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ESG: Its Threshold Effect on Asian Energy Company Profitability

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ABSTRACT

The impact of Environmental, Social, and Governance (ESG) factors on corporate financial performance remains a subject of ongoing debate among researchers. This study investigates the disaggregated components of ESG and their threshold effects on the profitability of Asian energy companies. Employing dynamic threshold panel regression, we find that the Environmental pillar score (E) enhances profitability when maintained below specific thresholds, while the social pillar score (S) shows profitability benefits when exceeding certain thresholds. Surpassing these thresholds, however, may either diminish or further enhance profitability, underscoring the dual risks and benefits associated with ESG practices. These findings reveal the profitability-enhancing potential of ESG scores while emphasizing the importance for energy companies to strategically manage their ESG components. Such careful management can mitigate the risk of diminishing returns and simultaneously improve financial performance through enhanced reputation and operational efficiency.

Keywords: ESG, Energy, Asian, Threshold, Profitability
JEL Classifications: G30; M21; Q40

1. INTRODUCTION

Environmental, Social, and Governance (ESG) scores have become widely recognized as standard proxies for assessing an organization's sustainability. These scores play a pivotal role in directing Sustainable and Responsible (SR) investments toward businesses that prioritize sustainable and ethical practices (Clément et al., 2022; Drempetic et al., 2020). According to the CFA Institute, over 70% of investors globally now consider ESG factors when making investment decisions (Abhayawansa and Mooneeapen, 2022). A survey of 2,000 empirical studies conducted by Friede et al. (2015) revealed that most studies reported a positive impact of ESG on corporate financial performance. However, Saygili et al. (2022) highlighted inconsistencies and contradictions in the literature regarding this relationship. Furthermore, recent research indicates that ESG scores are negatively associated with the cost of capital, suggesting financial benefits for organizations with higher ESG ratings (Breuer et al., 2018; Alves and Meneses, 2024). The inconclusive findings in the existing literature underscore the need for further investigation. This study seeks to reexamine the relationship between ESG and corporate financial performance, with a particular focus on energy companies in Asia.

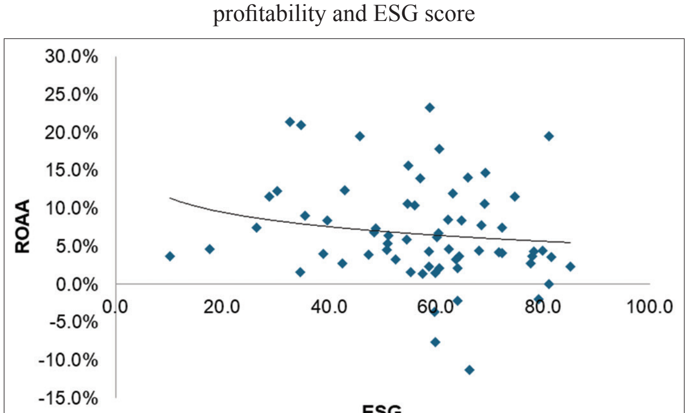
Asia is the fastest-growing economic region, driving a substantial increase in energy demand. Bloomberg Finance L.P. (2024) projects that total energy generation in the Asia-Pacific region will grow by 86% between 2023 and 2050. During the same period, total investment across the region is estimated to reach approximately $89 trillion. The report emphasizes that integrating ESG criteria and aligning energy diversification strategies with the Sustainable Development Goals (SDGs) can promote the development of more sustainable and resilient energy systems. In 2023, Asia added 328 gigawatts (GW) of renewable energy capacity, resulting in a 20% expansion in total energy generation—significantly surpassing the global average growth rate of 14% (International Renewable Energy Agency, 2024). As Asian companies increasingly shift toward renewable energy, understanding the role of ESG practices in shaping financial stability and profitability is essential to ensuring the success of this energy transition.

We conducted a preliminary analysis to explore the relationship between ESG scores and Return on Assets Average (ROAA) for 65 selected Asian energy companies over the period from 2019 to 2023. Figure 1 reveals that average ESG scores do not consistently predict financial performance, as firms across all ESG score ranges exhibited both high and low ROAA values. This high variability suggests that the relationship between ESG scores and ROAA may not follow a linear pattern. These findings highlight the need for further investigation into how ESG initiatives influence financial performance, with a particular focus on potential threshold effects of ESG scores on the profitability of Asian energy companies. Recent studies provide additional insights into the threshold dynamics of ESG impacts. For example, Pistolesi and Teti (2024) identified an inverted U-shaped relationship between ESG scores and systematic risk, while Agarwala et al. (2024) observed a U-shaped association between composite ESG scores and market performance.

