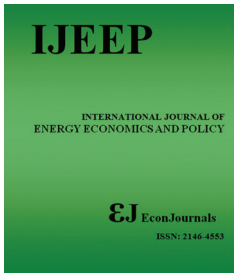

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Climate Risk and Bank Performance: What Role does Corporate Social Responsibility Play?

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ABSTRACT

Over the past decade, climate risk has emerged as one of the most urgent global challenges, posing serious threats to ecosystems, economic stability, and human well-being. A substantial body of research has explored the macroeconomic implications of climate risk. However, studies examining its micro-level effects, particularly on financial institutions remain relatively scarce. This imbalance underscores the need for deeper investigation into how climate risk influences bank-level performance. This paper explores whether corporate social responsibility (CSR) can mitigate the negative effect of climate risk on bank performance. The paper uses a sample of MENA banks from 2010 to 2022 and the system generalized method of moments (SGMM) model was used as an empirical approach. The findings of this paper support three major conclusions. First, climate risk was negatively and significantly associated with the bank performance measured by return on assets (ROA) and return on equity (ROE). Second, CSR scores were positively and significantly linked to bank profitability. Third, the findings indicated that banks in the MENA region benefit from an interactional between CSR and climate risk since it increases bank performance. This research completes an important missing piece of the debate on the moderating role of Corporate Social Responsibility (CSR) on the climate risk-bank performance interaction. This research addresses a significant gap in the ongoing debate surrounding the moderating role of CSR in the relationship between climate risk and bank performance. Findings of this study offer several practical insights. Notably, CSR initiatives may serve as an important mechanism in mitigating the adverse impact of climate risk on banking outcomes.

Keywords: Climate Risk, Bank Performance, Corporate Social Responsibility, MENA Region, System Generalized Method of Moments
JEL Classifications: G30; L25; M14

1. INTRODUCTION

Climate change and ecological degradation are widely recognized as among the most urgent global challenges requiring immediate action. Major international initiatives such as the 2015 Paris Agreement, COP26, and COP28 have mobilized significant financial resources to implement effective strategies aimed at reducing greenhouse gas emissions and advancing sustainable development. Moreover, the intersection of climate change and governance has broadened public discourse, highlighting the deep interconnection between environmental policies and institutional accountability. The growing urgency of climate change has prompted financial markets to increasingly prioritize green finance and sustainable investment. Green finance encompasses a range of activities from green bonds and sustainability linked loans to capital allocation mechanisms that support environmentally friendly projects. Green investments contribute to sustainable economic growth by channeling resources into renewable energy, clean technologies, and green infrastructure. Jointly, these developments reflect a gradual significant transformation in the role of financial markets, positioning them as key drivers of climate-aligned objectives and catalysts for steering global economic practices toward sustainability (Al Mamun et al., 2022; Cepni et al., 2023).

The banking sector remains one of the primary sources of economic financing, playing a pivotal role in fostering business activity and driving investment. As a cornerstone of economic growth, it is crucial to identify the factors that threaten banking stability and enhance profitability (Hakimi et al., 2023). Among these factors, climate change has emerged as a critical issue, given its varied and potentially profound effects on bank profitability. As key financial intermediaries, banks are increasingly exposed to climate-related risks through their loan portfolios, investment activities, and operational vulnerabilities (Siregar et al., 2024; and Sugiarto et al., 2023). This growing exposure compels banks to reassess their risk management frameworks and strategic priorities, particularly in sectors most susceptible to climate risks, as part of the broader transition toward a sustainable economy. Consequently, understanding the relationship between climate risk and bank performance has become a fundamental concern for policymakers, industry practitioners, and academic researchers alike (Walker et al., 2023; Noth and Schüwer, 2023; Zhou et al., 2023; Nguyen et al., 2023; Lee et al., 2024; Wang and Ling, 2024; Muzuva and Muzuva, 2024).

Against the background of increasing focus on CSR, its intervening effect on the climate risk-performance nexus in banks has not been extensively researched, especially in emerging economies with unique climatic and economic issues. By adopting proactive CSR strategies, banks can mitigate the adverse effects of climate-related risks. These practices not only enhance stakeholder trust but also improve risk management, enabling banks to better navigate environmental uncertainties. In doing, CSR initiatives contribute to maintaining or even improving financial performance under climate stress, positioning banks as resilient and responsible actors in the transition to a sustainable economy. This research aims to respond to the following research questions: Does climate risk affect the MENA bank's profitability? Does CSR moderate the impact of climate risk on bank profitability?

To achieve these goals, we used a sample of 40 MENA banks belonging to 10 MENA countries over the period 2010-2022 and we applied the SGMM as an empirical approach. Overall, empirical findings indicate that climate risk decreases bank profitability while, corporate social responsibility has a positive and significant and effect on the profitability of MENA banks. Findings also indicate that the interaction between CSR and climate risk significantly enhances bank profitability.

