilitating both the private and public sectors' access to sustainable finance, thereby amplifying the scale of sustainable financial initiatives [1]. This imperative is particularly salient when examining the case of Türkiye, where the achievement of Net Zero targets hinges significantly on transitioning its energy sector towards greater sustainability [2]. Given the pivotal role of the energy industry in realizing these objectives, it becomes evident that sustainability resonates deeply within Türkiye's energy sector, involving all its stakeholders.

The spotlight on sustainable finance by global entities not only aligns with overarching climate objectives but also intersects with Türkiye's strategic imperative to cultivate a sustainable energy framework [3]. The pursuit of Net Zero targets in Türkiye demands a fundamental overhaul of its energy infrastructure, prioritizing renewable sources and efficiency enhancements. In this context, ensuring the accessibility of sustainable finance becomes essential for Turkish enterprises, governmental initiatives, and energy sector participants alike. By broadening the array of sustainable finance opportunities, international financial institutions can spur Türkiye's transition towards a more sustainable energy model, fostering economic advancement while addressing environmental concerns. Consequently, the convergence of worldwide sustainability endeavours with Türkiye's energy aspirations highlights the interconnected nature of sustainability and the roles of energy sector stakeholders in effecting positive transformations.

In recent years, corporations have increasingly utilized Environmental, Social, and Governance (ESG) disclosures as a means to communicate their sustainability efforts. These disclosures serve multiple purposes, including fulfilling requirements to access climate finance, mitigating risks, meeting stakeholder expectations, and enhancing brand reputation. Evaluations of the efficacy of these disclosures are contingent upon their existence, transparency, and quality. Through various methodologies, companies are assessed and assigned ratings based on their performance across the

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environmental, social, and governance dimensions of ESG. These aggregated scores, known as ESG ratings, serve as indicators of a company's sustainability performance [4].

In investment circles, elevated ESG ratings are viewed as a measure of companies' resilience against both financial and climate-related risks [5]. The current global landscape, marked by economic turmoil, energy shortages, and supply chain disruptions, offers an opportune moment to scrutinize the validity of this proposition. The prevailing crises exacerbate market vulnerabilities associated with the shift towards a lower-carbon economy [6]. Thus, amidst this multifaceted crisis, a pertinent inquiry arises: do companies boasting higher ESG ratings indeed demonstrate superior financial performance?

The BIST Sustainability Index (XUSRD) was established to bolster comprehension, awareness, and implementation of sustainability, particularly among companies listed on Borsa Istanbul (BIST, Istanbul Stock Exchange), by incorporating shares of firms with strong sustainability performances. It's suggested that companies adept at managing risks and seizing opportunities can enhance their standing and gain a competitive edge through inclusion in this index. Furthermore, it's proposed that the index could foster the development of new investment products tailored to attract fresh capital and offer favourable financing terms to companies [7].

1.2. Research Significance

The significance of this research lies in its timely investigation into the nexus between sustainability and financial performance within Turkish energy market generator and retailer companies amidst the backdrop of a crisis amplifying market risks associated with transitioning to a lower-carbon economy. This study pioneers a comprehensive examination utilizing panel data regression analysis, offering a novel perspective on an underexplored area of inquiry. By delving into the intricacies of companies' operational domains, index engagement, and performance across different ESG pillars, this research provides a quantitative assessment of their interrelationships, thereby advancing our understanding of the dynamics between sustainability and financial outcomes.

This study holds paramount importance for Independent Power Producers (IPPs) as they navigate investment decisions within the Turkish energy market. By shedding light on the relationship between sustainability initiatives and financial performance, IPPs can make more informed investment choices that align with long-term economic and environmental objectives. Furthermore, this research is invaluable for governments and policymakers involved in shaping energy policies and regulations in Türkiye. By providing empirical evidence of the economic benefits associated with sustainability efforts within the energy sector, policymakers can justify and strengthen policies that promote renewable energy adoption and sustainable practices among energy companies. This study serves as a crucial resource for both IPPs and governments in making informed decisions that promote sustainable development and economic prosperity in Türkiye's energy landscape.

1.3. Literature

Despite the growing number of studies on the impact of sustainability performance on financial performance in recent years, it is difficult to draw solid conclusions. Ademi and Klungseth [8] investigate the correlation between ESG performance, financial performance, and market valuation using data from 150 S&P 500 companies. By utilizing fixed-effect regression and weighted least squares models across 5750 observations, the study reveals that companies exhibiting superior ESG performance tend to demonstrate stronger financial performance and command higher market valuations, even during crises such as the COVID-19 pandemic. Similarly, Liu et al. [9] apply configuration theory to examine how various ESG pillar configurations influence Corporate Financial Performance (CFP) using longitudinal fuzzy set qualitative comparative analysis (fsQCA). As a result of this analysis, it is stated that the social pillar consistently influences high CFP outcomes, remaining stable over time. In another study, Chen et al. [10] investigated ESG's impact on corporate financial performance over a decade (2011–2020) using a sample of 3332 listed firms worldwide. They apply multiple regression and categorized regression to analyze 24,076 valid observations. Results reveal a significant positive correlation between ESG performance and corporate performance, particularly for large-scale companies. Additionally, the study finds that the positive influence of ESG on financial performance is more pronounced in high-risk scenarios.

Furthermore, Iazzolino et al. [11] examine the influence of ESG factors on the financial performance of a selection of companies across various European industries utilizing the Data Envelopment Analysis (DAE) method. The study's results indicate varying effects of ESG considerations on firm efficiency across different sectors, with certain sectors exhibiting greater sensitivity to these factors than others. Additionally, the study explores the risk-return characteristics

associated with ESG considerations in the most responsive sectors, offering valuable insights for investors seeking to build portfolios that are both efficient and sustainable. More recently, Saha and Khan [12] delve into the relationship between ESG factors, financial performance, and corporate governance in the Nordic region. Using a dataset of 899 Nordic firms over a decade, refined to 1360 firm-years, the authors analyze the correlation between financial ratios and ESG scores. Findings highlight a significant relationship between ESG efforts and financial performance metrics. Moreover, corporate governance dimensions exhibit intriguing correlations with financial indicators.

