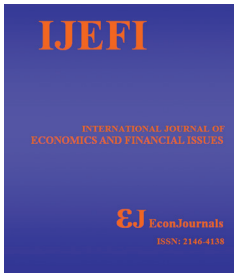

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# When ESG Meets Cybersecurity: The Moderating Effect of Digital Protection on Bank Performance in MENAT Countries

**Safa Benthabet***

Department of Finance, IFGT Research Laboratory (LR20ES12), Faculty of Economics and Management of Tunis, University of Tunis El Manar, Tunisia. *Email: safa.benthabet@fsegt.utm.tn

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**ABSTRACT**

This study advances sustainable finance literature by examining how financial institutions can enhance resilience through strategic integration of ESG principles and cyber-security policies. Using a sample of 35 banks from the Middle East, North Africa, and Türkiye (MENAT) region (2015-2023), we employ both static and dynamic panel estimators to analyze: (1) the direct relationship between ESG performance and financial metrics (ROA, ROE, MV), and (2) the moderating effect of cybersecurity policies on this relationship. Our results demonstrate that robust ESG performance significantly improves all financial measures, particularly ROA. The moderation analysis reveals that cybersecurity policies significantly enhance ESG's positive impact on profitability, despite initial implementation costs. These findings have three significant contributions: First, it provides novel empirical evidence from the under-researched MENAT context. Second, it pioneers the methodological approach of testing cybersecurity as an institutional-level moderator in the ESG-performance nexus. Third, it demonstrates how integrated sustainability-digital governance frameworks create value. These findings guide bank executives and regulators in developing coordinated ESG-cybersecurity investment strategies for emerging markets.

**Keywords:** ESG Scores, Banking Performance, Cybersecurity Resilience, Cybersecurity Policy, Moderating Effect, MENAT Countries
**JEL Classification:** G21, G32, M14, Q56

## 1. INTRODUCTION

In the context of increased environmental awareness and fast-paced digital transformation, the banking sector is under significant pressure to align sustainability initiatives with technological resilience (Xu et al., 2025; Khatib et al., 2025; Munira, 2025; Mishra et al., 2025). Given their significant role in driving economic growth, financial institutions must integrate Environmental, Social, and Governance (ESG) principles into their operational strategies. The importance of ESG factors in the banking sector is highlighted by their capacity to influence financial performance (Buallay, 2019; Nizam et al., 2019; Bătae et al., 2021; Gutiérrez-Ponce and Wibowo, 2023; Menicucci and Paolucci, 2023; Gonzalez-Ruiz et al., 2024). These effects extend beyond enhancing reputation or fulfilling regulatory requirements to encompass tangible financial metrics, risk management efficiency, and long-term profitability. Moreover, the relationship between sustainability reporting and financial indicators has been investigated in organizations across a range of industries and regions (Hong and Kacperczyk, 2009; Wu and Shen, 2013; Friede et al., 2015; Cornett et al., 2016; Gangi et al., 2019; Azmi et al., 2021; Huang, 2021; Wang and Yang, 2022; Dincer et al., 2023; Dobre et al., 2025). These studies reveal a notable correlation between ESG data and financial performance indicators, suggesting that traditional financial reporting alone is insufficient to meet the evolving needs and expectations of stakeholders. While the growing literature suggests a positive relationship between sustainable practices and banking profitability, the precise mechanisms through which ESG activities influence bank performance remain a subject requiring further investigation.

The increasing adoption of technological advances and digital transformation by financial institutions is driving them to develop

financial technology innovations to improve and modernize their services and strengthen their competitive position in the market (Rashwan and Kassem, 2021). Fintech solutions, which employ software, mobile applications, artificial intelligence (AI), big data analytics, and blockchain technology, have become indispensable to this transformation (Rahardja et al., 2025). However, these advancements involve considerable risks of cyber threats, making cybersecurity a critical component of governance strategies. Therefore, it is essential to develop a solid technological infrastructure, implement appropriate regulatory measures, and maintain rigorous procedures to protect data from cybercriminals (Kshetri, 2016; Onwujekwe et al., 2019; Bechara and Schuch, 2021; Qudus, 2025). This not only helps protect institutional assets but also maintains client confidence, particularly in the context of a rapidly changing digital landscape (WEF, 2023; Opuni-Frimpong et al., 2024; Li and Ding, 2024; Bruno et al., 2025).

Cybersecurity can be defined as a strategic process focused on the protection of computers, servers, networks, and digital assets against unauthorized access and potential destruction or attacks in the digital realm (Craigen et al., 2014). It is of utmost importance for the banking sector to prioritize the protection of its financial data, intellectual property, and reputation, as these elements are fundamental to its overall business strategy. The objectives of both corporate and governmental entities in utilizing cybersecurity measures include not only the protection of confidential data but also the assurance of its availability and maintenance of its integrity (AL-Alawi and AL-Bassam, 2020; Kim et al., 2022; Oyewole et al., 2024).

The dynamics of economic diversification and digitalization are particularly pronounced in the Middle East, North Africa, and Turkey (MENAT) region. For instance, nations such as Saudi Arabia and the United Arab Emirates (UAE) are actively pursuing economic diversification through initiatives like Saudi Vision 2030. Concurrently, the adoption of Environmental, Social, and Governance (ESG) principles is gaining traction as a strategy to attract global investments. The rapid digitalization of the region has elevated cybersecurity as a primary concern for maintaining financial resilience. Strong ESG practices, particularly in governance, have been demonstrated to enhance risk management capabilities, leading to improved operational efficiency and increased investor confidence. Emphasizing robust ESG frameworks is essential for navigating the evolving regulatory landscape, attracting sustainable investments, and fostering long-term growth in the MENAT banking sector. However, the swift adoption of digital technologies in this region has introduced cybersecurity as a critical component of ESG governance. The increasing frequency and sophistication of cyber-attacks targeting the financial systems of MENAT countries necessitate strong cybersecurity policies to protect both financial stability and customer trust (Baur-Yazbeck et al., 2019; Hassan et al., 2024). Moreover, effective cybersecurity is not merely a mitigating factor for operational risk; it also directly enhances the positive impact of ESG by safeguarding essential digital infrastructure (Kwilinski et al., 2023; Bruno et al., 2025). Therefore, the MENAT region, with its simultaneous focus on strengthening ESG practices and addressing escalating cybersecurity challenges, provides an ideal setting for examining the interconnectedness of these critical factors within the financial sector. Despite the growing recognition of ESG and cybersecurity as critical factors for bank performance, the existing literature often examines these concepts separately. ESG practices are recognized as key drivers of financial performance, particularly in MENAT, where governance frameworks and sustainability initiatives are essential for navigating economic diversification programs and fostering long-term growth (Mahmood and Alsayegh, 2020; El Khoury et al., 2023; Abdel Hameed, 2024; Athari et al., 2024). Robust ESG governance fosters enhanced risk management capabilities, optimizes operational efficiency, and attracts sustainable investments, thereby positioning banking institutions to align with evolving regulatory landscapes and global investor expectations (WEF, 2024). Concurrently, cybersecurity has emerged as a pivotal component of risk management in MENAT banking institutions and has become a strategic consideration that affects long-term business performance. Studies show that banks investing in robust cybersecurity frameworks not only enhance data protection and regulatory compliance but also build trust with investors and customers (WEF, 2023; Opuni-Frimpong et al., 2024). Additionally, cyber resilience can serve as a competitive advantage in the sustainable finance sector, as institutions that effectively mitigate cyber risks are better positioned to manage digital lending platforms, blockchain transactions and AI-based investment tools (Kluza and Kluza, 2022; Matviienko, 2022; Tashtamirov, 2023; Uddin et al., 2020; Xu et al., 2025).