The MENA region presents a compelling case study for several key reasons. Firstly, climate risks in this area represent an urgent challenge, exacerbated by its unique geographical and socio-economic vulnerabilities. As one of the hottest regions, the MENA area is warming at a rate significantly faster than the global average. Projections under high-emission scenarios indicate an increase in average temperatures of 2-4°C by the end of this century. Additionally, the region is the most water-scarce, with over 60% of its population already experiencing water stress. Secondly, over the past decade, CSR has gradually evolved in the MENA region, driven by a combination of regulatory reforms, international standards, and an increasing public awareness of environmental and social issues. CSR in this region is characterized by a unique blend of traditional values and contemporary practices aligned with global sustainability norms.

This research offers several significant contributions to the existing literature. Firstly, to the best of our knowledge, it is the first study to explore the moderating effect of CSR in the climate risk and bank profitability in the MENA region. It also fills a critical gap in the literature on banking in the MENA context. Secondly, this study expands the current body of research on the interplay between bank profitability and climate risk in the region. Thirdly, empirical studies linking CSR to bank performance in the MENA region remain limited, making this research adds to the existing literature. Finally, the findings provide policymakers and bankers with actionable insights, guiding them in restructuring credit portfolios and developing new lending products to bolster bank profitability taking into account climate risks.

The remainder of this paper follows the structure. Section 2 presents the literature review and hypotheses development. Section 3 outlines the sample and the empirical methodology. Section 4 discusses the empirical findings. Finally, Section 5 provides the conclusion and policy recommendations.

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

This chapter begins with a discussion of the link between climate risk and bank profitability. It then presents a current literature review of the link between corporate social responsibility and bank profitability. It concludes with a review of research on the moderating role of corporate social responsibility in the link between climate risk and bank profitability.

2.1. The Linkage between Bank Performance and Climate Risk

Bank profitability can be influenced by natural disasters. Empirical studies have determined the negative influence of natural disasters on bank profitability. For example, Lee et al. (2024), tested the influence of climate risk on the profitability of 87 Chinese banks from 2011 to 2022 using panel data. The study determined that climate risk has a significant influence on Chinese bank profitability. It highlights that climate risk reduces the worth of bank credit assets by increasing the probability of default and causing bank creditors to incur losses.

According to Walker et al. (2023), under natural disasters in the United States, the banks would most probably end up having worse profitability and solvency indicators like the equity ratio as well as the net-income-to-assets ratio. Noth and Schüwer (2023) took into perspective the impact of natural disasters and their relation with bank stability. According to them, weather-linked natural disasters in the US tremendously endanger the banks' financial endurance that are conducting operations in stricken regions. Higher default probability, lower z-scores, higher foreclosure and non-performing asset ratios, poorer asset returns, and lower equity ratios in the post-natural disaster period are all indicators of this.

Subsequently, Fan et al., (2024) determined the deepening concern among financial regulators with regard to climate change risks and examined the influence of climate risks on commercial bank profits. Agreeing with the research, predicated on 42 listed banks in China for the period from 2012 to 2022, the impact of climate risks on the profits of commercial banks is one that is tardy in onset in that its financial impact will not be instantaneous. Muzuva and Muzuva, (2024) conducted a systematic review to ascertain the effect of climate risk on the bank loan portfolio. Climate events have been shown to have the capacity to create colossal defaults and consequential credit losses for banks. It indicates how banks have to handle such risks in an effective manner. This essay is going to rely on the impact of climate risk on banks' loan books and the need for effective climate risk management practices. As events that are atypical are becoming increasingly common, banks must start incorporating climate risk in their risk management. Consequently, the banking sector should incorporate climate risk into its models as part of its risk management strategy to combat the hyperbolic risks that climate risk poses to loan portfolios. This has ramifications for the stability of the financial system with growing physical and transition risks.

Nguyen et al. (2023) took a look at the Asian context. They examined the impact of natural disasters on commercial bank performance and how financial integration influences it using a panel of East Asian banks between 1999 and 2014. Key findings of the study are that natural disasters are not associated with liquidity, credit risk, profitability, or default risk directly. They do decrease the deposit ratios substantially, though. The research further revealed that natural calamities result in a time lag effect with deposits increasing and liquidity decreasing after a year from occurrence. Overseas bank claims also regional Asian lenders' claims more specifically contribute to increasing the decline in deposits in natural calamities. To assess the impact of natural disasters, Zhou et al. (2023) performed a review of literature of climate risk and natural disasters impact on the financial system, for instance, banks, insurance, stock markets, bond markets, and international finance flows. Implications of the research are that climate risks have the potential to dampen insurers' profitability and risk-sharing capacity, banks' stability and supply of credit, return and stability of stock and bond markets. Based on theoretical and empirical evidence from existing literature, the following hypothesis will be tested:

- H_1: Climate risk reduces bank profitability.

2.2. Climate risk, CSR and Bank Profitability

The impact of CSR on bank profitability is multidimensional, and there is evidence that results are mixed and inconclusive. While many researchers have shown how CSR can reinforce financial performance through improved public image and customer loyalty, there are other researches that have revealed possible trade-offs that CSR activities could result in.