After the financial uncertainties caused by COVID-19, such arguments have been tested in a crisis environment. Many articles have been published examining the effects of ESG performance on financial performance during crisis periods. Broadstock et al. [13] explore the impact of ESG performance during the COVID-19 financial crisis using event study analysis. Analysing data from China's CSI300 constituents, it is revealed that high-ESG portfolios tend to outperform low-ESG ones. Moreover, ESG performance helps mitigate financial risk during crises, highlighting its importance in turbulent times compared to normal circumstances. Similarly, Al Amosh and Khatib [14] compare ESG performance between developing and developed countries pre- and post-COVID-19. Using a large dataset covering 12,325 company-year observations from 2016 to 2021, panel regression analysis is employed. Findings suggest companies prioritize ESG compliance during crises, questioning the assumption that developed countries outperform in ESG. Additionally, COVID-19 positively affects ESG performance, emphasizing the importance of ethical behaviour during crises. Furthermore, Gao et al. [15] examine how corporate ESG performance affects stock price crash risk. It finds that higher ESG performance correlates with reduced crash likelihood, a result confirmed through various robustness tests. ESG performance mitigates crash risk by attracting green investors, enhancing analyst competence, and guiding management behaviour.

In contrast to the abovementioned studies, Cornell and Damodaran [16] construct a value framework to assess how social responsibility translates into tangible value components. Despite the hype surrounding ESG, they find that its actual impact remains exaggerated, with claims of financial benefits largely unsubstantiated and research findings often inconclusive or contradictory. Besides, Demers et al. [17] find that ESG factors do not significantly explain returns during the COVID-19 crisis after controlling for industry affiliation, market-based risk measures, and accounting-based performance indicators. These findings remain robust across alternative measures of returns and different datasets capturing ESG performance. The study concludes that while ESG did not provide stock immunity during the pandemic, investments in intangible assets did.

1.4. Research Objectives and Motivation

In the Appendices, Table A1 displays a collection of studies that examine how ESG factors influence financial performance. In addition to these studies, amidst the backdrop of a crisis that accentuates market risks associated with transitioning to a lower-carbon economy, this study pioneers an examination into the correlation between sustainability and financial performance within Turkish energy market generator and retailer companies. Utilizing panel data regression analysis, a comprehensive evaluation is conducted for the first time. This analysis encompasses various factors, including the companies' operational domains, index engagement, and their performance across different ESG pillars, providing a quantitative assessment of their interrelationships.

This study will make three contributions to the literature. First, it will contribute to the existing literature on financial performance and sustainability performance as a new data point. Second, it will determine the sub-sectors of publicly traded companies in the Turkish energy market and their involvement in the XUSRD index and then reveal the relationship between sustainability performance and financial performance according to these conditions. Finally, this study will investigate the impact of Russia-Ukraine war on the financial performance of energy companies in Türkiye. To analyze the abovementioned objectives, the methodological framework of this study is given in Figure 1.

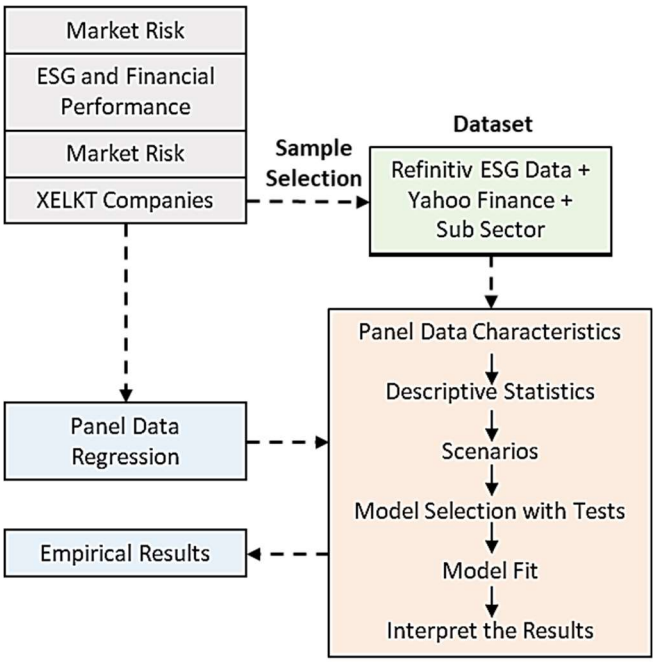

Figure 1. Framework of the study.

The organization of this paper consists of five sections. The first section introduces the research question and emphasizes the study's importance, while the second section explains the framework, presents the data, and describes the methods used. Subsequent sections report the analysis results and discuss the implications of the findings. The final section concludes the paper and offers recommendations for future research.

2. Methodology, Data and Model

Per TCFD, market risks represent a key segment of the risks associated with transitioning to a lower-carbon economy, influenced by shifts in consumer behaviour, market signal uncertainty, and rising raw material costs [6]. As a complement, Zhu et al. [18] explain that the potential risks of the carbon market depend on a lot of external factors, but oil and natural gas prices stand out as they are the most associated economic factors. In this context, when Russia-Ukraine war and the spillover effect it creates taken into account, it is clear to understand that market risks have been triggered for the energy sector.