This study aims to address the gap in understanding by adopting a nonlinear approach to analyze the individual contributions of ESG components to the profitability of Asian energy companies. Specifically, we utilize the dynamic threshold panel regression method developed by Seo and Shin (2016) and Seo et al. (2019) to examine the threshold levels of ESG scores, including their three subcategories, and their impact on profitability. This method is particularly suited for panel data analysis as it effectively accounts for time dynamics and addresses endogeneity issues more robustly than Hansen's (1999) static models. Furthermore, it captures nonlinear relationships, enabling the identification of threshold levels that are often overlooked by linear models. Unlike Kremer et al.'s (2013) approach, this method distinguishes independent variables across distinct regimes, providing a more comprehensive framework for analyzing complex panel data with dynamic and nonlinear characteristics.

Our study makes several notable contributions to literature. First, it addresses a critical gap by examining the threshold effects of disaggregated ESG components and their relationship with the profitability of Asian energy companies. Understanding these thresholds is essential, as surpassing specific ESG score levels can have adverse effects on risk and stability, particularly within the unique context of the Asian energy markets. Second, we leverage a comprehensive dataset encompassing a diverse range of Asian energy companies over an extended sample period to investigate the intricate relationship between ESG scores, their individual components, and corporate performance. By building on existing research, our study delves deeper into the disaggregated components of ESG, explores threshold dynamics, and offers valuable insights into their implications for profitability in the Asian energy sector.

Figure 1: The potential relationship between Asia Energy companies' profitability and ESG score



The remainder of this paper is structured as follows: Section 2 reviews the relevant literature on ESG and its relationship with corporate profitability. Section 3 details the data and methodology employed in the study. Section 4 presents the empirical findings, while Section 5 concludes with a discussion of the study's key insights and implications.

2. LITERATURE REVIEW

A substantial body of research indicates that strong ESG performance is generally associated with improved financial outcomes. Chen et al. (2021) argue that ESG compliance generates a "promotion effect," enhancing a company's overall financial standing. As a result, companies with high ESG ratings often achieve higher market valuations and greater investor appeal. This trend highlights the increasing importance investors place on corporate sustainability and social responsibility (Alareeni and Hamdan, 2020; Ademi and Klungseth, 2022). Friede et al. (2015), in their survey of 2,000 empirical studies, found that most of the research supports a positive correlation between ESG standards and corporate financial performance. While some studies suggest that ESG investments might negatively impact short-term financial outcomes, the prevailing evidence underscores their contribution to a company's long-term financial success.

In the energy sector, the relationship between ESG factors and corporate financial performance is complex and multifaceted, with research offering diverse perspectives. Numerous studies suggest that strong ESG performance can enhance corporate financial outcomes. For instance, Zhao et al. (2018) found that publicly listed power companies in China with strong ESG performance experienced improved financial results. Similarly, Ademi and Klungseth (2022), in their analysis of companies within the U.S. S&P 500 index, observed that firms excelling in ESG performance not only achieved better financial outcomes but also enjoyed higher market valuations. These findings underscore the positive correlation between ESG practices and financial performance, highlighting the value of sustainability in driving corporate success.

Previous studies suggest that the relationship between ESG factors and corporate financial performance is not always straightforward or consistent. For example, Baran et al. (2022) analyzed Poland's energy sector and found that the correlation between ESG scores and corporate financial performance was not uniformly positive, indicating the potential influence of additional factors. Similarly, Makridou et al. (2024), in a European study, observed that ESG performance can sometimes have a marginally negative impact on the profitability of energy companies, particularly in areas related to environmental responsibilities. These inconsistent findings may be influenced by mediating factors, such as operational efficiency and profitability, which play crucial roles in translating ESG practices into tangible corporate benefits (Dsouza and Krishnamoorthy, 2024; Widianingsih et al., 2024). This highlights the need for a deeper understanding of how financial metrics mediate the relationship between ESG initiatives and corporate outcomes.

The impact of ESG factors on financial performance in the energy sector varies significantly across regions. Mititean and Sărmaș (2023) found that ESG scores negatively influence financial performance in Europe, while their effect on return on equity (ROE) in North America is positive but not statistically significant. This discrepancy may be due to the challenges European companies face in implementing ESG strategies, such as high costs and complex regulatory environment—issues that are less pronounced in North America. In Asia, ESG scores have a negative impact on profitability ratios, with the effect being more pronounced in developing countries compared to developed ones. This disparity is likely driven by the limited resources and capabilities of companies in developing nations, which impede their ability to effectively implement ESG initiatives (Alhawaj et al., 2023).