It is evident that limited attention has been devoted to examining the joint influence of ESG factors and cybersecurity on bank performance in the MENAT region. This study aims to address this gap by investigating the relationship between ESG and bank performance, with particular emphasis on the moderating role of cybersecurity policies. By elucidating the interplay between these critical factors, this study seeks to contribute to the expanding body of literature on sustainable banking and offer several implications for financial institutions in the MENAT region. Conceptually, this study approaches the relationship between a bank's ESG activities and its performance measurement from three perspectives: financial performance (indicated by return on assets, ROA), operational performance (indicated by return on equity, ROE), and market performance (indicated by market value). Contextually, our study underscores the relevance of ESG activities for banks in the MENAT region, which are still in the nascent stages of implementation. Furthermore, it is crucial to focus on banks in the MENAT region, as the impact of ESG is more pronounced in this area, where regulatory frameworks, corporate governance, and transparency tend to be weaker (Maside□Sanfiz et al., 2024). Nonetheless, few studies have focused on the relationship between ESG activities and the financial performance of banks in the region (El Khoury et al., 2023; Buallay et al., 2020). Finally, from a managerial perspective, our research provides decision-makers in the banking sector with tools to facilitate strategic decision-making and identify the best practices that can guide investors and policymakers.

The remainder of this paper is structured as follows: Section 2 provides a detailed review of the existing theoretical and empirical

literature on the relationship between ESG, cybersecurity, and financial performance. Section 3 outlines the sample and empirical methodology. Section 4 presents the empirical findings and discusses the implications of the results. Section 5 is dedicated to robustness tests, and finally, section 6 concludes the paper and suggests areas for future research.

## 2. LITERATURE REVIEW

### 2.1. ESG and Banking Performance

The extant literature on the relationship between ESG disclosure and financial performance within the banking sector is inconclusive. A substantial body of literature suggests a positive correlation between banks in both developed and developing countries (Wu and Shen, 2013; Cornett et al., 2016; Oino, 2019; Akdogan et al., 2020; Chen et al., 2023). Conversely, other studies have reported no discernible relationship between ESG factors and the financial performance of national banks (Soana, 2011; Matuszak and Różańska, 2017). The integration of ESG principles in the banking sector has been observed to have a detrimental effect on operational, financial, and market performance. This situation is further compounded by the sector's significant lag in adopting suitable sustainability policies that could enhance operational outcomes and foster greater investor trust (Buallay, 2019).

According to Stakeholder Theory (Freeman, 1984), banks with strong ESG practices are better able to meet the expectations of a broader range of stakeholders, resulting in improved long-term performance (Zheng et al., 2015). This theoretical assertion is supported by empirical findings that demonstrate a positive relationship between ESG efforts and the market value of banks (Azmi et al., 2021; La Torre et al., 2021; 2023; and Al Amosh and Khatib, 2023). In line with these findings, Daszyńska-Żygadło et al. (2021) reported that governance performance favorably impacts banks' financial performance globally. In addition, Shakil et al. (2019) found a significant positive association between the financial performance of banks in developing markets and their environmental and social performances. These results imply that a strong commitment to ESG principles can enhance financial performance metrics in the banking sector, including profitability, market standing, and operational productivity.

The resource-based view (Barney, 1991) and legitimacy theory (Suchman, 1995) empirically justify the positive ESG–Financial Performance relationship. In accordance with resource-based theory, ESG initiatives can be considered strategic investments. Such investments can confer a competitive advantage to firms by fostering the development of distinctive competencies that are not easily replicated by others (Russo and Fouts, 1997). Therefore, improvements in corporate social performance through ESG activities are anticipated to be reflected in enhanced financial performance (Ruf et al., 2001). El Khoury et al. (2023) identified a positive correlation between ESG scores and key financial performance metrics, including return on equity (ROE) and return on assets (ROA). However, they observed that this positive correlation tended to weaken when ESG scores reached particularly high levels. Moreover, Agnese and Giacomini (2023) emphasize that ESG elements can markedly reduce banks' funding costs, particularly the costs associated with issuing bonds in primary markets.

Regarding legitimacy theory, Fernandez-Feijoo et al. (2014) argue that businesses in sensitive sectors, which are defined by substantial social and environmental impacts, face greater public scrutiny. Consequently, these companies experience heightened pressure to showcase their dedication to social responsibility and justify their actions and societal contributions.

In contrast, the neoclassical theory posited by Friedman (1970) suggests an inverse relationship between ESG practices and financial performance. This perspective argues that the implementation of ESG initiatives may lead to increased costs, negatively affect corporate performance, and undermine competitive advantage associated with inefficiently allocated capital (Aupperle et al., 1985; Friedman, 2007; Devinney, 2009). The literature on this subject shows a lack of agreement on the direction of this relationship (Bătae et al., 2021). The trade-off perspective (Modigliani and Miller, 1958) on ESG activities suggests that engaging in ESG initiatives may represent inefficient resource allocation. Reallocating resources to ESG activities can potentially improve efficiency if directed towards other objectives within the company. Devinney (2009) shows that improving the virtuous status of companies inevitably comes with associated costs. Moreover, Aupperle et al. (1985) note that firms with a pronounced focus on social responsibility tend to incur higher direct expenses and achieve lower profit margins than their less socially conscious counterparts. From this perspective, managers would prioritize maximizing corporate value rather than pursuing socially responsible initiatives to improve social conditions (Friedman, 1970). Thus, we propose to test the following hypothesis:

$H_1$: ESG positively impacts bank performance

### 2.2. ESG and Cybersecurity Framework

The recognition of effective cybersecurity strategies as integral to sound governance is growing, as they support risk management, transparency, and ethical business practices (Yusif and Hafeez-Baig, 2021; Mizrak, 2023). Within ESG frameworks, cybersecurity plays a pivotal role in the "Governance" pillar, underscoring how organizations manage data security, privacy, and digital risks while fostering stakeholder trust. This connection is particularly crucial for financial institutions, where the integration of ESG principles with robust cybersecurity strategies is essential for maintaining legitimacy and resilience in a highly regulated environment. The interplay between technological advancements and ESG principles is intricate and multifaceted. Resource-Based Theory (Barney, 1991) conceptualizes cybersecurity and ESG initiatives as intangible resources that contribute to a firm's sustainable competitive advantage. Strong ESG practices, particularly in governance, enhance a firm's reputation and risk management capacity, while effective cybersecurity bolsters operational resilience against emerging threats. Bouveret (2018) highlights that cybersecurity incidents can impair a company's ESG reputation, especially in governance, by exposing deficiencies in oversight and in risk management. Therefore, implementing comprehensive cybersecurity frameworks