ESG scores can be calculated by many different methods. Berg et al. [19] show how the six most popular ESG rating providers; KLD, Sustainalytics, Moody's ESG (Vigeo-Eiris), S&P Global (RobecoSAM), Refinitiv (Asset4), and MSCI distinguish from each other and how they interpret data points. Although Berg et al. [20] and Sahin et al. [21] criticize Refinitiv's approach to disclosure and incapabilities, Berg et al. [19] state that Refinitiv is the most popular rating agency.

Refinitiv's scoring methodology includes 186 publicly open data points which form 10 categories under three pillars of ESG. Relevance and transparency of these data points form 10 ESG categories' scores, then these category scores form pillar and ESG overall scores according to category and pillar weights [4]. Each ESG pillar and categories under those pillars are given in Table 1.

Table 1. ESG Pillars and Categories.

	Pillars	Categories
ESG Score	Environmental	Resource use
		Emissions
		Innovation
	Social	Workforce
		Human rights
		Community
		Product responsibility
	Governance	Management
		Shareholders
		CSR strategy

Starting from 2021, Refinitiv's ESG scores are utilized for selecting companies to be incorporated into the BIST Sustainability Index. Companies aspiring for inclusion in the BIST Sustainability Index are required to satisfy all three conditions specified [7];

- Overall ESG Score ≥ 50
- Each pillar ≥ 40
- At least 8 of the 10 categories ≥ 26.

2.1. Data

The BIST Sustainability Index and the BIST Electricity Index serve distinct but complementary purposes within the context of Türkiye's financial and sustainability landscape. The BIST Sustainability Index includes companies from various sectors that meet stringent criteria for ESG performance, aiming to promote transparency and encourage sustainable practices across industries. In contrast, the BIST Electricity Index specifically focuses on the financial and operational performance of companies within the electricity sector, reflecting trends and dynamics unique to this critical industry. While the BIST Sustainability Index provides a broad sustainability framework, the BIST Electricity Index offers a sector-specific lens, making it particularly suitable for evaluating the interplay between financial outcomes and sustainability efforts within the energy domain. This study primarily focuses on the BIST Electricity Index, leveraging its sector-specific scope, but incorporates insights from the BIST Sustainability Index where relevant to contextualize the findings within broader sustainability discussions. This dual consideration ensures a comprehensive understanding while maintaining a clear distinction between the two indices.

In the scope of the study, the financial and sustainability performance of 22 companies (AKENR.E, AKSEN.E, AKSUE.E, ALFAS.E, ARASE.E, AYDEM.E, AYEN.E, BIOEN.E, CANTE.E, CONSE.E, ENJSA.E, ESEN.E, GWIND.E, HUNER.E, KARYE.E, MAGEN.E, NATEN.E, NTGAZ.E, ODAS.E, PAMEL.E, SMRTG.E, ZOREN.E) listed in the BIST XELKT index were examined for the period between 2019 and 2022.

From 2023 onwards, the Republic of Türkiye Public Oversight Accounting and Auditing Standards Authority began implementing inflation accounting in the metrics used to gauge financial performance. Given the diminishing validity of year-on-year comparisons in balance sheets and cash flow statements, the updated approach permits assessment solely between 2019 and 2022, as both balance sheet and cash flow values adhere to a consistent calculation methodology throughout this period.

The financial performance of the companies was gathered by reviewing their publicly available quarterly/yearly financial statements through Yahoo Finance. "CONSE.E" and "ALFAS.E" had their initial public offerings in 2022, so 20 companies other than these two were included in the analysis. The companies' sub-sectors were obtained from Yahoo Finance as well. As previously mentioned, the sustainability performance obtained depends on the rating method used. As a measure of sustainability performance, Refinitiv's ESG, E, S, and G scores were used, as used in [17,22]. Descriptive statistics of the dataset is given in Table 2.

Table 2. Descriptive Statistics.

Variable	N	Mean	Std. Dev.	Min	Max
ESG	80	13.35	25.145	0	89
E	80	13.6	26.886	0	89
S	80	14.288	26.773	0	95
G	80	12.038	23.835	0	90
XUSRD	80	0.075	0.265	0	1
MRE	80	0.25	0.436	0	1
SUB	80	0.9	1.228	0	4
ROA	80	0.048	0.11	−0.22	0.42
LVR	80	0.38	0.19	0.038	0.9
SZE	80	22	1.7	18	25

Through the dataset, it can be noted that the size of the companies in XELKT is quite similar when standard deviation is taken into consideration. Similarly, the same argument can be said for leverage ratio as well. Since there are only 9 companies that have ESG scores amongst 20, the mean of ESG, E, S and G scores are relatively low. GWIND-2022 has the greatest ROA in the dataset while AKSUE-2019 has the lowest. AKENR-2021 has the highest "E" pillar score, while ENJSA-2022 and ENJSA-2021 have the highest "S" and "G" pillar scores, respectively. ENJSA-2022 also has the highest overall ESG score as well.

2.2. Proposed Model

Regression Model

When reviewing the literature focused on the effect of sustainability performance on financial performance, it is seen that there are multiple methods for indicating financial performance, such as Return on Assets (ROA), short- or long-run stock returns, and Tobin's Q [23]. Bruna et al. [24] have created a synthetic index instead of using a single financial performance indicator. In this study, ROA will be used as the financial performance indicator, as used in [25–28]. ROA will be used as the dependent variable representing the profitability of the company i at year t. The calculation method for ROA is given below:

$$\mathrm{ROA_{it}} = \mathrm{Net\ Income_{it}}/\mathrm{Total\ Assets_{it}} \quad (1)$$

ESG_{it} is added as an independent variable, which represents the ESG score of company i at time t. In addition to the overall ESG score, the E, S, and G pillars are also included as independent variables in the models, as in [9,26,29].

