Does Bank Size Matter? Examining the Impact of Green Lending on Bank Performance

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Abstract

We develop a model to study the impact of green lending on banks' performance using data from the financial statements of 44 banks in Pakistan. To examine this, data is collected from State Bank of Pakistan and official websites of respective banks, timespan from 2017 to 2022. We investigate the impact of green lending (GL) on bank performance by using the Generalized Method of Moments (GMM). Results of the study found that larger banks may benefit more from sustainable initiatives, emphasizing both long-term benefits and potential costs of green finance. To do so, we use Bank size as moderator between green lending and bank performance. Non-Performing Loans and Spread Ratio are not found to substantially affect bank performance. The heterogeneity of bank performance in environmental finance reinforces in this study. It highlights the crucial role of green lending in large banks. Green financing could grow in Pakistan with institutional support. These findings provide key implications for financial institutions and legislators.

Keywords: *Pakistan Banking Sector, Bank Size, Green Lending (GL), Return on Assets (ROA), Return on Equity (ROE).*

1. INTRODUCTION

The growing risk of environmental damage and global warming have made transformation critical in numerous economic sectors. The financial services sector (Banking) is rapidly responding to these challenges and embracing the concept of sustainability (Purcarea & Radulescu, 2024). Intergovernmental Panel on Climate Change (IPCC) recommend that global temperatures have risen by 1.1°C since pre-industrial times (Ramesh, 2025). The constancy of extreme weather events, developing greenhouse gas emissions, and melting arctic ice are all contributing factors at a rate of 13.2% year (Chai et al., 2022). Junita, D. (2025) suggest that forest ecology can play a role in mitigating catastrophic events such as earthquakes and typhoons. This highlights how essential it is to implement green finance, an innovative strategy that integrates environmental and economic goals. Prior literature indicates that green finance aims to promote economic sustainability (Zhou et al., 2020). Green finance creates a balance between economic growth and environmental sustainability. This includes conserving natural resources and preserving the environment.

Sustainable finance could be considered a mechanism of financial strategies and investment methods that promote eco-friendly initiatives. The fundamental element of green finance is lending money to sustainable practices and serves as a stimulant catalyst for promoting sustainable economic growth (Jiang et al., 2020). It encourages innovation by supporting investments in renewable energy technologies & eco-friendly business practices. It can support creating new markets and promote long-term economic sustainability. Integrating green finance into their operations allows banks to become more resilient against

environmental and economic challenges (Hoang & Tuan, 2023). Moreover, it enables banks to meet international standards and attract foreign investment, which can improve their growth prospects and competitiveness. Banks could gain several advantages by aligning their financial operations with sustainable development goals and being able to reduce exposure to climate-related risks. This may also help to attain customer trust and foster loyalty (Hsieh et al., 2023). The Paris Agreement and the G20 commitments (Zhao et al., 2025) initiatives reflected the protection of environment. Eco-friendly agricultural practices can play a vital role in enhancing food security, optimize resource utilization, and support the growth of rural communities.

According to Aslam et al. (2021), Pakistan is one of the countries severally affected due to environmental degradation and have started to damage infrastructure, public health, reduce economic productivity, and lower overall prosperity. Financial institutions can help reduce these risks and maintain stable operations by adopting green financing strategies. Banks are at the forefront to create positive social and environmental change while pursuing financial growth through green lending. Financing sustainable agriculture, renewable energy, and green infrastructure projects can help tackle environmental issues. The banking sector could play an important role that fosters sustainable economic growth (Javed et al., 2025). The incorporation of green finance in developing countries like Pakistan banks makes more resilient to climate-related risks such as droughts and floods (Mumtaz & De Oliveira, 2023). By aligning their activities with environmentally friendly goals, banks can position themselves as leaders in the transition to a greener economy. This not only boosts their reputation among customers, investors, and regulators but also helps them stay competitive in the market. Banks can reduce vulnerabilities, meet international standards attracting foreign capital and opening new growth opportunities & ensure smoother operations by using these strategies.