mitigates operational risks and enhances ESG performance by demonstrating effective risk management and compliance with data protection regulations. Institutional Theory (DiMaggio and Powell, 1983) further supports this integration, suggesting that organizations adopt institutional practices to align with societal expectations and enhance legitimacy. In the banking sector, adherence to ESG and cybersecurity standards satisfies regulatory requirements while reflecting a proactive commitment to ethical standards, data protection and sustainability (Fiordelisi et al., 2013). Banks are increasingly motivated to publicly disclose their ESG and cybersecurity initiatives to signal their alignment with societal values, foster stakeholder trust, and reduce compliance risks. Although substantial research has examined the impact of technological factors on overall ESG performance (Bătae et al., 2021; Chiaramonte et al., 2022), there is a critical gap in understanding the specific relationship between cyber risk and ESG issues, particularly within individual ESG pillars (Karagozoglu, 2021; Kluza and Kluza, 2022; Ziolo et al., 2023). Huang et al. (2023) demonstrate that digital transformation enhances the transparency of soft information, reduces management short-termism, and improves internal process efficiency. Additionally, Qian et al. (2023) emphasized how technological advancements strengthen supervisory mechanisms and governance. However, some studies highlight that cyber risks can undermine strategic operations, increase risk exposure, and negatively affect bank reputation, capitalization, and business models (Fiordelisi et al., 2013). These findings underscore the importance of further examining the relationship between cyber risks and specific ESG pillars to understand how technology holistically impacts sustainability. Integrating ESG considerations into cybersecurity strategies is crucial in contemporary corporate governance, particularly in the banking sector, where safeguarding confidential information is paramount. ESG frameworks emphasize governance structures and transparency, which are critical for shaping organizational responses to cybersecurity threats. Companies with robust governance frameworks are more likely to adopt proactive cybersecurity measures, safeguard sensitive data, ensure regulatory compliance, and reinforce stakeholder trust (Cheng et al., 2014). This proactive approach demonstrates greater resilience to evolving cyber threats and enables firms to anticipate and mitigate risks more effectively (Giese et al., 2019).

### 2.3. Moderating Effect of Cybersecurity Policy on the Relationship between ESG and Bank Performance

Recent studies suggest a mutually reinforcing relationship between ESG performance and cybersecurity. Giese et al. (2019) argue that companies with strong ESG scores, particularly in governance, are more likely to adopt proactive cybersecurity measures, enhancing their ability to withstand operational disruptions caused by cyber incidents. This alignment between ESG principles and robust cybersecurity practices not only improves corporate reputation but also strengthens the financial stability. In the banking sector, where cybersecurity risks are especially acute, Bouveret (2018) emphasizes the importance of integrating ESG frameworks with comprehensive cybersecurity strategies to ensure long-term sustainability, reduce financial losses, and mitigate risks associated with cyberattacks and data breaches.

The banking industry, which is heavily reliant on technology, has rapidly digitized its business processes (Mohammed, 2019). This transformation has heightened the focus on cybersecurity, as the protection of sensitive asset data has become critical. In this context, the sandbox regulatory framework has emerged as a vital tool for enhancing cybersecurity in financial institutions. By providing a controlled environment for testing new technologies under regulatory oversight, sandboxes allow firms to identify vulnerabilities, refine protective measures, and ensure compliance with regulatory standards before the full-scale deployment of technology (Balboni and Francis, 2023). By fostering innovation within a supervised structure, sandboxes also promote the integration of privacy protection, data ethics, and cyber resilience into technological solutions from the ideation phase.

The sandbox approach aligns closely with governance principles by emphasizing transparency, risk management and accountability. Financial institutions operating within sandboxes can test advanced cybersecurity measures, such as threat detection algorithms and data encryption protocols, while receiving feedback from regulators to ensure compliance with security standards (Christopher, 2025; Olutimehin, 2025). This regulatory-guided process strengthens organizational cybersecurity frameworks, enhancing their capacity to respond to evolving threats and safeguard sensitive data from cyberattacks. Furthermore, sandboxes contribute to the development of cybersecurity by design, embedding ethical considerations and sustainability goals into technologies to align them with broader ESG principles.

Although cybersecurity is increasingly acknowledged as a critical factor in improving organizational performance (Hasani et al., 2023), its specific implications for the banking sector, particularly concerning ESG performance, remain underexplored (Bruno et al., 2025). This study aims to bridge this research gap by examining how cybersecurity policies moderate the relationship between ESG performance and banking outcomes. As financial institutions progressively embed ESG principles into their strategic operations, robust cybersecurity measures evolve beyond mere technical protection to become integral governance mechanisms. These measures enhance transparency, safeguard sensitive stakeholder data, and bolster institutional trust, which are core components of ESG, thereby supporting stronger financial and reputational outcomes. Furthermore, corporate leadership increasingly views cybersecurity policy adoption as a strategic imperative, consistent with broader organizational performance objectives (Greiman, 2015; Bechara and Schuch, 2021). By conceptualizing cybersecurity as a governance instrument, this study offers critical insights into how banks can reinforce the positive association between ESG initiatives and sustainable performance. As demonstrated in the relevant literature, there is a clear correlation between the adoption of technology and an improvement in financial performance (El-Chaarani and El-Abiad, 2018; Martín-Rojas et al., 2017; Kaddumi et al., 2023; Gyau et al.,2024). The extant literature on business intelligence systems in banking (Owusu, 2017; Moussas et al., 2024) and knowledge management systems (Valmohammadi and Ahmadi, 2015; Mahboub and Ghanem, 2024) highlights the broader benefits of technology adoption. However, the role of cybersecurity

technology adoption in moderating the relationship between non-financial and financial performance requires further investigation. Finally, we test the following hypothesis:

$H_2$: Cybersecurity policy implementation enhances the ESG effects on bank performance.

# 3. METHODOLOGY

## 3.1. Sample Selection and Data Collection

To examine the relationship between ESG dimensions and financial performance through the adoption of cybersecurity policy, we were interested in MENAT's banking sector. Then, our dataset includes 160 observations from 35 listed banks in the MENAT region during the period 2015-2023. The specific timeframe was selected for several reasons, primarily because it was characterized by the adoption of ESG and sustainable development strategies among companies and banks in the MENAT region. Furthermore, banks exhibiting data deficiencies for a duration of over two years were excluded from the analysis. Data used in this study were collected from two sources. First, we extract financial data and information about ESG scores from the Refinitiv DataStream database. The sample was limited to banks for which data regarding ESG issues could be sourced from this database. Second, we collect other bank-level variables from the same database. Finally, we collect data on GDP growth and financial development from World Development Indicators (WDI).

Table 1 presents a summary of the distribution of the sample by country. It is noteworthy that the number of banks from Turkey and Qatar is relatively high, with 12 banks included in the sample compared to the total number of banks in the region, which stands at 35. The number of banks belonging to Saudi Arabia and Oman is, respectively, five. These countries collectively account for 62.86% of the total sample analyzed. In addition, Kuwait and the UAE collectively account for approximately 23% of the sample. It is also noteworthy that Egypt and Jordan have two banks included in the sample, while Bahrain and Morocco have only one bank each.

## 3.2. Variables Measurement

The following section outlines the variables used in the current research:

### *3.2.1. Dependent variable*

This research employs a combination of operational, financial and market metrics to assess bank performance, drawing on insights from prior studies (Esteban-Sánchez et al., 2017; Velte, 2017; Atan et al., 2018; Buallay, 2019). Return on assets (ROA) is employed as an indicator of operational performance, whereas return on equity (ROE) is used to measure financial performance (Esteban-Sánchez et al., 2017; Buallay, 2019;). Finally, market value is used as a proxy of market performance.