The nonlinear relationship between ESG factors and corporate performance has emerged as a key focus in recent research. Agarwala et al. (2024) identified a U-shaped relationship between ESG and market performance in Indian firms, emphasizing the importance of long-term planning. Similarly, Bagh et al. (2024) documented an inverted U-shaped relationship in U.S. and Chinese firms, indicating diminishing returns and eventual negative effects at higher ESG levels. In the European banking sector, Bouattour et al. (2024) provided evidence of regime-switching behaviors, linking varying ESG scores to banking stability. Pistolesi and Teti (2024) also demonstrated an inverted U-shaped relationship between ESG and systematic risk for NYSE-listed firms, while Pu (2022) reported a similar dynamic in Chinese companies, advocating for threshold optimization to maximize ESG benefits. Despite the growing body of evidence, limited research has explored the threshold effects of ESG performance specifically within the context of Asian energy companies. This represents a significant gap in understanding how ESG strategies can address the unique challenges faced by this sector.

3. DATA AND METHODOLOGY

The sample period for our analysis spans from 2019, a pivotal year when ESG became a central focus for companies globally, to 2023. This 5-year timeframe was chosen based on the availability of ESG data for Asian energy companies. We focused on companies that consistently reported ESG scores throughout this period. To meet this criterion, only firms with continuous ESG reporting during the sample period were included, ensuring a comprehensive and reliable observation window. Additionally, companies with extreme outliers were excluded to enhance the robustness and reliability of statistical results. This approach ensures that the findings are both meaningful and representative of the broader trends in ESG performance among Asian energy companies.

We retrieved data on publicly listed Asian energy companies from the LSEG database, narrowing the initial sample of 839 listed Asian energy companies to 65 that meet the specified selection criteria. This filtering process results in an unbalanced panel comprising 325 observations. To examine the impact of aggregated ESG factors on the profitability of Asian energy companies, we employ the following regression specification:

$$Profitability_{it} = \alpha + \beta_1 ESG_{it} + \beta_2 X_{it} + \varepsilon_{it} \quad (1)$$

Where $Profitability_{it}$ is measured using Return on Asset Average (ROAA), defined as net profit by average total assets over the preceding 5 years for company *i* in year *t*, and ESG_{it} represents ESG score. We then replace the aggregated ESG_{it} independent variable, one at a time, with its disaggregated components: environmental pillar score (E), Social Pillar Score (S), and governance pillar score (G). We use the system generalized methods of moments (GMM) approach to estimate Equation (1); this estimation approach is more robust than other GMM estimators in addressing concerns related to endogeneity and heterogeneity (Blundell and Bond, 1998). In addition, Roodman (2009) contends that this specific GMM method is robust to weak instrumentation and measurement errors, making it suitable for diverse econometric applications.

We include several control variables (X_{it}) identified by prior studies as significant determinants of companies' profitability (Agarwala et al., 2024; Makridou et al., 2024). First, we include the current ratio (CR), a liquidity metric calculated as current assets divided by current liabilities. This ratio evaluates a firm's short-term financial health and operational efficiency. Firms with higher liquidity are better equipped to manage short-term obligations, although excessive liquidity may suggest underutilized assets. To capture firm value, we incorporate the market-to-book ratio (MB), an indicator of growth opportunities and market valuation efficiency. Firms with higher MB ratios are typically more attractive in equity markets, reflecting favorable growth prospects.

We further include leverage (LEV) as a measure of a company's financial risk and funding structure. Defined as the ratio of total debt to total equity, leverage reflects a company's financial obligations. While high leverage can undermine profitability due to increased financial burdens, in some contexts, leveraged firms may benefit from tax advantages. To account for potential economies of scale and operational advantages, we add company size (SIZE) to the regression. Measured as the natural logarithm of total assets, larger entities may utilize resources more efficiently, although they can also face diminishing returns to scale as they expand. Finally, we incorporate company age (AGE) as a proxy for reliability. Measured in years since incorporation, older firms often benefit from established market presence and experience, though they may face structural inertia compared to younger, more agile companies. Table 1 provides a detailed summary of all variables, including their symbols and descriptions.

We estimate the following regression model to analyze the threshold effects of the ESG score and its disaggregated components on the profitability of Asian energy companies:

$$Profitability_{it} = (\beta_1 Profitability_{it-1} + \beta_{12} K_{it} + \beta_{13} X_{it}) D(K_{it} \leq \gamma) + (\beta_2 Profitability_{it-1} + \beta_{22} K_{it} + \beta_{23} X_{it}) D(K_{it} > \gamma) + \varepsilon_{it} \quad (2)$$

Where K_{it} refers to one of the key independent variables {ESG, E, S and G}, and $D(K_{it} \leq \gamma)$ is an indicator variable equal to 1 if K_{it} is less than or equal to a threshold value γ, and zero otherwise. The error term, ε_{it} ($\varepsilon_{it} = u_i + v_{it}$), is composed of individual fixed effects (u_i) and idiosyncratic random disturbances (v_{it}). The coefficients β_1 and β_2 capture the effects of the covariates in the lower and upper regions, respectively.