In the regression, dummy variables have been added to allow for the observation of the effects of subgroups [29]. MRE_{it} for Market Risk Exposure, $XUSRD_{it}$ for BIST Sustainability Index inclusion, and SUB_{it} for XELKT company sub-sectors are added as dummy variables. The start date of the Russia-Ukraine war is taken into account for MRE_{it}. The dummy variables are given in Table 3.

Table 3. Dummy variables.

Market Risks Exposure	Value
Before War	0
Russia-Ukraine War	1
Sub-Sector	
Generation	0
Distribution	1
Generation and Distribution	2
Technology	3
Natural Gas Transportation	4
XUSRD Index	
Not Listed	0
Listed	1

In order to determine the specific relationship between the variables of interest more accurately, LVR_{it} and SZE_{it} are introduced to models as control variables [30]. LVR_{it} represents the leverage ratio of the company i in year t. Similarly, SZE_{it} represents the size of the company i in year t. Equations for LVR_{it} and SZE_{it} are given below.

$$\mathrm{LVR_{it}} = \mathrm{Total\ Debts_{it}}/\mathrm{Total\ Assets_{it}} \quad (2)$$

$$\mathrm{SZE_{it}} = \ln\left(\mathrm{Total\ Assets_{it}}\right) \quad (3)$$

As provided in Table A1, researchers often use panel data regression to show how a dependent variable changes over time for multiple subjects. The panel data regression models to be used in this study are given below.

Model 1:

$$\mathrm{ROA_{it}} = \beta_0 + \beta_1 \mathrm{ESG_{it}} + \beta_2 \mathrm{MRE_{it}} + \beta_3 \mathrm{SUB_{it}} + \beta_4 \mathrm{XUSRD_{it}} + \beta_5 \mathrm{LVR_{it}} + \beta_6 \mathrm{SZE_{it}} + \varepsilon_{it} \quad (4)$$

Model 2:

$$\mathrm{ROA_{it}} = \beta_0 + \beta_1 \mathrm{E_{it}} + \beta_2 \mathrm{S_{it}} + \beta_3 \mathrm{G_{it}} + \beta_4 \mathrm{MRE_{it}} + \beta_5 \mathrm{SUB_{it}} + \beta_6 \mathrm{XUSRD_{it}} + \beta_7 \mathrm{LVR_{it}} + \beta_8 \mathrm{SZE_{it}} + \varepsilon_{it} \quad (5)$$

Model 3:

$$\mathrm{ROA_{it}} = \beta_0 + \beta_1 \mathrm{ESG_{it}} + \beta_2 \mathrm{LVR_{it}} + \beta_3 \mathrm{SZE_{it}} + \varepsilon_{it} \quad (6)$$

Model 4:

$$\mathrm{ROA_{it}} = \beta_0 + \beta_1 \mathrm{E_{it}} + \beta_2 \mathrm{S_{it}} + \beta_3 \mathrm{G_{it}} + \beta_4 \mathrm{LVR_{it}} + \beta_5 \mathrm{SZE_{it}} + \varepsilon_{it} \quad (7)$$

In these models, ROA_{it} represents the dependent variable. ESG_{it}, E_{it}, S_{it}, G_{it}, MRE_{it}, SUB_{it} and $XUSRD_{it}$ are included as independent variables. LVR_{it} and MRE_{it} are included as control variables. The i and t indices represent the value of company i in year t. ε_{it} represents the error.

2.3. Model Fit

In ensuring the methodological rigor of our analysis and identifying potential sources of bias that could compromise the robustness of our findings, it is imperative to employ appropriate statistical models. Initially, the suitability between a pooled Ordinary Least Squares (OLS) model and a fixed effects model was determined through the F-test. Subsequently, the application of the Hausman Test elucidated whether a fixed effects or random effects model better suited the dataset's characteristics. Thirdly, the presence of serial correlation within the dataset was assessed using the Breusch-Godfrey/Wooldridge test. Fourthly, the Breusch-Pagan Test was employed to ascertain the presence of heteroscedasticity within the dataset. Lastly, the Variance Inflation Factor (VIF) was computed for the random effects model to examine potential multicollinearity among the independent variables.

2.4. Model Implementation

The process commenced with data cleansing, involving the removal of missing values and ensuring data conformity to the requisite format. This pre-emptive action aimed to forestall potential inaccuracies or biases in subsequent analyses. Subsequently, relevant independent and dependent variables essential for model construction were identified. Models (1) and (2) were applied to a comprehensive dataset encompassing all companies, while Models (3) and (4) were exclusively deployed on a dataset comprising companies indexed within the XELKT index, possessing sustainability scores divergent from zero between 2019 and 2022. Following the model specification, parameter estimation ensued, employing the selected dataset and variables. Finally, the model underwent comprehensive evaluation, assessing its fit and performance through the utilization of various statistical tests.

3. Results

3.1. All XELKT Companies

Model 1 and Model 2 were run in a dataset that includes all companies included in the XELKT index. The Pearson correlation coefficient matrix for Model 1 and Model 2 variables is given in Figure 2 as a heatmap. As expected, each ESG pillar score and ESG overall score are highly positively correlated. It should also be noted that all ESG related variables are moderately highly correlated with company size and XUSRD index involvement. Since XUSRD involvement depends on sustainability performance constraints, it can be said that it is also an expected outcome. Yet, it is important to emphasize that only three of the 22 XELKT companies satisfy the requirements of XUSRD. Leverage ratio has a negative correlation with the profitability of companies and war-related market risk exposure.