**Table 1: Distribution of the sample by country**

| Country | Banks number | Observations | % |
|---|---|---|---|
| Bahrain | 1 | 9 | 2.85 |
| Egypt | 2 | 18 | 5.71 |
| Jordan | 1 | 9 | 2.85 |
| Kuwait | 4 | 36 | 11.44 |
| Morocco | 1 | 9 | 2.85 |
| Oman | 5 | 45 | 14.28 |
| Qatar | 6 | 54 | 17.15 |
| Saudi Arabia | 5 | 45 | 14.28 |
| Turkey | 6 | 54 | 17.15 |
| UAE | 4 | 36 | 11.44 |
| Total | 35 | 315 | 100 |

Source: Author's work

### *3.2.2. Independent variable*

To proxy ESG ratings, we rely on the ESG combined score (ESG), which ranges from 0 to 100. Used in previous banking studies, this score provides a comprehensive measure of a bank's ESG disclosure (Peni and Vähämaa, 2012; Esteban-Sánchez et al., 2017; Buallay et al., 2020;). The interaction term Cybersecurity policy × ESG captures the moderating effect, based on the assumption that the adoption of cybersecurity policies by banks can help them achieve their ESG objectives (Bruno et al., 2025).

### *3.2.3. Control variables*

In line with previous studies, this research includes several control variables: bank size, liquidity, leverage ratio, asset quality, and capital adequacy ratio.

- Bank Size is calculated using the natural logarithm of total assets. Prior research has shown that a firm's performance may vary with its size (Velte, 2017; Atan et al., 2018).
- Liquidity is measured by the ratio of total deposits to total assets, indicating the extent to which a bank's financing relies on deposit funds (Singh and Sharma, 2016). While Helms (2006) notes that deposits are generally an optimal funding source for banks, the interest paid to depositors can become burdensome, potentially reducing profitability. Supporting this view, Anbar and Alper (2011) found a significant negative relationship between the deposit-to-asset ratio and bank profitability. However, Riaz and Mehar (2013) and Sultan et al. (2020) reported opposite findings, showing that a higher deposit-to-asset ratio can have a significant positive effect on profitability.
- The leverage ratio is defined as the ratio of long-term debt to total assets. It is considered as a control variable due to its potential impact on bank performance (Atan et al., 2018; Esteban-Sanchez et al., 2017; Bitar et al., 2018; Bătae et al., 2021; Menicucci and Paolucci, 2023).
- Asset quality is proxied by non-performing loans to total loans. This is a measure of credit risk and an important indicator of banking sector stability (Ozili, 2024). An increase in NPLs often necessitates larger loan loss provisions and greater capital reserves, which negatively affect bank performance (Fiordelisi et al., 2011; Louzis et al., 2012).
- Capitalization serves as a compliance measure for regulatory capital requirements and reflects the solvency or capital adequacy of banks (Siueia et al., 2019; Naimy et al., 2021). It provides the foundation for pursuing growth opportunities and expanding operational activities (Bachtiar et al., 2023).

We also include country-specific characteristics. More precisely, we incorporate GDP growth and the level of financial development (Goddard et al., 2011; Azmi et al., 2021). Financial development is measured as domestic credit to the private sector as a percentage of GDP, a broad indicator of the total value of loans, trade credit,

and other forms of credit provided to the private sector. The proportion of private credit extended by deposit banks to GDP serves as a key indicator of the role these institutions play in the national economy. Additionally, it provides insight into how financial development influences bank performance (Demirgüç-Kunt and Huizinga, 1999).

Finally, a sandbox regulatory framework is incorporated into the econometric models as a dummy variable. This variable takes the value 1 for a country-year t in which a regulatory sandbox was implemented, and 0 otherwise.

Table 2 outlines the sample variables employed in the present study. The variables are organized in accordance with their respective functions within the model.

### 3.3. Research Design

The present study formulates and estimates econometric models, guided by the methodologies discussed in the relevant literature (Peni and Vähämaa, 2012; Esteban-Sanchez et al., 2017; Siueia et al., 2019; Shakil et al., 2019; Buallay et al., 2020;). We estimate the following two models:

$$BP_{it} = \beta_0 + \beta_1 BP_{it-1} + \beta_2 ESG_{it} + \beta_3 CP_{it} + \beta_4 Size_{it} + \beta_5 Liq_{it} + \beta_6 CAP_{it} + \beta_7 AQ_{it} + \beta_8 Lev + \beta_9 GDPgrowth_t + \beta_{10} FinDev_t + \beta_{11} Sandbox_{it} + \epsilon_{it} \quad (1)$$

where $BP_{it}$ represents a bank's financial performance measured by two scales of ROA and ROE of bank (i) in year (t), $\beta_i$ is the estimated coefficient of each independent variable in the regression equation; $\varepsilon_{it}$ is the error term.

To test the moderating effect of cybersecurity policy on the relation between ESG and bank performance, model (2) is established based on model (1):

$$BP_{it} = \beta_0 + \beta_1 BP_{it-1} + \beta_2 ESG_{it} + \beta_3 CP_{it} + \beta_4 ESG*CP_{it} + \beta_5 Size_{it} + \beta_6 Liq_{it} + \beta_7 CAP_{it} + \beta_8 AQ_{it} + \beta_9 Lev + \beta_{10} GDPgrowth_t + \beta_{11} FinDev_t + \beta_{12} Sandbox_{it} + \epsilon_{it} \quad (2)$$

Following Shakil et al. (2021), our analysis employs a combination of static and dynamic panel data methodologies, allowing us to exploit variations across banks and over time. This dual approach enhances the robustness of our findings by accounting for unobserved heterogeneity and controlling for potential temporal biases in the estimation process. The fixed-effects model captures time-variant characteristics specific to each bank by permitting bank-level intercepts, thereby isolating within-bank variation. In contrast, the random effects model posits that unobserved bank-specific effects are randomly distributed and uncorrelated with regressors. This approach enhances estimation efficiency by pooling both within, and between, bank variation without estimating separate parameters for each institution.

To address potential endogeneity and dynamic relationships within the model, we utilize the System Generalized Method of Moments (System GMM) estimator. This methodology was initially developed by Arellano and Bond (1991), further refined by Arellano and Bover (1995), and subsequently extended by Blundell and Bond (1998; 2000). It offers consistent and efficient parameter estimates in dynamic panel settings.

## 4. RESULTS AND DISCUSSION

### 4.1. Descriptive Statistics and Correlation

Table 3 presents the descriptive statistics of the main variables for the entire sample.