On the contrary, Purwanti et al. (2024) investigate how the practice of CSR is affecting the public perception of society towards the banks and their own financial performance bearing in mind the sustainability and the social responsibility. It has been indicated that banks involved in CSR have better publicity and thus attract more loyal customers and could always lure new customers. The effect of corporate social responsibility on bank financial performance was investigated by Sholikudin and Hwihanus (2024). Five earlier papers were reviewed in a meta-analysis. In general, CSR initiatives improve a bank's financial performance, particularly when measured by ROE and NIM.

On the negative side, Ben Slama and Ben Hamouda (2024) studied the relationship between Corporate Social Responsibility and the financial performance of 27 European banks during the period from 2011 to 2018. In this research, a simultaneous equation model has been used for analyzing data. The results show that the implementation of CSR practices negatively affects the financial performance of these banks. This result is significant, as it means that for banks, pursuing CSR may involve some trade-offs. The study by Yasir et al. (2023) was conducted on the link between Corporate Social Responsibility and Financial Performance in the banking sector of Pakistan from the year 2008 to 2020 and covered 32 banks listed in the PSX. Findings indicated that CSR had a positive influence on Earnings per Share and Market Value per Share but negatively impacted ROE, ROA, and TOBIN's. It highlights that CSR is gaining momentum within the financial sector and infuses the fact that while companies have to be profitable; they have to serve their stakeholders.

Overall, CSR may improve profitability only through better customer relations and some financial measures, although these effects are not always consistent across different banks and contexts. The complexity requires careful weighing of CSR strategies in balancing financial and social objectives. Hence, we can put the following hypothesis:

- H_2: Corporate social responsibility increases bank profitability.

The challenges of bank performance given climate risks, whether physical or transition risks are considered high. It has also been found that CSR significantly moderates the relationship between climate risk and bank profitability. CSR activities might mitigate the adverse impact of climate risk on bank performance by improving risk management practices and meeting stakeholder expectations. This relationship is bound to be influenced by various factors that include the bank's size, ownership, and the socio-cultural context in which the bank operates.

An et al. (2023) investigated how green credit influences bank risk and the way CSR works on that. They used a sample data was considered for 35 listed banks in China, from 2010 to 2021. The findings indicated green credit significantly lowers the overall risk. The above effect is heterogeneous among bank types, showing a more positive effect on large banks, state-owned banks, and high-profit-margin banks. Besides, it finds that CSR reinforces the positive effect of green credit on bank risk, which suggests that banks with good CSR performance may be more capable of enjoying the benefits brought about by green credit policies.

CSR initiatives may also be important in the way banks manage to address climate risks. Various studies suggest that good CSR practices can decrease firm-specific risks and improve the overall financial performance of a firm. For example, Neitzert and Petras

(2022) note that by engaging in CSR activities, banks may reduce reputational risks resulting from environmental mismanagement and, therefore, reduce volatility in profitability during adverse climate events. The latter, corporate social responsibility strongly moderates the relationship between climate risk and bank profitability. Beyond mitigating the impact of climate-related risks on their operations, only comprehensive CSR strategies can therefore provide added value for banking business profitability. With growing regulatory pressure and changing expectations on the part of the general public, embedding CSR within the core processes of banking will become crucial for long-term financial success. Based on the development above, we can formulate the following hypothesis:

- H_3: Corporate social responsibility moderates the relationship between climate risk and bank profitability.

3. METHODOLOGY AND DATA

3.1. The Sample

To investigate the moderating role of corporate social responsibility in the relationship between climate risk and bank profitability, we used a sample of conventional banks belonging to ten MENA countries between 2010 and 2022. The initial sample was made up of 68 banks. However, a number of banks have been excluded because of the unavailability and discontinuity of bank information. As a result, 40 traditional banks made up the final sample (Table 1). There are three main sources for the date used in this study. Climate Risk Index (CRI) data were obtained from Germanwatch. Bank-level data, including financial and accounting variables, were retrieved from the Refinitiv Eikon database and the annual reports of individual banks. Country-level data, reflecting industry-specific and macroeconomic conditions, were gathered from two primary sources: the Global Financial Indicators database and the World Bank Indicators database.

3.2. Variable Selection and Theoretical Justification

3.2.1. Dependent variable: Bank profitability

To investigate the relationship between climate risk, CSR and bank performance, we used the return on assets (ROA) and the return on equity (ROE) ratios as a measure of bank profitability. Referring to Goddard et al. (2004), and Hakimi et al. (2023), we have used two metrics representing different dimensions of bank performance. ROA reflects bank efficiency in using its assets to generate income and is calculated as the net income-to-total assets ratio. The net income-to-total equity ratio is called return on equity, or ROE.

Table 1: Distribution of the sample by country

Middle East North Africa countries		
Countries	**Number of banks**	**Percentage**
Jordan	4	10
Kuwait	4	10
Oman	2	5
Lebanon	1	2.5
Qatar	4	10
Saudi Arabia	7	17.5
United Arab Emirates	6	15
Egypt	1	2.5
Morocco	2	5
Tunisia	10	25
Number of banks	40	100

3.2.2. Main explanatory variable: Climate risk

We utilize the Global Climate Risk Index (CRI), which was developed and published by Germanwatch to quantify climate risk by nation, as explanatory variables (Kreft & Eckstein, 2014). The index seeks to illustrate how climate change has negatively impacted several nations. These include weather phenomena like storms, hydrological phenomena like floods, and climatological phenomena like wildfires. A higher index score indicates a higher climate danger, whereas a high index score indicates a low climate risk. Before doing the empirical study, we multiplied this index by −1.