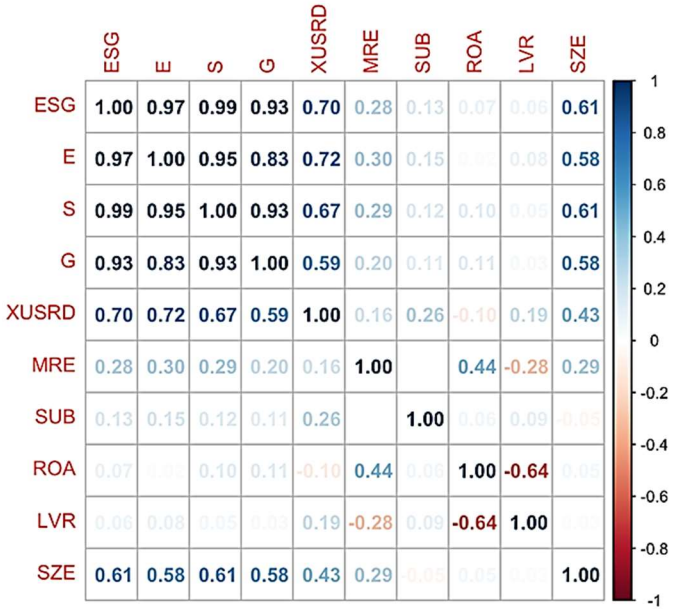

Figure 2. Pearson Correlation Coefficient Matrix for Model 1 and Model 2 Variables.

3.1.1. Test

As previously mentioned, the initial step involves conducting an F-test to determine the appropriateness of employing either a pooled OLS model or a fixed effects model for Model 1 and Model 2. Given the *p*-values of 0.0016 and 0.0058, significantly lower than the 0.05 threshold, we reject the null hypothesis (that pooled OLS is more appropriate than fixed effects) and opt for the fixed effects model. Subsequently, a Hausman Test is conducted to ascertain the preferable model between the fixed effects and random effects models. With the *p*-values of 0.674 and 0.765, exceeding the 0.05 threshold, we accept the null hypothesis, indicating that the random effects model is more suitable than the fixed effects model.

To assess the presence of serial correlation and heteroscedasticity, the Breusch-Godfrey/Wooldridge and Breusch-Pagan Tests were conducted for the random effects model. The results indicate that for the Breusch-Godfrey/Wooldridge test, with the *p*-values of 0.894 and 0.91, surpassing the 0.05 threshold, it can be concluded that there is no evidence of serial correlation. Similarly, for the Breusch-Pagan Test, the obtained *p*-values of 0.219 and 0.208 exceed the significance level of 0.05, indicating the absence of heteroscedasticity in the data. A summary of the tests for Model 1 and Model 2 is given in Table 4.

Table 4. *p*-values of tests for Model 1 and Model 2.

Tests	Model 1	Model 2
F Test	0.00155	0.00579
Hausman Test	0.6744	0.7647
Breusch-Godfrey/Wooldridge Test	0.8941	0.9099
Breusch-Pagan Test	0.2192	0.2077

Both for Model 1 and Model 2, random effects are suitable. There is no serial correlation or heteroscedasticity.

3.1.2. Regression

Once the statistical validity of the models has been confirmed, the outcomes of the regression models can be considered reliable. Thus, the regression models are deemed reliable based on the *p*-values provided in Table 4. In this regard, the regression results for Model 1 and Model 2 are given in Table 5.

Table 5. Random Effects Regression Results for Model 1 and Model 2.

All XELKT Companies		
	Dependent variable: ROA	
Varaible/Model No	(1)	(2)
ESG	0.001	
	(0.001)	
E		−0.002
		(0.001)
S		0.002
		(0.002)
G		0.001
		(0.001)
XUSRD	−0.056	−0.046
	(0.046)	(0.046)
MRE	0.080 ***	0.081 ***
	(0.022)	(0.022)
SUB	0.011	0.011
	(0.012)	(0.011)
LVR	−0.308 ***	−0.309 ***
	(0.066)	(0.063)
SZE	−0.008	−0.009
	(0.009)	(0.009)
Constant	0.311	0.329 *
	(0.192)	(0.175)
Observations	80	80
R^2	0.475	0.501
Adjusted R^2	0.432	0.445
F Statistic	66.144 ***	71.217 ***

Note: * $p < 0.1$; *** $p < 0.01$.

Since both models' F statistics are significant, it can be said that both models are significant and descriptive. The war and leverage have significant in every *p* level. The Russia-Ukraine War has positive effect on Turkish energy

companies' profitability. On contrary, leverage affects companies' profitability negatively. Though ESG or each pillar do not have significant impacts on profitability, while E pillar has negative relation S pillar has positive relation with ROA. The limited presence of ESG scores in the 80 observations could have impacted the outcome of the conclusion made from these models.

3.2. "Responsible" Companies

Models (3) and (4) were used for "Responsible" companies. "Responsible" companies refer to the companies (AKENR.E, AKSEN.E, BIOEN.E, ENJSA.E, ESEN.E, GWIND.E, MAGEN.E, NATEN.E, ZOREN.E) in the XELKT index with sustainability scores that were different from 0 at any time between 2019 and 2022. In order to reduce complexity, all categorical variables (MRE, SUB and XUSRD) are omitted in these models. The Pearson correlation coefficient matrix for Model 3 and Model 4 variables is given in Figure 3 as a heatmap.