Table 4 shows the correlation coefficients between the variables included in the regression models. The correlation matrix

**Table 2: Summary of the variables**

| Variable | Definitions | Source |
|---|---|---|
| Dependent | | |
| Return on equity (ROE) | Profitability of investment equity (financial performance): Net Profit after Tax/Total Equity | Refinitiv |
| Return on assets (ROA) | Profitability of total assets (operational performance): Net profit/Total Assets | Refinitiv |
| Independent focus variables | | |
| ESG | Composite score based on several ESG parameters | Refinitiv |
| CP | Cyber security policy refers to specific elements or factors within a cybersecurity framework that is designed to manage and mitigate cyber risks. designed to protect networks, devices, programs, and data from attack, damage, or unauthorized access | Refinitiv |
| ESG*CP | Interaction term to examine the moderating impact of cybersecurity policy on the relationship between ESG and bank performance | |
| Control variables | | |
| Bank level variables | | |
| Size | Natural logarithm of total assets | Refinitiv |
| Liquidity | Total deposit/total assets | Refinitiv |
| Leverage | Long term debt/total assets | Refinitiv |
| Asset quality | Non-performing loans/total loans | Refinitiv |
| Capitalization | Shows the extent to which a bank can absorb losses using different specific equity components: Total own funds divided by total risk weighted assets. | Refinitiv |
| Country-level variables | | |
| GDP growth | Percentage change in GDP | WDI |
| Financial development | Measured by Domestic credit to private sector (% of GDP) | WDI |
| Sandbox | Dummy Variable: "1" indicates the implementation of a regulatory sandbox, and "0" otherwise | WB |

Source: Author's work

**Table 3: Descriptive statistics**

| Variables | Obs | Mean | Standard Deviation | Min | Max |
|---|---|---|---|---|---|
| ROA | 315 | 1.758309 | 0.8732669 | −0.34 | 6.5 |
| ROE | 315 | 13.4227 | 7.551459 | −2.42 | 55.59 |
| MV | 315 | 9.288044 | 1.930206 | 5.364526 | 12.77846 |
| ESG Score | 315 | 48.13413 | 19.43371 | 8.9 | 89.67 |
| EPS | 315 | 52.33354 | 26.85432 | 15.56 | 98.57 |
| SPS | 315 | 46.88359 | 25.30383 | 3.16 | 97.26 |
| GPS | 315 | 56.09617 | 21.0178 | 4.81 | 94.87 |
| PoCyb | 315 | 0.4857143 | 0.5005911 | 0 | 1 |
| Size | 315 | 18.2277 | 2.067555 | 14.39775 | 21.80171 |
| Liquidity | 315 | 66.2364 | 9.219916 | 36.05 | 86.68 |
| Leverage | 315 | 8.651913 | 6.400179 | 0.0185364 | 32.32724 |
| Asset Quality | 315 | 4.398413 | 3.027731 | 0 | 16.63 |
| Capitalization | 315 | 11.38863 | 2.524864 | 4.614487 | 19.12888 |
| Sandbox | 315 | 0.6095238 | 0.4886333 | 0 | 1 |
| Financial Development | 315 | 67.5654 | 25.81418 | 3.533314 | 138.4197 |
| GDP Growth | 315 | 2.550741 | 3.446392 | −7.178207 | 11.4394 |

Source: Author's work

shows the important relationships between the main variables of this study.

Bank Performance is positively related to ESG scores, Cybersecurity Policy, Bank Size, and Liquidity. Specifically, the results confirm that the highest correlation is between ESG scores and Bank Size, as well as between Bank Performance (ROE and MV) and Bank Size, whereas the correlation between Liquidity and Leverage is the lowest. In addition, Cybersecurity Policy was positively correlated with ESG scores ($P < 0.05$). These relationships reveal that banks that are most engaged in cybersecurity policies often establish committees dedicated to sustainability and have the best ESG scores. Interestingly, the Cybersecurity Policy variable is positively related to both Bank Performance indicators and ESG scores, which shows that banks with cybersecurity policies are more profitable. Similarly, Bank Size is positively correlated with Bank Performance and ESG scores.

As shown in Table 4, the correlations among the variables were relatively weak. The variance inflation factor (VIF) analysis revealed that there was no multicollinearity problem (Hair et al., 2006).

## 4.2. Estimation and Discussion of Results

The results derived from Equations (1) offer valuable insights into the correlation between ESG performance and banking outcomes across a range of indicators. The findings demonstrate a significant positive relationship between ESG scores and bank performance in the MENA region, as measured by ROA (Table 5), ROE (Table 6), and MV (Table 7).

Our empirical analysis, utilizing fixed effects, random effects, and dynamic System GMM estimations, uncovers nuanced relationships between ESG performance, cybersecurity policies (PoCyb), and bank performance (ROA, ROE, and MV) that align with existing theoretical frameworks. The fixed effects models for ROA and ROE, supported by the Hausman test, confirm that ESG practices positively influence financial performance via enhanced stakeholder trust, reputational capital, and operational efficiencies, in line with stakeholder theory (Freeman, 1984) and previous evidence that ESG adoption reinforces the premise that adherence to societal and environmental expectations fosters long-term organizational resilience and performance (Friede et al., 2015; Aouadi and Marsat, 2016; Gangi et al., 2021). Notably, the incorporation of cybersecurity factors (PoCyb) and their interaction with ESG in Model 2 nuances this narrative. The findings of this study indicate that the negative effect of ESG on ROA, as measured by GMM estimations in Model 2 ($\beta = -0.12$, $P < 0.01$), suggests that ESG initiatives may have limited potential to enhance performance when aligned with digital risk management policies. This is in accordance with the recognized short-term financial burden and resource intensiveness of cybersecurity investments. This is particularly pronounced in the banking sector, given its high regulatory scrutiny and critical infrastructure status (Bouveret, 2018; Ruan et al., 2020). While cybersecurity implementation imposes short-term profitability constraints (as evidenced by significant negative coefficients in statistic and dynamic models), the statistically significant positive interaction term (for ROA and ROE) between ESG scores and cybersecurity policy demonstrates its critical moderating role. It is important to note the statistically significant positive interaction between ESG and PoCyb across the fixed and random effects models, which indicates a synergistic effect. This finding indicates that integrating cybersecurity governance with ESG frameworks has a substantial positive impact on banking performance. This synergy supports the resource-based view (Barney, 1991), suggesting that cybersecurity represents a strategic intangible asset that, when combined with ESG capabilities, creates competitive advantages through operational resilience and stakeholder confidence. These findings are of particular significance when contextualized within the MENAT region. In MENAT countries, financial institutions operate in an environment characterized by accelerated digital transformation. However, these institutions also face amplified cyber risk exposure, a phenomenon attributable to a combination of geopolitical tensions, regulatory heterogeneity, and the emergence of digital fintech ecosystems (Alsmadi, 2023; World Bank, 2022).

The progressive implementation of cybersecurity regulations in the Middle Eastern and North African (MENAT) financial

**Table 4: Pairwise correlations**

| Variables | ROA | ROE | MV | ESG score | PolicyCyb | Size | Leverage | Capitalization | Asset quality | Liquidity | Financial deviation | GDP growth |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ROA | 1.0000 | | | | | | | | | | | |
| ROE | 0.8653*** | 1.0000 | | | | | | | | | | |
| MV | 0.5199*** | 0.5899*** | 1.0000 | | | | | | | | | |
| ESG Score | 0.3096*** | 0.2723*** | 0.4245*** | 1.0000 | | | | | | | | |
| PolicyCyb | 0.0137 | 0.0021 | 0.2131*** | 0.3517*** | 1.0000 | | | | | | | |
| Size | 0.5050*** | 0.5628*** | 0.5873*** | 0.5490*** | 0.3152*** | 1.0000 | | | | | | |
| Leverage | −0.0732 | −0.0990* | −0.1676*** | −0.0212 | 0.0493 | −0.0272 | 1.0000 | | | | | |
| Capitalization | −0.0194 | −0.2397*** | −0.1582*** | −0.1836*** | −0.0954* | −0.3859*** | −0.2751*** | 1.0000 | | | | |
| Asset Quality | −0.2436*** | −0.2672*** | −0.3505*** | −0.0954* | −0.1587*** | −0.2042*** | −0.0187 | 0.1220** | 1.0000 | | | |
| Liquidity | 0.1126** | 0.2179*** | 0.1159** | −0.2504*** | −0.1250** | −0.0776 | −0.5749*** | 0.2018*** | −0.1471*** | 1.0000 | | |
| Financial development | −0.1909*** | −0.1749*** | 0.0265 | −0.0079 | −0.0417 | −0.0457 | 0.2702*** | −0.1654*** | 0.1570*** | −0.2895*** | 1.0000 | |
| GDP Growth | 0.3046*** | 0.3027*** | 0.1830*** | 0.1853*** | −0.0437 | 0.2536*** | −0.0233 | −0.1415* | −0.1094* | 0.0268 | −0.1735*** | 1.0000 |