3.2.3. Other explanatory variable: Corporate social responsibility

The study applies, according to Boussaada et al. (2023), a composite Environmental, Social, and Governance (ESG) index. This is an index that comes in the form of a pillar score that provides a general and balanced indication of the performance of a firm based on environmental, social, and governance dimensions.

3.2.4. Control variables

As outlined, our econometric model incorporates several control variables. The first category pertains to bank-specific factors, including bank size (BS), which is used to explain variations in bank performance (Anginer et al., 2018), the capital adequacy ratio (CAR), a key determinant of bank performance (Molyneux and Thornton, 1992), the liquidity risk (LTD) and the diversification (NII) (Hakimi et al., 2023). The second category relates to industry-specific variables, such as bank concentration (CONC) recognized as significant drivers of bank profitability (Hakimi et al., 2023). The third category encompasses macroeconomic conditions and the financial environment, represented by the GDP growth rate (GDPG), and inflation rate (INF), (Abreu and Mendes, 2001). The Domestic credit to the private sector (% of GDP) (DCTPS), and the Gross domestic savings (% of GDP) (GDS) (Ozili and Ndah 2024).

3.3. Empirical Approach and Model Specification

The SGMM methodology is the main the empirical approach used in this investigation. Using the SGMM technique, endogeneity, one of the main issues in corporate and banking finance, can be resolved. Furthermore, OLS and fixed-and-random-effect (FE and RE) models are frequently plagued by bias from omitted variables and measurement mistakes. The SGMM technique, which Blundell and Bond (1998) suggested, was employed in this work to achieve this. (Hakimi et al., 2023; Danisman and Tarazi 2020, and Teixeira and Queirós, 2016) The SGMM approach yields more dependable and practical results.

The empirical approach in this work is based on two steps. First, we explore the relationship between climate risk and bank profitability. Equation (1) presents the econometric to be tested in this step:

$$PROF_{i,t} = \beta_0 + \beta_1 PROF_{i,t-1} + \beta_2 CRI_{i,t} + \beta_3 BS_{i,t} + \beta_4 CAR_{i,t} + \beta_5 LTD_{i,t} + \beta_6 NII_{i,t} + \beta_7 CONC_{i,t} + \beta_8 GDPG_{i,t} + \beta_9 INF_{i,t} + \beta_{10} DCTPS_{i,t} + \beta_{11} GDS_{i,t} + \varepsilon_{i,t} \quad (1)$$

The second step checks whether the link between climate risk and bank profitability can be moderated by corporate social responsibility. In order to capture the interplay between climate risk and corporate social responsibility, we incorporate an interactional variable into the econometric model. Equation (2) provides the econometric model to be tested:

$$PROF_{i,t} = \beta_0 + \beta_1 PROF_{i,t-1} + \beta_2 CRI_{i,t} + \beta_3 ESG_{i,t} + \beta_4 CRI_{i,t} * ESG_{i,t} + \beta_5 BS_{i,t} + \beta_6 CAR_{i,t} + \beta_7 LTD_{i,t} + \beta_8 NII_{i,t} + \beta_9 CONC_{i,t} + \beta_{10} GDPG_{i,t} + \beta_{11} INF_{i,t} + \beta_{12} DCTPS_{i,t} + \beta_{13} GDS_{i,t} + \varepsilon_{i,t} \quad (2)$$

Table 2 provides definitions for all variables.

4. EMPIRICAL RESULTS AND DISCUSSION

4.1. Summary Statistics and Correlation Matrix

Descriptive statistics for our analysis's variables are shown in Table 3. It describes this dataset's salient features. Each variable's mean, standard deviation, minimum and maximum values are listed in this table. The SGMM model's variables are summed up in these statistics.

Bank profitability, as expressed by Return on Assets or (ROA), stands at an average of 1.358%, while a maximum value of 3.808% and a minimum value of −2.576% were achieved. (ROE) ranges between −23.056% and 50.393% with an average value of 12.249%. For conventional banks, the Climate Risk Index (CRI) oscillates at an average value of −100.21, while the maximum achieved is −17. While calculating the ESG scores (ESG), its average worked out to 40.357, ranging from 80.794 as the maximum value to 12.842 as the minimum. The average bank size is 23.500, ranging from 20.942 to 26.512. The CAR stands for Capital Adequacy Ratio, which averages 15.839%, ranging from 1.25% to 40.350%. According to the ratio of liquid assets to deposits, the mean level of liquidity risk reaches about 84.858% from a minimum value of 42.21% and a maximum value of 162.312%. The average value of bank diversification as determined by NII is 38.12%, with a high value of 96% and a low of 9.552%. Industry-specific factors are that the average bank concentration (CONC) is 80.888, with a maximum of 100.000 and a minimum of 56.035.