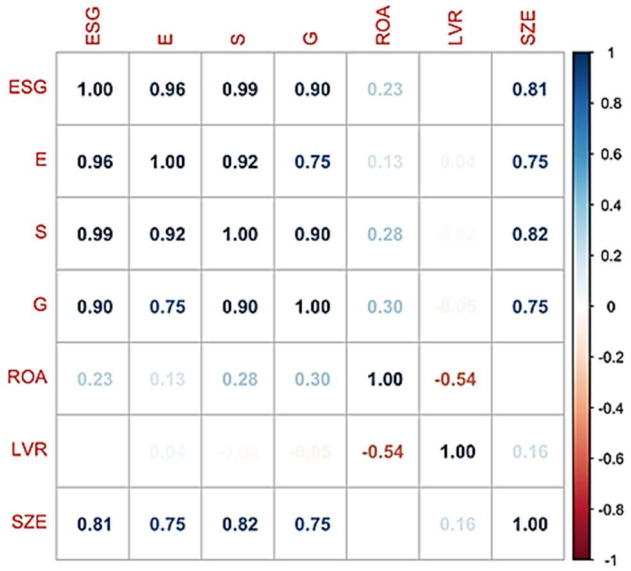

Figure 3. Pearson Correlation Coefficient Matrix for Model 3 and Model 4 Variables.

As anticipated, there exists a strong positive correlation between the scores of each ESG pillar and the overall ESG score. Furthermore, it is noteworthy that all ESG-related variables exhibit a significant correlation with company size. The control variables, namely leverage ratio and company size, demonstrate a positive correlation. Additionally, the leverage ratio exhibits a negative correlation with companies' profitability.

3.2.1. Test

Similar to previous statistical validation tests conducted for prior models, the initial step involves performing an F-test to determine the suitability between employing a pooled OLS model or a fixed effects model for Model 3 and Model 4. With a *p*-value of 0.0064 and 0.0195, significantly lower than the 0.05 threshold, the null hypothesis (suggesting that pooled OLS is more appropriate than fixed effects) is rejected in favour of the fixed effects model. Subsequently, a Hausman Test is employed to determine the preferable model between the fixed effects and random effects models. The obtained *p*-values of 0.756 and 0.935 exceed the 0.05 threshold, leading to the acceptance of the null hypothesis, indicating that the random effects model is more suitable than the fixed effects model.

To evaluate the presence of serial correlation and heteroscedasticity, the Breusch-Godfrey/Wooldridge and Breusch-Pagan Tests were conducted for the random effects model. Results from the Breusch-Godfrey/Wooldridge test yielded *p*-values of 0.645 and 0.327, surpassing the 0.05 threshold, thus indicating no evidence of serial correlation. Similarly, the Breusch-Pagan Test produced *p*-values of 0.0803 and 0.356, exceeding the significance level of 0.05, suggesting the absence of heteroscedasticity in the data. A summary of the tests for both Model 3 and Model 4 is provided in Table 6.

Table 6. *p*-values of tests for Model 3 and Model 4.

Tests	Model 3	Model 4
F Test	0.006375	0.01949
Hausman Test	0.7555	0.9349
Breusch-Godfrey/Wooldridge Test	0.6451	0.327
Breusch-Pagan Test	0.08028	0.3564

Both for Model 3 and Model 4, random effects are suitable. There is no serial correlation or heteroscedasticity.

3.2.2. Regression

Upon confirmation of the statistical validity of the models, the reliability of the regression outcomes can be assured. Therefore, based on the *p*-values presented in Table 6, the regression models are considered reliable. In this context, the regression results for Model 3 and Model 4 are presented in Table 7.

Table 7. Random Effects Regression Results for Model 3 and Model 4.

"Responsible" Companies		
	Dependent variable: ROA	
Varaible/Model No	(3)	(4)
ESG	0.002 **	
	(0.001)	
E		−0.002 *
		(0.001)
S		0.004 **
		(0.001)
G		−0.0001
		(0.001)
LVR	−0.281 *	−0.248 **
	(0.117)	(0.118)
SZE	−0.015	−0.023
	(0.016)	(0.016)
Constant	0.443	0.590 *
	(0.356)	(0.294)
Observations	36	36
R^2	0.321	0.426
Adjusted R^2	0.257	0.330
F Statistic	15.111 ***	22.234 ***

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Both models are deemed valid and informative, as indicated by their significant F statistics. The results demonstrate that ESG, E pillar, and S pillar exert significant effects on ROA for both Model 3 and Model 4. Additionally, the leverage ratio also exhibits a significant impact. Notably, while overall ESG and S pillar demonstrate a positive impact on the profitability of "responsible" companies, the E pillar shows a negative relationship. Similarly, the leverage ratio demonstrates a negative impact. Hence, it can be inferred that sustainability plays a pivotal role in the financial performance of companies integrating sustainability reporting into their operations. However, despite the model's explanatory power, the relatively low R-squared value indicates that its predictiveness is limited.

4. Discussion

The results of the first scenario showed that profitability was significantly affected by the Russia-Ukraine War and the company's leverage ratio, but ESG performance had no significant effect on the financial performance. It can be revealed that the assertion that the Russia-Ukraine War positively impacts Turkish energy companies' profitability suggests a complex interplay of geopolitical factors influencing financial outcomes within the sector. The observed increase in profitability amid such geopolitical tensions underscores Türkiye's strategic positioning as an energy hub and its ability to capitalize on market opportunities arising from supply disruptions or shifts in global energy dynamics. However, it's essential to recognize the potential ethical and humanitarian implications associated with profiting from geopolitical conflicts, which may raise questions about corporate social responsibility and stakeholder expectations.

Conversely, the negative impact of leverage on profitability highlights the financial risks inherent in high debt levels for Turkish energy companies. Excessive leverage can amplify vulnerabilities to economic shocks, interest rate

fluctuations, and liquidity constraints, potentially eroding profitability and financial stability over the long term. Therefore, prudent financial management practices, including maintaining an optimal capital structure and managing debt levels effectively, are crucial for mitigating financial risks and ensuring sustainable profitability amid volatile market conditions.