To estimate Equation (2), we use the dynamic threshold panel regression approach of Seo and Shin (2016), and Seo et al. (2019). This approach builds traditional panel threshold models by incorporating dynamics and addressing endogeneity within panel data. Using a bootstrap algorithm, we test for threshold effect by evaluating the null hypothesis ($\beta_1 = \beta_2$) through the Wald statistic, calculated for each fixed threshold value (γ). A detailed discussion of the advantages of using the dynamic threshold panel regression over alternative models has been provided in the Introduction section of this study.

4. EMPIRICAL FINDINGS

We begin the analysis by presenting the correlation estimates among key financial, ESG, and firm characteristics in Table 2. Several notable relationships emerge: First, ROAA and ROACE exhibit a strong positive correlation (0.92), indicating that these metrics are closely aligned in capturing financial performance. Both metrics display a negative correlation with the ESG score (−0.19 and −0.18), suggesting potential trade-offs between financial returns and ESG commitments. Second, the ESG score correlates strongly with its individual components: Environmental (E) at 0.86, Social (S) at 0.85, and Governance (G) at 0.58. This underscores that ESG performance is a composite measure, with

Table 1: Variables

Variable name	Variable code	Unit of measurement	Definition
Return on average total assets	ROAA	%	Profitability ratio that measures how efficiently a company generates net profits from its assets
Return on average common equity	ROACE	%	Profitability ratio that measures how well a company uses its investment dollars to generate profits for common shareholders
ESG score	ESG	0-100	Assessment of a company's ESG performance
Environmental pillar score	E	0-100	The weighted sum of the resource use, emissions, and environmental innovation category scores
Social pillar score	S	0-100	The weighted sum of a company's scores in the following categories: Workforce, Human rights, Community, and Product responsibility
Governance pillar score	G	0-100	The weighted sum of the management, shareholders, and CSR Strategy category scores
Current ratio	CR	%	A liquidity measurement used to track how well a company may be able to meet its short-term debt obligations
Market-to-book ratio	MB	%	Compares a company's market value to its book value, to determine the value of companies
Leverage	LEV	%	Total debt percentage of total equity. The ratio helps assess a company's ability to meet its financial obligations and the risk of default
Company size	Size	Natural logarithm	A company's total assets are the sum of all its assets, including current and long-term assets
Company age	Age	Years	A company's age is the length of time it has been in operation.
Renewable energy use	RE	0=Not involved; 1=Involved	Dummy variable to capture expansion in developing and using renewable energy sources

ESG: Environmental, social, and governance

Table 2: Correlation analysis

Variables	ROAA	ROEA	ESG	E	S	G	CR	MBV	LEV	Size	Age
ROAA	1										
ROACE	0.92***	1									
ESG	−0.19***	−0.18***	1								
E	−0.09	−0.11**	0.86***	1							
S	−0.18***	−0.21***	0.85***	0.65***	1						
G	−0.18***	−0.12	0.58***	0.28***	0.22***	1					
CR	0.15***	−0.04	0.13**	0.15***	0.20***	−0.06	1				
MBV	0.45***	0.42***	−0.28***	−0.24***	−0.23***	−0.19***	0.16***	1			
LEV	−0.17***	0.01	−0.11*	−0.21***	−0.09*	0.06	−0.44***	−0.01	1		
SIZE	−0.07	−0.03	0.22***	0.24***	0.12**	0.11**	−0.20***	−0.09	−0.02	1	
AGE	−0.10*	−0.06	0.16***	0.08	0.32***	−0.09	−0.10*	−0.16***	0.09	−0.02	1

*P<0.1, **P<0.05, ***P<0.01. RE: Renewable energy the environmental and social dimensions playing a slightly more prominent role. Finally, correlations among the ESG pillars are moderate. For example, E and S correlate at 0.65, reflecting some overlap in practices that drive both environmental and social scores. In contrast, G shows weaker correlations with E (0.28) and S (0.22), suggesting that governance practices may operate more independently of environmental and social initiatives. These findings highlight the nuanced role of the disaggregated components of ESG in profitability analysis, demonstrating that aggregated ESG scores may not fully capture the complexity of their individual contributions.