Macroeconomic conditions, represented by the GDP growth rate (GDPG) and inflation rate-(INF) are on average 2.53%, with a maximum of 19.59% and a minimum of −21.39%. The inflation rate averages 3.877, ranging from −3.749 to 171.20. Finally, the Domestic credit to the private sector (DCTPS) has an average of 68.79%, with a maximum of 138.85% and a minimum of 3.70%. The average value of Gross domestic savings (GDS) is 30.56% with a high value of 75.54% and a low of −21.37%.

The correlation matrix determines the nature and the level of relationship between the independent variables by calculating the coefficients of linear correlations. The correlation matrix for each variable utilized in this study is shown in Table 4.

We used the Variance Inflation Factor (VIF) test for multicollinearity, which quantifies the extent to which correlations between predictors inflate the variance of estimated regression coefficients, to further corroborate the findings in Table 4. No correlation is shown by a VIF value of 1, moderate correlation is suggested by values between 1 and 5, and potentially severe multicollinearity is indicated by values larger than 5.

Results in Table 5, present the mean VIF for the first model-that is 1.45, thereby indicating no severe multicollinearity among the variables and thus showing a good moderate correlation across all values. Table 5 also shows the mean VIF value for the second model that probes the interaction effect of both corporate social responsibility and climate risk on bank profitability is 1.41. Thus,

Table 2: Definition of variables

Variables	Definitions	Measures
Dependent variables (PROF)		
ROA	Return on assets	Net income after tax to total assets
ROE	Return on equity	Net income after tax to total equities
Climate risk		
CRI	Climate risk index	Climate risk index (CRI) of German Watch
Corporate social responsibility		
ESG	Corporate social responsibility	Composite environmental, social and governance index (ESG).
Interaction variables		
CRI*CSR	Interactional variable	The interaction between CRI and CSR
Bank specifics		
BS	Bank size	Natural logarithm of total assets
CAR	Capital adequacy ratio	Bank capital to total assets (%)
LTD	Liquidity risk	Loans to deposits ratio (%)
NII	Bank diversification	Non-interest income in % of total income.
Industry specifics		
CONC	Bank Concentration	Bank concentration (%)
Macroeconomic conditions and financial environment		
GDPG	The growth rate of GDP	Annual growth rate of GDP (%)
INF	The inflation rate	Consumer price index (%)
DCTPS	Domestic credit to private sector	Domestic credit to private sector (% of GDP)
GDS	Gross domestic savings	Gross domestic savings (% of GDP)

Table 3: Descriptive statistics

Variable	Mean	Standard deviation	Min	Max
ROA	1.358	0.743	−2.576	3.808
ROE	12.249	7.151	−23.056	50.39
CRI	−100.21	31.934	−173.670	−17
ESG	40.357	12.702	12.842	80.794
BS	23.500	1.313	20.942	26.512
CAR	15.839	10.987	1.256	40.350
LTD	84.858	25.228	40.218	162.312
NII	38.120	17.499	9.552	96
CONC	80.888	14.140	56.035	100
GDPG	2.253	4.050	−21.399	19.592
INF	3.877	10.913	−3.749	171.20
DCTPS	68.796	20.011	3.706	138.857
GDS	30.565	21.374	−21.417	75.549

Table 4: Correlation matrix

	CRI	ESG	BS	CAR	LTD	NII	CONC	GDP	INF	DCTPS	GDS
CRI	1.0000										
ESG	−0.2602*	1.0000									
	0.0000										
BS	−0.0112	0.0761*	1.0000								
	0.7110	0.0121									
CAR	0.1654*	0.4606*	0.0073	1.0000							
	0.0000	0.0000	0.8091								
LTD	0.0684*	0.3027*	−0.1930*	0.0556	1.0000						
	0.0240	0.0000	0.0000	0.0668							
NII	0.0127	0.4544*	−0.2379*	0.2359*	0.1586	1.0000					
	0.7457	0.0000	0.0000	0.0000	0.0000						
CONC	0.1114*	0.1874*	−0.0843*	0.0304	0.0101	−0.0022	1.0000				
	0.0002	0.0000	0.0054	0.3168	0.7398	0.9562					
GDPG	0.0602	−0.070*	0.0820*	−0.0904*	0.1356*	−0.2422*	−0.1157*	1.0000			
	0.0529	0.0228	0.0083	0.0037	0.0000	0.0000	0.0002				
INF	−0.2932*	−0.0173	0.1239*	−0.0648*	0.0733*	0.1573*	−0.3571*	−0.032	1.0000		
	0.0000	0.5693	0.0000	0.0327	0.0155	0.0001	0.0000	0.3009			
DCTPS	−0.1158*	−0.590*	−0.3580*	−0.2391*	−0.0581	−0.4822*	−0.1384*	0.0817*	0.0150	1.0000	
	0.0001	0.0000	0.0000	0.0000	0.0555	0.0000	0.0000	0.0086	0.6217		
GDS	−0.1158*	−0.490*	−0.3580*	−0.2391*	−0.0581	−0.4859*	−0.1347*	0.0859*	0.0181	0.0101	1.0000
	0.0001	0.0000	0.0000	0.0000	0.0555	0.0000	0.0000	0.0086	0.6217	0.7398	