In the second scenario, the scope of the dataset was narrowed to only "responsible" companies and the evaluation focused on the effects of ESG performance on financial profitability. The findings from the panel data regression model shed light on the intricate relationship between sustainability factors and financial performance within the electricity sector. The significant impacts of ESG, as well as its individual pillars, on ROA underscore the multifaceted nature of sustainability's influence on corporate profitability. The positive effects observed for ESG and the Social (S) pillar suggest that companies emphasizing social responsibility and environmental stewardship tend to exhibit higher financial performance. This corresponds with the increasing acknowledgment that socially responsible actions can lead to improved brand reputation, customer allegiance, and operational effectiveness, thereby strengthening financial results [31]. However, the negative relationship observed for the Environmental (E) pillar implies a nuanced dynamic, where specific environmental initiatives might entail upfront costs or operational constraints that temporarily depress financial metrics. Despite this, the overall positive impact of ESG underscores the net benefit of integrating sustainability considerations into corporate strategies.

Importantly, the convergence of sustainability factors and financial performance underscores the evolving landscape where environmental, social, and governance considerations are increasingly intertwined with corporate value creation. Therefore, these results underscore the imperative for electricity sector companies to prioritize sustainability initiatives not only for ethical reasons but also as a strategic imperative for long-term financial success and stakeholder value creation.

The unfavourable results for the environmental pillar (E) highlight the inherent trade-offs in sustainability efforts within the electricity sector. Environmental initiatives, such as adopting cleaner technologies, reducing emissions, and optimizing resource use, often require significant upfront investment. These costs can temporarily strain financial performance, particularly in capital-intensive industries. This highlights the importance of adopting a long-term perspective when evaluating the economic feasibility of environmental commitments. Policymakers and stakeholders must acknowledge that, despite short-term financial challenges, these investments are critical to building resilience against climate-related risks and regulatory demands.

Additionally, the increased profitability observed during the Russia-Ukraine War underscores Türkiye's strategic position in global energy markets but also raises ethical concerns. Benefiting from geopolitical conflict presents moral dilemmas and can undermine stakeholder trust. This underscores the importance of integrating ethical governance into corporate strategies to ensure financial success aligns with social responsibility and equitable resource allocation. Addressing these interconnected challenges enables companies to better balance profitability with ethical and environmental objectives, strengthening their role in advancing sustainable development.

When considering the possibility that sustainability practices will be mandatory in the future with upcoming regulations, it can be inferred that companies that already have sustainability practices in place will be prepared for potential financial liabilities. The possibility of a deepening of market risks with potential recession in the future also supports this conclusion.

To enhance the financial performance of electricity companies, it is essential to identify strategies that can effectively increase ROA. Drawing from insights derived from previous analyses, the following recommendations offer actionable implications aimed at optimizing operational efficiency, managing financial risks, and leveraging sustainability initiatives to bolster ROA within the electricity sector.

- Invest in sustainable infrastructure and technologies: Given the significant positive impact of ESG factors on ROA, electricity companies should prioritize investments in sustainable infrastructure and technologies. This may include upgrading power generation facilities to utilize renewable energy sources, implementing energy-efficient technologies to reduce operational costs, and enhancing environmental management practices to mitigate regulatory risks.
- Optimize capital structure and debt management: Recognizing the negative impact of leverage on ROA, electricity companies should focus on optimizing their capital structure and effectively managing debt levels. This may involve conducting thorough financial analyses to determine the optimal mix of debt and equity financing, refinancing high-cost debt to lower interest expenses, and implementing rigorous debt management practices to

minimize financial risks. By maintaining a balanced capital structure and prudently managing leverage, electricity companies can enhance financial stability, reduce interest costs, and improve ROA.

- Foster stakeholder engagement and social responsibility: Recognizing the positive impact of Social (S) factors on ROA, electricity companies should prioritize fostering stakeholder engagement and Corporate Social Responsibility (CSR) initiatives. This includes engaging with local communities, implementing inclusive business practices, and investing in social impact projects to address societal needs. By actively engaging with stakeholders and demonstrating a commitment to social responsibility, electricity companies can enhance brand reputation, build customer loyalty, and improve ROA.

In response to the complex dynamics shaping Turkish energy companies' profitability, policymakers must devise strategic interventions to navigate geopolitical risks and promote sustainable growth. The following recommendations offer actionable strategies to enhance resilience, mitigate financial vulnerabilities, and integrate sustainability principles into regulatory frameworks, ensuring long-term viability amidst evolving market landscapes:

- Enhancing geopolitical risk management is imperative for Turkish energy companies, given the significant impact of events like the Russia-Ukraine War on profitability. Policymakers should develop robust risk management frameworks, including diplomatic efforts to mitigate conflict risks and measures to diversify energy sources, bolstering resilience to geopolitical disruptions.
- Integrating ESG criteria into regulatory frameworks is essential, considering the positive impact on financial performance. Policymakers should mandate ESG disclosure standards, incentivize ESG performance, and foster collaboration to promote sustainable business practices.
- Strengthening CSR initiatives is vital to address ethical concerns associated with profiting from geopolitical conflicts. Policymakers should encourage ethical supply chain practices, support community development projects, and engage stakeholders to ensure responsible business conduct.

5. Conclusions

This study analyzed the financial and sustainability performance of 20 companies listed in the BIST XELKT index over the period spanning from 2019 to 2022. The study used panel data of XELKT companies to investigate the effects of ESG performance, subsectors, sustainability index inclusion, and market risk exposure on financial performance. Control variables such as leverage ratio and size of the companies were taken into account.

The findings from the two scenarios underscore the complex dynamics shaping the financial performance of Turkish energy companies and highlight the critical role of geopolitical factors and sustainability considerations. In the first scenario, the significant impact of the Russia-Ukraine War and leverage ratio on profitability reveals the susceptibility of energy companies to geopolitical tensions and financial risks associated with high debt levels. While capitalizing on market opportunities arising from geopolitical disruptions, it's imperative for companies to navigate ethical and humanitarian implications and uphold corporate social responsibility standards.