Turning to the control variables, the CR shows a weak but statistically significant positive correlation with ROAA (0.15) and no significant correlation with ROACE. This finding suggests that higher liquidity may slightly enhance asset efficiency but has a minimal impact on equity-driven profitability. The MB exhibits strong positive correlations with both ROAA (0.45) and ROACE (0.42), highlighting that profitability is often aligned with higher market valuation. LEV demonstrates a significant negative correlation with ROAA (−0.17) but no meaningful relationship with ROACE. This implies that higher debt levels may constrain asset-based profitability while having little impact on equity returns. SIZE shows weak, non-significant negative correlations with ROAA (−0.07) and ROACE (−0.03), indicating that size has limited influence on profitability. Similarly, AGE exhibits a weak negative correlation with ROAA (−0.10) and no significant relationship with ROACE, suggesting that older firms may experience slightly reduced asset profitability but do not show a clear impact on equity-driven returns. Overall, these low correlation coefficients confirm that the control variables maintain distinct relationships with the profitability metrics, alleviating concerns about multicollinearity and ensuring the robustness of the analysis.

Table 3 presents descriptive statistics for the variables included in the analysis, offering an overview of their distribution and variability. Profitability indicators, ROAA and ROACE, have mean values of 6.71% and 13.09%, respectively. Their standard deviations (7.59% for ROAA and 14.63% for ROACE) and wide ranges (−44.35-30.64% for ROAA; −96.08-58.63% for ROACE) underscore the substantial variability in financial performance across the sample. The ESG score averages 57.31, with the individual pillars—Environmental (E), Social (S), and Governance (G)—having mean values of 59.91, 56.25, and 54.48, respectively. Among these, the Environmental pillar exhibits the highest variability, with a standard deviation of 21.57 and a range from 0 to 93.27. This reflects significant differences in the sustainability practices and commitments of Asian energy companies.

Table 3: Descriptive statistics

Variables	Mean	Minimum	Maximum	SD	Observation
ROAA	6.71	−44.35	30.64	7.59	325
ROACE	13.09	−96.08	58.63	14.63	325
ESG	57.31	8.61	89.06	17.16	325
E	59.91	0.00	93.27	21.57	325
S	56.25	1.23	95.83	22.57	325
G	54.48	1.24	95.04	22.25	325
CR	144.12	33.69	485.16	75.04	325
MB	146.04	10.50	468.37	83.85	325
LEV	74.62	1.19	378.79	67.64	325
SIZE	10.03	8.88	11.60	0.60	325
AGE	37.41	3.00	129.00	24.57	325

SD: Standard deviation

The control variables exhibit considerable diversity across the sample, reflecting the varied operational, financial, and structural characteristics of the firms analyzed. Liquidity, measured by the CR, averages 144.12%, with substantial variability (standard deviation: 75.04%) and a range of 33.69% to 485.16%, indicating significant differences in firms' ability to meet short-term obligations. Valuation, represented by the MB, has a mean of 146.04% and similarly high variability (standard deviation: 83.85%), highlighting substantial differences in market perceptions of firm value relative to book value. Leverage (LEV) averages 74.62% but spans a wide range, from 1.19% to 378.79%, reflecting diverse capital structures across firms. Firm size (SIZE), measured as the natural logarithm of total assets, shows less variability (standard deviation: 0.60) and ranges from 8.88 to 11.60, suggesting relatively consistent firm sizes within the sample. Finally, company age (AGE) averages 37.41 years, with a standard deviation of 24.57 years and a range of 3-129 years, capturing the spectrum from young startups to long-established firms. These control variables provide critical insights into the diversity of financial and structural attributes influencing the profitability of Asian energy companies.

Table 4 presents the estimated results of Equation (1). The Hansen tests indicate no over-identification problems, with P-values ranging from 0.2185 to 0.2517, confirming that the instruments are well-specified. Additionally, the AR (1) and AR (2) tests show no significant serial correlation in the first-differenced errors, supporting the robustness of the model. The results reveal that the impact of ESG on the profitability of Asian energy companies varies in sign, magnitude, and statistical significance. Among the ESG components, Governance (G) has the strongest effect, with a coefficient of −0.0363 (t-statistic = −3.64), indicating a significant negative contribution to profitability. In contrast, the Environmental (E) and Social (S) components exhibit positive but statistically insignificant coefficients. The aggregated ESG score also shows a negative and insignificant relationship with profitability. These findings suggest that only the Governance component plays a significant role in reducing profitability for Asian energy companies. Our results contrast with the findings of Dsouza and Krishnamoorthy (2024), who reported that ESG has a significant negative impact on the profitability of oil and gas companies, and Makridou et al. (2024), who found that only the Environmental component negatively affects European energy companies.