*, indicate level of significance at 5%

Table 5: Variance inflation factor (VIF)

Model 1			Model 2		
Variable	VIF	1/VIF	Variable	VIF	1/VIF
GDS	2.42	0.413	GDS	2.43	0.412
BS	1.91	0.523	BS	2.06	0.485
CONC	1.77	0.564	CONC	1.79	0.559
LTD	1.42	0.705	LTD	1.43	0.699
NII	1.22	0.818	NII	1.3	0.769
GDPG	1.20	0.830	CRI*ESG	1.26	0.794
INF	1.18	0.848	DCTPS	1.19	0.840
DCTPS	1.15	0.866	GDPG	1.19	0.840
CRI	1.11	0.904	CRI	1.14	0.877
CAR	1.08	0.922	ESG	1.11	0.901
			INF	1.09	0.917
			CAR	1.01	0.990
Mean VIF	1.45		Mean VIF	1.41	

Table 6: Results of the effect of CRI on bank profitability

ROA	ROA		ROE	ROE	
	Coef.	Z		Coef.	Z
ROA (−1)	0.426	12.64***	ROE (−1)	0.247	7.45***
CRI	−0.001	−3.97***	CRI	−0.015	−6.28***
BS	0.037	0.49	BS	0.949	2.10***
CAR	0.000	2.08**	CAR	0.003	0.66
LTD	−0.004	−2.60***	LTD	−0.023	−1.87*
NII	−0.002	−1.84*	NII	−0.036	−2.48**
CONC	−0.003	−1.45	CONC	−0.021	−0.63
GDPG	0.034	14.14***	GDPG	0.143	5.42***
INF	−0.002	−2.73***	INF	0.000	0.02
DCTPS	−0.002	−1.86**	DCTPS	0.004	0.66
GDS	0.004	1.85	GDS	0.086	4.68***
_cons	1.799	0.98	_cons	35.112	3.51***
AR (1)	−3.480			−1.7809	
Prob	0.0005			0.0749	
AR (2)	0.1983			1.1041	
Prob	0.8428			0.2696	
Sargan test	29.1338			33.6065	
Prob	1.0000			1.0000	

***, **, and * indicate the rejection of null hypothesis at 1%, 5% and10% significance levels, respectively

similar to the first model, no severe multicollinearity would be expected, though this would show a moderate correlation between the variables.

4.2. Findings of the Effect of Climate Risk on Bank Performance

Testing the effect of climate risk, as determined by the Climate Risk Index (CRI), on bank performance in the MENA area, as determined by the ROA and ROE, is the first stage of the empirical approach used in this article. The empirical results are shown in Table 6.

The results of the Sargan and serial correlation diagnostic tests indicate that the null hypothesis, which assumes the validity of over-identifying restrictions and the absence of correlation, cannot be rejected. This conclusion is supported by P-values for both the Arellano and Bond AR (2) test and the Sargan test, which exceed the 5% threshold. From the results in Table 6, we note that the lagged dependent variable has a significant and positive coefficient for both ROA and ROE. This means that bank profitability in this current year is positively dependent to the level of profitability of the previous year.

Overall, Table 6's empirical findings for the entire sample indicate a negative relationship between profitability and climate risk. An increase in the climate risk index significantly lowers bank profitability for MENA banks. This result is confirmed for both ROA and ROE. Climate risk has a negative impact on bank performance by raising credit risk because climate-related disturbances like droughts or floods may make it difficult for borrowers in susceptible industries to repay loans, which raises the number of non-performing loans (NPLs). Additionally, it increases operating expenses by physically damaging infrastructure and generates market risks by depreciating assets in industries with

high carbon emissions. Additionally, if banks are perceived as funding ecologically damaging initiatives, their reputations would suffer, potentially costing those customers and investors' money. While economic instability in impacted countries may result in liquidity issues, climate rules further increase the cost of compliance. When combined, these elements increase ambiguity, interfere with sources of income, and jeopardize the stability and profitability of banks. This finding is in line with the works of Lee et al. (2024) and Walker et al. (2023). Therefore, we accept H1.

According to empirical findings, there is a positive and substantial correlation between the dependent variable ROE and the bank size coefficient. Given that larger banks create more often than smaller ones, this might be explained. It is also possible to argue that large banks benefit from economies of scale. The following study results are related to Adusei (2015).

The findings also show that more capitalized banks tend to be more profitable. This finding is strongly supported for both Return on Assets (ROA) and Return on Equity (ROE). The capital adequacy ratio has a positive and statistically significant coefficient at the 5% level. Increases in equity result in lower costs of capital, which raises profitability. Additionally, higher estimated expenditures and financial difficulties might result from a rise in bank capital. A greater amount of money lessens the motivation for shareholders to engage in excessive risk-taking and speculative behavior. High bank ratings and well-capitalized banks have an impact on debt costs, lower financial costs, and increase bank profitability. Bank profitability may benefit from capital through monitoring channels. Shareholders are more motivated to keep an eye on and demand more efficiency in order to prevent losses, which boost bank profitability. This finding is in line with the works of Molyneux and Thornton (1992) and Goddard et al. (2004).