This study contributes to the literature following ways: - State Bank of Pakistan encourages adoption of Green Banking (Green Banking Guidelines (GBG) through IH&SMEFD Circular No. 08 of 2017, dated October 09, 2017). Therefore, all the banks are constantly working on Green Banking. According to Jamal et al. (2020), bankers' willingness to adopt green banking is positively affected by central bank policy and regulation requirements. Although adoption goals are commendable, have they resulted in more loans and greater profitability? We still do not fully understand whether socially conscious investing affects bank performance (Mishra et al., 2023). Prior research indicates that when a green credit business scale grows, the significance of green lending's effects on productivity and even the banking industry's ability to compete will increase. Vietnam, Bangladesh and China were among the first countries in Asia to implement green credit facilitation and environment risk management principles in their lending operations. The lack of empirical evidence in the developing economies of the impact of green lending on bank performance is still scarce. This study investigates relationship between bank performance and green lending in the context of Pakistan. Secondly, there is a noteworthy correlation between the financial performance of commercial banks and the size of the company (Maila & Sichoongwe, 2024). To support sustainability activities, they can use their economies of scale, recruit qualified personnel, and invest in R&D (Aldier & Vinci, 2018). This study explores the key role of a moderator (bank size) that influences the relationship between green lending and bank performance. The growth of sustainable banking practices across different types of financial institutions can encourage more support & inclusive participation. However, smaller banks face operational difficulties and limited resources prevent them from engaging in a green lending activity (Putri and Putri, 2025). Green finance initiatives suggest ways to enhance the capacity of various stakeholders, including smaller banks.

2. AGENCY THEORY

Agency theory explains the principle-agent relationship which exists between the shareholders and managers (Jensen & Meckling, 2019). This theory investigates how manager's decision affects shareholder wealth. Effective management tools like monitoring and performance inducement can ensure managers' actions align with shareholders, making sure green lending efforts improve the bank's overall performance (Siddik and Shari, 2024). Sometime, managers might focus on short-term financial achievements rather than the long-term sustainability of the bank, which can lead to conflicts of interest especially when it comes to green lending decisions (Al-Ajmi et al.,2023). Larger banks have complex structures often face higher agency costs but usually have better resources to manage risks and oversee operations (Ononiwu et al., 2024). Conversely, smaller banks might lack the financial strength to fully engage in green lending initiatives (Belova et al., 2023) and have fewer conflicts of interest. Sustainable lending can boost a bank's reputation and strengthen its financial stability (Zeidan, 2025) by increasing transparency and reducing agency costs. Generally, effectively managed green finance practices can advantage both the bank's long-term success and its credibility in the community.

2.1. Stake Holder Theory

Stakeholders refer to those individuals, groups, or organizations that are likely to influence, or be influenced by the operations and decision of firm. The concept of this theory introduced by Freeman & Velamuri, (2023), which advocates that companies should focus on interests of all stakeholders including employees, customers, regulators, and the community instead of maximizing solely shareholder value. Green lending can be a powerful way for banks to demonstrate corporate social responsibility (CSR) and enhance their reputation (Javeed et al., 2022) by creating value for everyone involved. Banks can maintain strong relationships with these stakeholders by prioritizing long-term growth and environmental sustainability (Kılıç & Kuzey, 2022) as people become more concerned about environmental issues. This innovative strategy aligns well with Stakeholder Theory for a wider group of interested parties, such as government regulators, environmental advocates, and society because it expands a bank's responsibility. Larger banks have more resources and stronger risk management systems Stulz, R. M. (2022) and are often better equipped to incorporate green lending into their practices which can improve a bank's performance by reducing financial risks associated with industries that are not sustainable (Lian et al., 2022) & attracting environmentally conscious clients. Involving in sustainable banking also raises investor confidence, lowers funding costs, and helps banks position themselves as forward-thinking players & responsible in the market (Panagopoulos & Tzionas, 2023).