Among the control variables, leverage (LEV) and the firm value (MB) demonstrate statistically significant relationships with profitability, as measured by ROAA. LEV consistently exhibits a negative effect on ROAA, with coefficients ranging from −0.0103 to −0.0110 ($P < 0.05$). This suggests that higher debt levels are associated with reduced profitability, likely due to increased financial risk and the cost of debt. In contrast, MB has a positive influence on ROAA, with coefficients between 0.0144 and 0.0168 ($P < 0.01$), indicating that higher market valuations relative to book value are linked to improved profitability. This reflects stronger market confidence and more efficient asset utilization. In the energy sector, profitability is often driven by long-term investments, which may explain why LEV and renewable energy use (RE) do not significantly impact the profitability of Asian energy companies. Additionally, profitability in this sector frequently depends on innovation, technology adoption, and the ability to adapt to market shifts. As a result, company size and age may not significantly enhance profitability, as larger or older firms are not necessarily better positioned to respond to the dynamic demands of the energy market.

Table 5 presents the results of the dynamic panel threshold regression model, with consistent estimated threshold values. Statistically significant thresholds are identified for ESG and its sub-components: E, S, and G, at 59.9, 45.0, 74.0, and 52.3, respectively. Below these thresholds, ESG and its sub-components exert an insignificant impact on Asian energy companies' profitability, except for the E, which shows a significantly positive effect. Specifically, within the threshold, a 1% increase in the environmental score contributes to a 0.2988% increase in profitability. However, the positive effect of the environmental pillar on profitability reverses above its threshold, turning negative. Conversely, for the social pillar, the impact transitions to positive above the threshold but with weak statistical significance. These findings highlight that while the Environmental pillar score enhances profitability, Asian

Table 4: Results for equation (1) for return on asset average

Variables	ESG	E	S	G
$ROAA_{-1}$	0.6878*** (8.37)	0.6837*** (8.25)	0.6941*** (8.56)	0.6927*** (8.83)
ESG	−0.0084 (−0.57)	0.0116 (0.93)	0.0085 (0.69)	−0.0363*** (−3.04)
LEV	−0.0103** (−2.35)	−0.0102** (−2.35)	−0.0110** (−2.47)	−0.0095** (−2.15)
CR	−0.0002 (−0.03)	−0.0006 (−0.07)	−0.0021 (−0.24)	−0.0007 (−0.09)
MB	0.0158*** (3.18)	0.0168*** (3.24)	0.0167*** (3.23)	0.0144*** (3.23)
SIZE	−0.3652 (−0.94)	−0.4323 (−1.11)	−0.4105 (−1.08)	−0.3528 (−1.05)
AGE	0.0128 (1.27)	0.0126 (1.28)	0.0107 (1.03)	0.0076 (0.78)
RE	−0.34 (−0.52)	−0.61 (−1.02)	−0.57 (−0.89)	−0.21 (−0.34)
Constant	4.4153 (1.00)	4.0321 (0.94)	4.2910 (1.00)	6.0992* (1.52)
Hansen	0.2284	0.2185	0.2304	0.2517
AR (1)	0.5290	0.5197	0.4939	0.4421
AR (2)	0.0587	0.0550	0.0540	0.0817
Observation	325	325	325	325
Companies	65	65	65	65

*P<0.1, **P<0.05, ***P<0.01. Robust t-statistics are shown in parentheses, while P-values are displayed in square brackets. ESG: Environmental, social, and governance, RE: Renewable energy

Table 5: Results for equation (2) for return on asset average

Variables	ESG	E	S	G
Threshold	59.9117*** (11.55)	45.0002*** (10.34)	74.0289*** (15.07)	52.2800*** (4.12)
Lower regime (≤γ)				
$ROAA_{-1}$	0.2424* (1.94)	0.0184 (0.16)	0.0184 (0.16)	−0.7894*** (−3.49)
ESG	0.0312 (0.24)	0.2988* (1.74)	−0.1220 (−1.15)	0.0482 (0.47)
LEV	−0.0153 (−0.69)	−0.1050** (−2.27)	−0.0250 (−1.04)	−0.1094*** (−4.10)
CR	−0.0572*** (−3.01)	−0.1097*** (−2.67)	−0.0446*** (−3.82)	−0.0180 (−0.87)
MB	0.0188 (0.63)	0.1060*** (2.83)	0.0165 (0.61)	0.1038*** (2.87)
SIZE	15.1297 (1.24)	12.5671 (1.28)	−0.5035 (−0.03)	49.5208*** (3.72)
AGE	−1.1935*** (−3.16)	−0.7519* (−1.77)	−0.0650*** (−0.22)	−1.2203*** (−4.24)
RE	3.4041* (1.46)	19.7020** (2.26)	0.6150 (0.76)	3.7412 (1.03)
$ROAA_{-1}$	−0.3155** (−2.45)	−0.1201 (−1.42)	−0.1939 (−0.42)	0.6460*** (6.14)
ESG	0.3161 (1.06)	−0.1800*** (−2.88)	0.7422* (1.75)	0.0377 (−0.08)
LEV	−0.0273 (−0.33)	0.0501*** (2.86)	−0.0230 (0.03)	0.0011*** (3.28)
CR	−0.0106*** (2.60)	0.0123*** (2.94)	0.0240*** (2.90)	0.0062 (0.77)
MB	−0.0194* (−1.68)	−0.0268*** (−2.93)	−0.2004** (−2.08)	0.1051 (0.04)
SIZE	5.9117** (−2.18)	9.8494 (−0.45)	−2.4911 (−0.67)	49.7068 (0.05)
AGE	−0.8587* (1.82)	−1.0182* (−1.77)	−0.4178** (−2.02)	−1.2692 (−0.79)
RE	−12.3934*** (−2.97)	−1.5823** (−2.43)	14.6747** (2.57)	−4.0121** (−1.97)
Constant	74.3884 (1.63)	68.3367 (1.08)	−37.1590 (−0.71)	−16.9463 (−0.44)
Linearity (P)	0.00	0.00	0.00	0.00
Observation	325	325	325	325
Companies	65	65	65	65