Source : Author's work
***P<0.01, **P<0.05, *P<0.1

sectors, as demonstrated by the regulatory frameworks in Saudi Arabia's SAMA Cybersecurity Framework and Turkey's recent Cybersecurity Law (2025), reflects an increased awareness of cybersecurity as a governance imperative (Menna and Kılıç, 2025). The findings of this study indicate that financial institutions in the MENAT region that incorporate cybersecurity measures into their Environmental, Social and Governance (ESG) strategies appear to demonstrate a more effective approach to addressing the identified vulnerabilities. This enhanced ability to navigate these challenges is concomitant with improvements in operational sustainability and stakeholder legitimacy. The latter is crucial, given its role in attracting investment and fostering financial stability in transitional economies.

The findings related to market value (MV) suggest a less pronounced relationship with environmental, social, and governance (ESG) scores, as well as with cybersecurity policy and their interaction. This inconsistency may be attributed to the propensity of market valuations to incorporate investor risk perceptions, which, in turn, are influenced by the prevailing macroeconomic and geopolitical uncertainties in MENAT markets (Flammer, 2015; IMF, 2023). The weaker MV results may be indicative of regional investor scepticism: As demonstrated in the relevant literature, markets often discount ESG efforts due to transparency gaps (S&P Global, 2023) and geopolitical volatility (Ghosh, 2022), though it is important to note that cybersecurity breaches can trigger severe market penalties (Karagozoglu, 2021).

The control variables align with prior findings in the banking performance literature: larger banks, better liquidity, and stronger macroeconomic growth correlate positively with performance, while higher asset quality issues and leverage ratios exert adverse effects (Demirgüç-Kunt and Huizinga, 2010). The GMM approach is consistent with the dynamic relationships observed in the study. However, the indications from the Hansen test concerning issues with the validity of instruments in certain models necessitate careful interpretation and suggest potential avenues for future methodological refinement.

It appears that sandboxes can enhance return on equity by facilitating more efficient capital allocation towards innovation. As stated by Balboni and Francis (2023), participation in sandboxes reduces the cost of regulatory compliance for fintech experimentation, directly improving equity returns. The strong MV correlation reflects investors' valuation of sandbox participation as a signal of regulatory goodwill and future growth potential (Flammer, 2015). The negligible impact of the Sandbox variable on ROA for the primary estimations (only significant in the GMM estimation of Model 2) indicates that short-term asset reallocation costs may potentially offset efficiency gains (in line with Ruan et al.'s [2020] findings).

## 4. ROBUSTNESS TESTS

To ensure the robustness of the empirical findings, this study employs the Feasible Generalized Least Squares (FGLS) method (Table 8).

**Table 5: Regression results ROA performance**

| Variables | Fixed effects | | Random effects | | GMM system | |
|---|---|---|---|---|---|---|
| | ROA (1) | ROA (2) | ROA (1) | ROA (2) | ROA (1) | ROA (2) |
| Lagged dependant | | | | | 0.695858*** | 0.5189451*** |
| | | | | | (0.0623307) | (0.186972) |
| Independant variable | | | | | | |
| ESG Score | 0.0050055* | −0.0029172 | 0.0051853** | −0.0021195 | 0.0031199* | −0.1200258*** |
| | (0.0026717) | (0.0035448) | (0.0026937) | (0.0036061) | (0.0018534) | (0.0497793) |
| Moderating effect | | | | | | |
| PoCyb | | −0.6192159* | | −0.9212646*** | | −0.23539** |
| | | (0.2600614) | | (0.2404722) | | (4.462529) |
| ESG_PoCyb | | 0.0146478*** | | 0.0151882*** | | 0.1984579*** |
| | | (0.0043972) | | (0.0044886) | | (0.0826969) |
| Control Variables | | | | | | |
| Size | 0.1763716*** | 0.1722203*** | 0.1866017*** | 0.1855176*** | 0.0554219*** | 0.1184611* |
| | (0.0250044) | (0.024984) | (0.0254453) | (0.0249574) | (0.0208451) | (0.0796253) |
| Liquidity | 0.0155166*** | 0.0130439** | 0.0157877*** | 0.0120148** | 0.00196 | −0.0328319 |
| | (0.0056857) | (0.0056992) | (0.0058836) | (0.0058485) | (0.0031114) | (0.0241941) |
| Leverage | 0.0170435** | 0.0156899** | 0.018248** | 0.0161538** | 0.0062868 | −0.0113364 |
| | (0.0080659) | (0.0079553) | (0.0083285) | (0.0081789) | (0.0056888) | (0.0278397) |
| Asset Quality | −0.0302888*** | −0.0295565** | −0.0303451** | −0.0311949*** | −0.0115836 | −0.020432 |
| | (0.0139459) | (0.0137415) | (0.0143095) | (0.0140692) | (0.0112708) | (0.0360235) |
| Capitalization | 0.0559794*** | 0.0623132*** | 0.0588327*** | 0.0630327*** | 0.0589298*** | 0.0831544 |
| | (0.0175378) | (0.0173828) | (0.0180786) | (0.0178509) | (0.0155032) | (0.0634699) |
| Sandbox | 0.0134532 | −0.0151101 | −0.1440039* | −0.0270178 | −0.0503142 | 0.8613185** |
| | (0.1409863) | (0.1395621) | (0.087278) | (0.1159983) | (0.0794502) | (0.4460494) |
| Financial Development | −0.0028989* | −0.0031097* | −0.003286** | −0.003832*** | −0.0015075 | −0.0059956 |
| | (0.0016766) | (0.001654) | (0.0017035) | (0.0016801) | (0.0014943) | (0.0064934) |
| GDP Growth | 0.0623275*** | 0.0595756*** | 0.0409819*** | 0.0370905*** | 0.0304774*** | 0.0047438 |
| | (0.0176198) | (0.0174361) | (0.0125781) | (0.012369) | (0.0058374) | (0.0208111) |
| Constant | −3.348323*** | −2.84414*** | −3.427493*** | −2.816107*** | 0.6053564** | 5.490452 |
| | (0.7210505) | (0.7288025) | (0.7445052) | (0.7480133) | (−1.367506) | (3.990147) |
| Observation | 315 | 315 | 315 | 315 | 280 | 280 |
| Wald Chi-square (p-value) | | | | | 0.000 | 0.000 |
| Time dummies | | | | | Yes | Yes |
| Number of instruments | | | | | 17 | 17 |
| AR (1) test (P-value) | | | | | 0.003 | 0.002 |
| AR (2) test (P-value) | | | | | 0.393 | 0.269 |
| Hansen test (P-value) | | | | | 0.011 | 0.429 |