It has been discovered that liquidity risk has a negative and considerable impact on bank profitability for both ROA and ROE. Liquidity risk adversely affects bank performance by increasing their funding costs, as they have to borrow at higher rates in times of stress. It also limits their ability to grant loans, thereby reducing their interest income. In times of urgent liquidity needs, banks may be forced to sell assets at a loss, resulting in direct financial losses. In addition, this risk can erode the confidence of depositors and investors, leading to mass withdrawals or increased capital requirements. Liquidity problems also expose banks to regulatory sanctions and disrupt other diversified sources of income, further worsening their situation. In this way, liquidity risk compromises banks' profitability and financial stability. This result is in line with Hakimi et al. (2022).

Bank profitability declines with increased bank diversification. This outcome may be explained as follows: non-interest revenue is enabling banks in the MENA area to have a positive influence on bank profitability at this stage of bank diversification. It's also possible that MENA banks have made significant investments in IT infrastructure to offer more financial services and electronic banking, but they haven't learned as much. This IT investment has an unbalanced cost and return. The detrimental impact of NII on bank profitability is consistent with the findings of Duho (2020), Hai Trung (2021), and Githaiga (2020).

The results also show that bank profitability is positively and considerably impacted by economic growth, but inflation has a negative and large impact. The rate of economic growth is a key factor in determining bank profitability. The quality of loans improves under a stable macroeconomic environment characterized by improving economic conditions, which increases borrowers' capacity to fulfill their obligations. Thus, the likelihood of solvency rises and the amount of non-performing loans falls, both of which have a beneficial impact on bank profitability. This result is in line with Calza et al. (2003), and Athanasoglou et al. (2008).

We discovered that, in contrast to the GDP effect, bank profitability is considerably reduced by any increase in the inflation rate. An elevated rate of inflation raises financial and operational costs, which in turn lowers bank profitability. Furthermore, every rise in the inflation rate lowers borrowers' capacity to repay their debts because of rising financial costs. In this instance, bank profitability is lowered when loan quality declines and the amount of non-performing loans rises. This result corroborates the works of Perry (1992), Pasiouras and Kosmidou (2007) and Revell (1979).

Domestic credit to the private sector was found to bear a significant and negative influence on the bank profitability. Too much domestic credit to the private sector can adversely affect banks' performance by increasing their exposure to the risk of default, particularly if borrowers are over-indebted or the economy is experiencing a slowdown. Excessive credit expansion can also reflect a misallocation of resources, where loans are granted without rigorous risk assessment, leading to an increase in bad debts. In addition, over-reliance on domestic credit can leave banks vulnerable to economic shocks, compromising the quality of their assets and reducing their long-term profitability. This result is in line with Hallak (2013).

Our analysis indicates that, High gross domestic savings as a percentage of GDP can have a positive impact on bank performance by providing them with a stable and plentiful source of deposits, reducing their dependence on costly external financing and improving their profitability. Increased savings also enhance banks' financial stability by enabling them to deal more effectively with liquidity crises. In addition, it supports investment by fuelling credit to the private sector, stimulating economic activity and reducing the risk of default by borrowers, thereby improving asset quality and the overall performance of banks. These findings are consistent with the results obtained by Anila et al. (2020)

4.3. Findings of the Interactional Effect of Climate Risk and Corporate Social Responsibility on Bank Performance

The third step of the empirical approach examines the relationship between bank profitability, climate risk, and corporate social responsibility. In other words, we investigated whether climate risk and CSR may increase bank profitability in the MENA region. The empirical results are shown in Table 7.

Results in Table 7 indicate corporate social responsibility (ESG) significantly increases bank profitability measured by ROA and ROE. The coefficient of ESG is positive and statistically significant

Table 7: The interactional effect of CSR and climate risk on bank profitability

ROA	ROA		ROE	ROE	
	Coef.	Z		Coef.	Z
ROA (−1).	0.409	14.28***	ROE (−1).	0.221	8.65***
CRI	−0.003	−2.89***	CRI	−0.05	−6.32***
ESG	0.006	8.77***	ESG	0.034	3.49***
CRI*ESG	0.001	7.42***	CRI*ESG	0.001	5.02***
BS	0.015	0.37	BS	0.929	2.05**
CAR	0.000	1.43	CAR	−0.001	−0.43
LTD	−0.004	−3.23***	LTD	−0.027	−2.36**
NII	−0.004	−2.88***	NII	−0.045	−3.46***
CONC	−0.003	−1.39	CONC	−0.052	−1.64
GDPG	0.038	15.40***	GDPG	0.132	4.37***
INF	−0.002	−1.84***	INF	0.007	0.44
DCTPS	0.003	2.14**	DCTPS	0.021	2.69***
GDS	0.001	0.90	GDS	0.108	7.78***
_cons	0.767	0.91	_cons	35.914	3.47***
AR (1)	−3.448			−1.6502	
Prob	0.0006			0.0989	
AR (2)	0.0857			1.0047	
Prob	0.9316			0.3151	
Sargan test	32.4685			34.2734	
Prob	1.0000			1.0000	