Conversely, the second scenario emphasizes the positive influence of ESG factors on financial performance, particularly within the electricity sector. The observed multifaceted nature of sustainability's impact underscores the importance of integrating ESG considerations into corporate strategies to enhance profitability and stakeholder value creation. As sustainability practices become increasingly vital and potentially mandatory under future regulations, companies with existing sustainability initiatives are better positioned to mitigate financial liabilities and navigate evolving market risks. Thus, these findings emphasize the strategic imperative for electricity sector companies to prioritize sustainability initiatives not only for ethical reasons but also for long-term financial resilience and competitiveness in a rapidly evolving landscape.

In addition to the valuable insights provided by this study, certain methodological limitations warrant attention for future research endeavours aimed at enhancing the rigor of findings. Firstly, to improve model resolution, it is suggested to utilize quarterly data instead of yearly data. Moreover, evaluating ESG data on a quarterly basis could be feasible if access to the release dates of sustainability reports is available.

Furthermore, for enhanced granularity, it is proposed to group sub-sectors and evaluate them individually rather than treating them as dummy variables within the same panel. While each sub-sector is subject to the risks outlined in this study, their respective impacts may differ. Additionally, to bolster the robustness of the model, testing it with various financial performance indicators from previous studies is recommended, albeit this would necessitate scrutiny of additional data points.

Appendix A

Table A1. Summary of Literature Review.

Reference	Methodology	Purpose	Findings
Boffo and Patalano [5]	Review	Explain ESG investments.	gives a general idea of ideas, evaluations and perform numerical examination to disclose the advancements and difficulties regarding the present state of ESG investing.
Zhu et al. [18]	Meta regression analysis	Evaluating driving forces of carbon market risk	Integrates both qualitative and quantitative research and employs Meta-Regression Analysis to investigate the causes of variation
Berg et al. [19]	Regression based decomposition	How rating methodologies differ from each other	Measures the factors that lead to variations and develops a technique that makes it easier to handle dissimilarities in ESG evaluations.
Berg et al. [20]	Descriptive Statistics	Investigating the outcomes of rewriting ESG scores	Tracks the evolution of historical ESG scores of Refinitiv ESG over time.
Sahin et al. [21]	Derivative free optimization	Studying the role of missing ESG information as a potential source for a release of new ESG information with impacts on ESG scores in the future.	Introduces an additional component referred to as the Missing (M) pillar and suggests an optimization approach to connect ESG scores and risk indicators.
Ademi and Klungseth [8]	Fixed-effect regression and a weighted least squares model	Investigates the relationship between a company's ESG performance and its financial performance.	Offers empirical data to clarify conflicting findings in existing literature
Cornell and Damodaran [16]	Review	Investigates the interaction between ESG related investment criteria and value	Constructs a structure based on value and key determinants
Liu et al. [9]	fsQCA (longitudinal fuzzy set qualitative comparative analysis)	How the different configurations of the ESG pillars impact financial performance	Assists emerging energy firms in enhancing their corporate social responsibility practices and increasing the use of fsQCA in long-term datasets.
Shanaev and Ghimire [32]	Calendar-time portfolio approach	Investigates the effect of specialised ESG rating upgrades and downgrades on stock returns.	Records the significance of modifications in ESG ratings, as opposed to ESG rating levels, on stock performance
Bruna et al. [24]	Time-lagged panel regression model	impact of Environmental, Social, and Governance (ESG) performance on financial performance	The non-linearity of the relationship between environmental, social, and governance (ESG) performance and financial performance.
Broadstock et al. [13]	Event Study	Examining ESG performance during market-wide financial crisis, triggered in response to the COVID-19 global pandemic.	Demonstrates that portfolios with high ESG generally perform better than those with low ESG, and that ESG performance reduces financial risk during financial crisis.
Gao et al. [15]	Regression model	Investigating the effect of ESG performance on stock price crash risk	Presents recent findings from the Chinese capital market that indicate that ESG performance can decrease the risk of stock price crash.
Albuquerque et al. [22]	Cross sectional regression	Examining ESG performance during COVID-19 based stock market crash	Demonstrates that stocks with higher environmental and social (ES) ratings have notably higher returns, lower return volatility, and higher operating profit margins during Q1 2020.
Yoo et al. [29]	Panel Data Regression	examining the effect of ESG performance on stock returns and volatility during the financial crisis resulting from the coronavirus (COVID-19)	Offers empirical data that demonstrates that better environmental, social, and governance (ESG) performance reduces financial risk during financial crises.
Demers et al. [17]	Panel Data Regression	ESG scores' effects on financial performance during COVID-19 crisis	Indicates that ESG did not protect stocks during the COVID-19 crisis
Chen et al. [10]	Multiple Regression and Categorized Regression	investigating ESG's impact on corporate financial performance	Finds that the positive influence of ESG on financial performance is more pronounced in high-risk scenarios
Saha and Khan [12]	Descriptive Statistics	analyzing the correlation between financial ratios and ESG scores.	Highlights that a significant relationship between ESG efforts and financial performance metrics
Al Amosh and Khatib [14]	Panel Regression	comparing ESG performance between developing and developed countries pre- and post-COVID-19	Suggests that companies prioritize ESG compliance during crises, questioning the assumption that developed countries outperform in ESG
Iazzolino et al. [11]	Data Envelopment Analysis	examining whether ESG factors influence the financial efficiency of a diverse set of firms across various European sectors.	Indicates that varying effects of ESG considerations on firm efficiency across different sectors, with certain sectors exhibiting greater sensitivity to these factors than others
Elamer and Boulhaga [33]	Tobin's Q	exploring the correlation between ESG controversies and firm performance	identifies a negative link between ESG controversies and firm performance.

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