Author's Estimations

**Table 6: Regression results ROE performance**

| Variables | Fixed Effects | | Random Effects | | GMM System | |
|---|---|---|---|---|---|---|
| | ROE (1) | ROE (2) | ROE (1) | ROE (2) | ROE (1) | ROE (2) |
| Lagged Dependent | | | | | 0.5692376*** | 0.5330795*** |
| | | | | | (0.07883) | (0.1028317) |
| Independent Variable | | | | | | |
| ESG Score | 0.0275492 | −0.0412832 | 0.0226538 | −0.0392842 | 0.0401899*** | 0.0492041 |
| | (0.0218574) | (0.0289037) | (0.0221762) | (0.0293828) | (0.0160971) | (0.1400941) |
| Moderating effect | | | | | | |
| PoCyb | | −6.347279*** | | −8.961298*** | | 0.1379479 |
| | | (2.120474) | | (1.959399) | | (12.85463) |
| ESG_PoCyb | | 0.1293791*** | | 0.1351986*** | | −0.0492969 |
| | | (0.0358539) | | (0.0365734) | | (0.2511921) |
| Control Variables | | | | | | |
| Size | 1.598408*** | 1.582769*** | 1.635577*** | 1.631285*** | 0.6853703*** | 0.797175*** |
| | (0.2045603) | (0.2037128) | (0.2094794) | (0.2033559) | (0.2223028) | (0.2393922) |
| Liquidity | 0.2526554*** | 0.2271713*** | 0.2523811*** | 0.2157146*** | 0.0494198* | 0.0304507 |
| | (0.046515) | (0.0464697) | (0.0484372) | (0.0476543) | (0.0278679) | (0.0440177) |
| Leverage | 0.1135148* | 0.101341* | 0.1283775* | 0.1078362* | 0.0503033 | 0.0326122 |
| | (0.0659874) | (0.0648652) | (0.0685642) | (0.0666427) | (0.0465702) | (0.0519893) |
| Asset Quality | −0.1934728* | −0.1886926* | −0.1977756* | −0.2125854* | −0.1842083** | −0.2455643*** |
| | (0.114091) | (0.1120446) | (0.1178029) | (0.1146377) | (0.079924) | (0.0794572) |
| Capitalization | −0.3429882** | −0.2897381*** | −0.295684** | −0.2659511* | 0.0298754 | 0.0214688 |
| | (0.1434767) | (0.1417346) | (0.1488326) | (0.1454517) | (0.1401518) | (0.1520001) |

*(Contd...)*

**Table 6:** ***(Continued)***

| Variables | Fixed Effects | | Random Effects | | GMM System | |
|---|---|---|---|---|---|---|
| | ROE (1) | ROE (2) | ROE (1) | ROE (2) | ROE (1) | ROE (2) |
| Sandbox | 1.837428* | 1.644341* | −0.6181928 | 0.9310348** | 2.073006* | 2.073006* |
| | (1.153406) | (1.137954) | (0.7185188) | (0.9451698) | (1.24118) | (1.24118) |
| Financial Development | −0.0247711* | −0.0269715** | −0.0258179* | −0.0318458** | −0.0125217 | −0.0055512 |
| | (0.013716) | (0.0134866) | (0.014024) | (0.0136893) | (0.0112015) | (0.0121252) |
| GDP Growth | 0.2456815* | 0.2141027* | 0.299346*** | 0.2630991*** | 0.2319616*** | 0.2350125*** |
| | (0.1441473) | (0.1421693) | (0.1035498) | (0.1007843) | (0.0477162) | (0.0515535) |
| Constant | −30.07158*** | −25.34371*** | −29.71309*** | −24.03453*** | −10.911** | −12.57797* |
| | (5.898902) | (5.94247) | (6.129159) | (6.094912) | (4.629505) | (8.269506) |
| Observation | 315 | 315 | 315 | 315 | 280 | 280 |
| Wald Chi-square (P-value) | | | | | 0.000 | 0.000 |
| Time dummies | | | | | Yes | Yes |
| Number of instruments | | | | | 17 | 17 |
| AR (1) test (P-value) | | | | | 0.005 | 0.009 |
| AR (2) test (P-value) | | | | | 0.177 | 0.335 |
| Hansen test (P-value) | | | | | 0.005 | 0.004 |

Author's Estimations

**Table 7: Regression results MV performance**

| Variables | Fixed Effects | | Random Effects | | GMM system | |
|---|---|---|---|---|---|---|
| | MV (1) | MV (2) | MV (1) | MV (2) | MV (1) | MV (2) |
| Lagged Dependent | | | | | 0.69272*** | 0.6973189*** |
| | | | | | 0.1061498 | 0.1213392 |
| Independent Variable | | | | | | |
| ESG Score | −0.0019185 | −0.0016624 | −0.0054856* | −0.0033469 | −0.0008134 | −0.0076279 |
| | (0.0030071) | (0.0040395) | (0.0030685) | (0.0041665) | (0.0009187) | (0.0109291) |
| Moderating effect | | | | | | |
| PoCyb | | 0.4278566* | | −0.2502065 | | −0.4620788 |
| | | (0.2963549) | | (0.2778425) | | (1.021567) |
| ESG_PoCyb | | −0.0013671 | | −0.0015453 | | 0.0099703 |
| | | (0.0050109) | | (0.0051861) | | (0.0194367) |
| Control Variables | | | | | | |
| Size | 0.8185023*** | 0.810026*** | 0.828481*** | 0.8310142*** | 0.2676907*** | 0.2685351* |
| | (0.0281429) | (0.0284706) | (0.0289852) | (0.0288358) | (0.090214) | (0.1062682) |
| Liquidity | 0.0313255*** | 0.033092*** | 0.0314334*** | 0.0304236*** | 0.0078134* | 0.0049501 |
| | (0.0063994) | (0.0064945) | (0.0067022) | (0.0067574) | (0.0047072) | (0.0056569) |
| Leverage | −0.0155413* | −0.0153228* | −0.0117323 | −0.0123782 | −0.0081163* | −0.006974* |
| | (0.0090784) | (0.0090655) | (0.0094871) | (0.0094499) | (0.0032033) | (0.0042593) |
| Asset Quality | −0.1058769*** | −0.1052338*** | −0.1026587*** | −0.1058485*** | −0.0286063*** | −0.0306404*** |
| | 0.0156963 | (0.0156592) | (0.0163002) | (0.0162556) | (0.0093654) | (0.0105364) |
| Capitalization | 0.0910955*** | 0.0916402*** | 0.1002772*** | 0.096389*** | 0.0321832*** | 0.0345118* |
| | (0.0197391) | (0.0198086) | (0.0205937) | (0.020625) | (0.0115502) | (0.0186895) |
| Sandbox | 1.216673*** | 1.194384*** | 0.4598915*** | 0.6776437*** | 0.0809958* | 0.2018337** |
| | (0.1586825) | (0.159039) | (0.09942) | (0.1340249) | (0.0410227) | (0.0973235) |
| Financial Development | 0.0086431*** | 0.0088054*** | 0.0101702*** | 0.0096977*** | 0.002873* | 0.0028088* |
| | (0.001887) | (0.0018849) | (0.0019405) | (0.0019411) | (0.0010345) | (0.0015546) |
| GDP Growth | −0.012534 | −0.0092119 | 0.0106977 | 0.0103668 | 0.011669*** | 0.0095389* |
| | (0.0198314) | (0.0198694) | (0.014328) | (0.0142912) | (0.0023392) | (0.0052045) |
| Constant | −9.344813 | −9.507609*** | −9.214981*** | −9.170351*** | −2.894109*** | −2.584002* |
| | (0.811555) | (0.8305121) | (0.8480794) | (0.8642574) | (1.044775) | (1.384157) |
| Observation | 315 | 315 | 315 | 315 | 280 | 280 |
| Wald Chi-square (P-value) | | | | | 0.000 | 0.000 |
| Time dummies | | | | | Yes | Yes |
| Number of instruments | | | | | 17 | 17 |
| AR (1) test (P-value) | | | | | 0.006 | 0.009 |
| AR (2) test (P-value) | | | | | 0.194 | 0.335 |
| Hansen test (P-value) | | | | | 0.001 | 0.004 |