***, **, and * indicate the rejection of null hypothesis at 1%, 5% and10% significance levels, respectively

at the level of 1% for both ROA and ROE. This result is an indication that CSR enhances bank performance by enhancing reputation and customer and investor loyalty, boosting market share and revenue. Reputational and regulatory risks are at a minimum with CSR initiatives while building up stakeholder trust. It improves employee satisfaction and reduces labor turnover, hence improving productivity and reducing recruitment costs. A good CSR reputation also attracts socially responsible investors and ensures access to funds at the best terms. CSR drives market differentiation and enables innovation in sustainability-oriented products, like green loans, by emerging markets. All of these benefits put together contribute to strengthening long-term profitability and financial stability for banks. This result is in line with Purwanti et al. (2024). Therefore, we accept H2.

We discovered that an increase in climate risk considerably lowers bank performance, which is consistent with the findings shown in Table 6. This outcome is likewise verified for ROE and ROA. Nonetheless, results show that the degree of bank profitability is positively and significantly correlated with the interplay between climate risk and corporate social responsibility (CRI*CSR). This implies that corporate social responsibility, influenced by climate risks, can positively impact bank profitability. Corporate social responsibility can, therefore, moderate the climate risk-profitability nexus of banks by cushioning the negative shocks that may arise from climatic vagaries. Banks can strategically raise above-increased credit risks to borrowers in vulnerable sectors of the economy or market risks due to transition industries through certain CSR initiatives on sustainable finance. CSR practices, including the adoption of environmentally sustainable policies or financing green projects, would enhance the reputation of a bank and may attract socially responsible investors, hence cushioning the financial loss resulting from risks related to climate change. Besides, CSR activities promote resilience in the portfolio and diversification, therefore keeping a portfolio from heavy exposure to climate-sensitive sectors such as fossil fuels. It also allows access to new sources of revenues, such as green bonds or sustainable investments, improving profitability. In other words, CSR cushions and enhances the bank's resilience to weather adverse climate conditions and ensures long-term profitability by aligning business practices with global sustainability trends. This result is in line with An et al. (2023). Therefore, we accept H3.

Regarding the effects of bank-specific factors, industry characteristics, and macroeconomic conditions, there are no significant changes compared to the results presented in Table 6.

5. CONCLUSION

This paper seeks to examine whether CSR enhances bank profitability within the MENA region. Specifically, it explores the moderating role of CSR in the relationship between climate risk and bank profitability. Using empirical estimation through the System Generalized Method of Moments (SGMM), the study analyzes data from 40 conventional banks spanning the period 2010-2022. The findings reveal that, across the entire sample, climate risk exerts a negative impact on bank profitability. However, a greater commitment to CSR is shown to bolster profitability. Furthermore, the interaction between CSR and climate risk serves to further improve bank profitability in the MENA region.

The findings of this study carry important policy implications for both policymakers and bankers. Firstly, policymakers should enhance the regulation of climate risk and incentivize green finance initiatives. They are also urged to improve financial literacy on climate risks, support the transition to a low-carbon economy, and promote investment in climate-resilient infrastructure. Secondly, banks in the MENA region should focus on diversifying their investment portfolios, adopting robust CSR policies, promoting sustainable financing practices, integrating climate risk into their risk management frameworks. Finally, when combined, these actions would not only help mitigate the impacts of climate risk but also offer innovative approaches to sustainability, thereby safeguarding the long-term financial stability and profitability of local banks.

The following study has some limitations concerning the relationship between climate risk, bank profitability, and CSR in the MENA region. First, there may be limited availability and reliability of consistent, updated data on climate risk, CSR activities, and bank performance, which complicates comparisons. The diversity within the MENA region with regard to economic, political, and environmental factors may also limit the generalization of findings. Additionally, the focus on a short period might result in data that cannot capture the long-term effects of climate risk and CSR variables on profitability. The scope of CSR considered might not encompass all its dimensions, especially those concerning environmental sustainability. Lastly, exogenous factors could include political instability or an economic crisis that may affect bank performance and mask the impact of climate risk and CSR.

In this regard, future research on the subject should be directed to include other dimensions of corporate social responsibility. An increased sample size through the inclusion of Islamic banks would widen the scope of analysis to present a comparison between Islamic and conventional banks within the MENA region, entailing further details on the relationship between climate risk and performance, along with the moderating role of corporate social responsibility. Cross-country comparative studies could also provide details on how local factors, such as financial development and the regulatory environment, further modify the outcomes. The developments and implementations of global policies against climate change, along with recent changes in the financial sectors associated with technologies like Fintech and blockchain, taken into perspective toward improvements of climate risk management and CSR in regional economies, would also be extremely useful.

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