*P<0.1, **P<0.05, ***P<0.01. Robust t-statistics are shown in parentheses, while P-values are displayed in square brackets. The initial coefficient results show the difference between the lower and higher regimes, authors calculate the higher regimes coefficients by lower+difference which are shown in the above tables. ESG: Environmental, social, and governance, RE: Renewable energy

Table 6: Results for equation (1) for ROACE

Variables	ESG	E	S	G
ROACE$_{-1}$	0.5573*** (6.11)	0.5528*** (6.02)	0.5612*** (6.13)	0.5715*** (6.29)
ESG	−0.0275* (−0.88)	0.0140 (0.53)	0.0047 (0.17)	−0.0721*** (−2.37)
LEV	−0.0126*** (−1.12)	−0.0127*** (−1.13)	−0.0135*** (−1.18)	−0.0112*** (−0.96)
CR	−0.0113 (−0.67)	−0.0124 (−0.72)	−0.0137 (−0.78)	−0.0133* (−0.82)
MB	0.0402*** (3.59)	0.0421*** (3.62)	0.0421*** (3.61)	0.0375*** (3.78)
SIZE	−0.6546 (−0.78)	−0.7864 (−0.93)	−0.7582 (−0.92)	−0.6765 (−0.92)
AGE	0.0315 (1.28)	0.0302 (1.26)	0.0294 (1.18)	0.0210 (0.88)
RE	−0.7456 (−0.52)	−1.2944 (−0.95)	−1.1342 (−0.81)	−0.6076 (−0.42)
Constant	9.7401 (1.03)	8.9988 (0.96)	9.3917 (1.00)	13.0408 (1.47)
Hansen	0.3506	0.3411	0.3448	0.3684
AR (1)	0.3352	0.3347	0.3116	0.2389
AR (2)	0.0794	0.0720	0.0711	0.1219
Observation	325	325	325	325
Companies	65	65	65	65

*P<0.1, **P<0.05, ***P<0.01. Robust t-statistics are shown in parentheses, while P-values are displayed in square brackets. ESG: Environmental, social, and governance, RE: Renewable energy

Table 7: Results for equation (2) for ROACE

Variables	ESG	E	S	G
Threshold	58.7694*** (9.91)	52.7668*** (6.53)	69.8928*** (13.76)	52.2800*** (3.90)
Lower regime (B)				
ROACE$_{-1}$	0.4650*** (3.46)	−0.3729* (−1.68)	0.1512 (1.03)	−0.9171*** (−3.81)
ESG	0.1537 (0.32)	1.0892** (2.20)	0.3410* (1.76)	0.5041* (1.88)
LEV	−0.0550 (−1.05)	−0.0690 (−0.86)	0.0212 (0.36)	−0.0217 (−0.36)
CR	−0.2023*** (−3.65)	−0.0990* (−1.72)	0.0203 (0.49)	0.0237 (0.62)
MB	0.0182 (0.29)	0.0640 (0.77)	0.0939** (1.98)	0.0203 (0.28)
SIZE	2.0414 (0.06)	18.5854 (0.60)	44.9161 (1.62)	−2.5529 (−0.09)
AGE	−1.6966 (−1.54)	−0.4309 (−0.49)	−1.3346* (−1.74)	−1.2508* (−1.68)
RE	8.1809 (1.45)	−15.5249** (−2.37)	3.9759* (1.94)	−7.1600 (−0.90)
ROACE$_{-1}$	−0.5349*** (−5.78)	−0.2991 (0.28)	−0.7400* (−1.81)	0.6440*** (7.00)
ESG	0.9626 (0.74)	0.5132 (−0.92)	−0.3959 (−0.84)	0.3476 (−0.48)
LEV	0.0988** (2.22)	−0.0308 (0.41)	−0.2271*** (−2.58)	0.0856*** (1.75)
CR	0.0238*** (2.80)	0.0309 (1.52)	−0.0835*** (−1.49)	0.0422 (0.42)
MB	−0.0846 (−1.63)	0.1261 (0.47)	0.1108 (0.28)	0.0219 (0.03)
SIZE	−8.0293 (−1.17)	19.5719 (0.08)	32.6825 (−1.65)	2.3846 (0.65)
AGE	−1.3167 (0.92)	0.3471* (3.01)	32.6825** (−1.65)	−1.3637 (−0.83)
RE	−38.5935*** (−3.60)	5.6693*** (2.89)	25.7516* (1.67)	−1.2024 (−0.90)
Constant	42.6181 (0.31)	−73.4755 (−0.59)	234.7010* (1.83)	−77.6152 (−1.17)
Linearity (P)	0.00	0.00	0.00	0.00
Observation	325	325	325	325
Companies	65	65	65	65