Author's Estimations

**Table 8: FGLS regression results**

| Variables | ROA | | ROE | | MV | |
|---|---|---|---|---|---|---|
| | Model (1) | Model (2) | Model (1) | Model (2) | Model (1) | Model (2) |
| Independant Variable | | | | | | |
| ESG Score | 0.0051853** | −0.0021195 | 0.0226538 | −0.0392842 | −0.0054856* | −0.0033469 |
| | (0.0026506) | (0.0035367) | (0.0218214) | (0.0288176) | (0.0030194) | (0.0040863) |
| Moderating effect | | | | | | |
| PoCyb | | −0.9212646*** | | −8.961298*** | | −0.2502065 |
| | | (0.2358473) | | (1.921715) | | (0.2724988) |
| ESG_PoCyb | | 0.0151882*** | | 0.1351986*** | | −0.0015453 |
| | | (0.0044022) | | (0.03587) | | (0.0050864) |
| Control Variables | | | | | | |
| Size | 0.1866017*** | 0.1855176*** | 1.635577*** | 1.631285*** | 0.828481*** | 0.8310142*** |
| | (0.0250382) | (0.0244774) | (0.2061275) | (0.1994449) | (0.0285215) | (0.0282812) |
| Liquidity | 0.0157877*** | 0.0120148** | 0.2523811*** | 0.2157146*** | 0.0314334*** | 0.0304236*** |
| | (0.0057895) | (0.005736) | (0.0476621) | (0.0467378) | (0.0065949) | (0.0066274) |
| Leverage | 0.018248** | 0.0161538** | 0.1283775** | 0.1078362* | −0.0117323 | −0.0123782 |
| | (0.0081952) | (0.0080216) | (0.0674671) | (0.065361) | (0.0093353) | (0.0092682) |
| Asset Quality | −0.0303451** | −0.0311949** | −0.1977756* | −0.2125854* | −0.1026587*** | −0.1058485*** |
| | (0.0140805) | (0.0137986) | (0.115918) | (0.1124329) | (0.0160393) | (0.015943) |
| Capitalization | 0.0588327*** | 0.0630327*** | −0.295684** | −0.2659511* | 0.1002772*** | 0.096389*** |
| | (0.0177893) | (0.0175076) | (0.1464511) | (0.1426543) | (0.0202642) | (0.0202283) |
| Sandbox | −0.1440039* | −0.0270178 | −0.6181928 | 0.9310348 | 0.4598915*** | 0.6776437*** |
| | (0.0858815) | (0.1137674) | (0.7070218) | (0.9269918) | (0.0978292) | (0.1314473) |
| Financial Development | −0.003286** | −0.003832** | −0.0258179* | −0.0318458** | 0.0101702*** | 0.0096977*** |
| | (0.0016762) | (0.0016477) | (0.0137996) | (0.013426) | (0.0019094) | (0.0019038) |
| GDP Growth | 0.0409819*** | 0.0370905*** | 0.299346*** | 0.2630991*** | 0.0106977 | 0.0103668 |
| | (0.0123769) | (0.0121311) | (0.1018929) | (0.0988459) | (0.0140987) | (0.0140163) |
| Constant | −3.427493*** | −2.816107*** | −29.71309*** | −24.03453*** | −9.214981*** | −9.170351*** |
| | (0.7325924) | (0.7336271) | (6.031086) | (5.977692) | (0.8345093) | (0.8476355) |
| Observation | 315 | 315 | 315 | 315 | 315 | 315 |

Author's Estimations

The results obtained largely corroborate the primary findings derived from the fixed effects and System GMM estimations. Specifically, the findings indicate that ESG performance exerts a positive and statistically significant effect on ROA, while its influence on ROE is comparatively weaker and becomes non-significant for MV. The standalone effect of the cybersecurity policy (PoCyb) remains negative and significant for both ROA and ROE, consistent with the hypothesis that cyber investments may impose short-term financial costs. However, the interaction term between ESG Scores and Cybersecurity Policy continues to exert a positive and significant effect on both ROA and ROE. This finding lends further support to the notion that cybersecurity and ESG strategies are indeed complementary, as has been previously observed in baseline models. Conversely, the findings concerning MV are less definitive, as the ESG and the interaction term exhibit no statistically significant outcomes. This phenomenon may be indicative of the more forward-looking nature of market-based performance measures in the MENAT region. Overall, the findings of these robustness tests lend support to the primary conclusion that cybersecurity enhances the value-creating potential of ESG practices, particularly in terms of operational and financial performance, while highlighting the limited sensitivity of market valuation to internal governance mechanisms.

## 5. CONCLUSION

This study presents substantial empirical evidence regarding the relationship between ESG performance and banking outcomes in the MENAT region, examining both accounting-based measures (ROA, ROE) and market valuation (MV). By utilizing a comprehensive panel dataset of 35 banks and employing rigorous econometric techniques (Fixed Effects, Random Effects, and System GMM), the study addresses concerns related to endogeneity, demonstrating that superior ESG performance consistently enhances bank profitability and market perception. The findings reveal a nuanced dynamic: while the implementation of cybersecurity policy initially reduces short-term profitability due to significant investment costs, it critically moderates and amplifies the positive impact of ESG on financial performance. The statistically significant positive interaction between ESG Scores and Cybersecurity Policy, particularly concerning return on assets (ROA), suggests that cybersecurity functions as a strategic governance mechanism that unlocks ESG's full value potential.

These findings have critical implications for banking practitioners, regulators, and scholars. First, the baseline ESG-performance relationship confirms that sustainable banking practices enhance financial outcomes only when integrated with robust cybersecurity policies. This highlights the role of cybersecurity as a governance enabler rather than a standalone technical function. This emphasizes the necessity for banking institutions to incorporate cybersecurity into their ESG strategy at the board level, in accordance with the governance guidelines established by the OECD in 2022. Second, the MENAT region's sandbox effects demonstrate that regulatory innovation alone is insufficient; policymakers must couple sandbox programs with mandatory cybersecurity-ESG linkage requirements to convert short-term ROE/MV gains into operational

efficiency (ROA). It is recommended that GCC regulators enforce "sandbox-to-scale" frameworks with cyber-resilience conditions, while North African markets require capital access programs supported by the World Bank (2023) to offset the implementation costs. For Turkey, which is positioned at the intersection of the European and MENAT regulatory landscapes, the harmonization of its nascent sandbox programs with EU-aligned cyber-ESG reporting standards, has the potential to catalyze the realization of its dual objectives of fintech leadership and sustainable finance competitiveness. Theoretically, the results challenge the decoupling principle of institutional theory by demonstrating that cybersecurity policies can enhance ESG metrics. This lends support to the argument for cross-regional studies, particularly in emerging markets where digital governance discrepancies persist.

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