*P<0.1, **P<0.05, ***P<0.01. Robust t-statistics are shown in parentheses, while P-values are displayed in square brackets. The initial coefficient results show the difference between the lower and higher regimes, authors calculate the higher regimes coefficients by lower+difference which are shown in the above tables. ESG: Environmental, social, and governance, RE: Renewable energy

energy companies should closely monitor and manage exposure to these thresholds to avoid diminishing returns. Interestingly, renewable energy use positively impacts profitability within the ESG and E regimes. However, this positive impact turns negative when ESG scores or their sub-components exceed their respective thresholds. This suggests that while renewable energy adoption supports profitability initially, over-investment or excessive focus on ESG objectives may lead to diminishing returns, necessitating a balanced approach to sustainability strategies.

Turning to the control variables, companies with lower leverage (LEV) exhibit reduced profitability from E and G alignment below their thresholds. However, higher E and G scores improve financial performance by reducing the cost of debt, driven by enhanced reputational benefits. The firm value (MB) enhances profitability under E and G thresholds, reflecting investor confidence, but this effect diminishes when ESG, E, and S commitments become excessive. Larger firms (SIZE) leverage economies of scale within the G threshold and above the ESG threshold, leading to improved profitability. Established firms benefit from maturity and stakeholder trust below thresholds, but their legacy systems and challenges with adaptability reduce profitability in higher ESG regimes. These findings reveal that ESG, and its sub-components significantly redefine the roles of traditional control variables in shaping the profitability of Asian energy companies. This represents a novel insight not previously documented in the literature, underscoring the nuanced interplay between ESG factors and corporate financial dynamics in the energy sector.

We conducted a robustness test by replacing the dependent variable ROAA with return on average common equity

(ROAEC) and reported the estimates of Equations (1) and (2) in Tables 6 and 7, respectively. The findings remain consistent in terms of coefficient effects and statistical significance, with only negligible differences observed. For instance, the threshold values are marginally lower, and slight variations in significance levels are noted. Specifically, while the S and G components were insignificant in Table 5, they exhibit weak statistical significance in Table 7. These minimal variations reinforce the robustness of our key findings, confirming that the relationships identified are stable and not dependent on the choice of profitability metric.

5. CONCLUSION

The impact of ESG on corporate financial performance remains a subject of ongoing debate among researchers, particularly in the energy sector, which faces the dual challenge of balancing sustainability and profitability. Simultaneously, corporate management seeks clarity on this relationship to inform strategic planning. This study contributes to the discourse by examining the threshold effects and the roles of various ESG components on the profitability of Asian energy companies. To achieve this, we employed an advanced methodology—dynamic panel threshold regression—to explore the nonlinear relationship between ESG and corporate profitability. Additionally, we conducted thorough diagnostic and robustness tests to ensure the reliability and validity of the empirical findings, thereby reinforcing the credibility of our results.

Using GMM estimation, the results indicate that ESG and its two sub-components, Environmental (E) and Social (S), have no significant impact on the profitability of Asian energy companies, with the exception of the Social pillar, which shows a negative effect. These findings align with previous studies that report either negative or insignificant impacts of ESG in the energy sector. This study takes a novel approach by exploring the nonlinear relationship between ESG and profitability. Our analysis reveals that profitability improves when the Environmental pillar score remains below a threshold of 45, while the Social pillar score exceeds a threshold of 74. These findings underscore the profitability-enhancing potential of ESG scores but also highlight the importance of careful management. Energy companies must strategically monitor their ESG components to mitigate the risk of diminishing returns and enhance financial performance, particularly through improved reputation and sustainability practices.

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