3. LITERATURE REVIEW

Green lending has become increasingly important in recent years as financial institutions work to align their activities with sustainability goals (Chai et al., 2022). As financial intermediaries for allowing innovative finance and environmental initiatives, banks play a crucial role. Studies reveal that banks may help to improve the environment. Banks are in a unique position to promote a protective green culture on Earth (Bukhari et al.,2020). Banks lend money to clients who operate more sustainably and are less prone to suffer loan losses (Chen & Anwar, 2024). Ozili (2022) claim that the idea of green loans illustrates how the financial industry may adapt to worldwide environmental and social issues. In the context of

green banking, green loans are among the most popular products, and their continued existence is vital to all market participants. Banks that provide green loans help their more ecologically aware individual and business clients fund and finish their initiatives. When several significant American banks, including Wells Fargo and the Bank of America, committed capital to the sustainable sector in 2005, green lending got underway notion (Iddrisu et al.,2025). China is the fastest-growing market for green loans (Lei et al., 2021), with the United States, United Kingdom, Australia, France, Japan, and China having approved the largest overall amount of these loans, according to a country-by-country analysis (Gong et al., 2023). Thus, the discipline of green finance gave rise to the concept of green loans. Jin et al., (2021), where banks provide loans preference to businesses that use more environmentally friendly and efficient production techniques. Green loans improve economic performance and lessen pollution (Koval et al., 2022). However, enterprises must meet the strict standards of the green loans to receive additional capital (Chai et al., 2022). Additionally, green loans protect the capital structures of small firms against unanticipated costs (Barre et al., 2024). Furthermore, these loans support the rise of green ideas for major enterprises with little financial restraints (Huang et al., 2022). Bank loans support individual consumers and may be designed as green loans to improve a home's energy efficiency.

In fact, studies around the world indicate that banks are increasingly considering environmental factors when deciding who to lend money to (Siwela & Ngwakwe, 2024). Overall performance and long-term sustainability of bank (Yin et al., 2025) can increase by Growing the share of green loans which are responsible for making money and managing risks, particularly loan losses (Gu et al., 2023). Research shows that environmentally conscious borrowers often fall into this category and tend to favor borrowers who are less risky. Sometimes banks contributing to environmental degradation) and have a direct and indirect impact on environmental health (Ahmad et al., 2024).

Green loans have advantages for the environment as well as for the performance and operations of banks. Banks can increase liquidity and profitability by implementing equator principles and environmental practices in their operations (Song et al., 2019). Long-term profitability as well as improved product and service quality in banks are made possible by increased environmental consciousness (Gao et al., 2022). A more sustainable economy has significant influence in driving the shift toward a greener because banks contribute a lot of money to the economy (Cui et al., 2020). Financial Institutions must be given more authority to promote ecological issues with public and governmental backing while a greater tendency towards green lending is associated with reduced profitability (Tiwari et al., 2024). Banks can tackle environmental issues while also improving their own performance by giving financial support for environmentally friendly businesses & green initiatives. They can enjoy benefits like higher profits and increased financial stability by integrating their lending practices with sustainability goals also supporting a more sustainable future.

Numerous studies have explored how green lending relates to bank performance, but the results can vary depending on factors like regulations, economic environment and individual bank characteristics. Correlation between green lending and bank performance also relies on how advanced a country is in its eco-friendly initiatives. Ullah et al. (2019) refer that there's a positive and significant relationship when banks grow and perform well. Green lending practices can significantly improve a bank's performance (Badrous et al., 2025). Data from Pakistani's banks between 2017 and 2022 shows that the positive impact of green lending on financial performance becomes stronger in countries with higher levels of green development

(Zhang et al, 2022). These commercial banks follow the guidelines set by the State Bank of Pakistan is becoming more prominent for green banking. Various banks now conduct environmental assessments before giving out loans (Majeed & Rasheed, 2024). Sustainable finance offers new opportunities for banks to boost profits through supports sustainability & innovative lending approaches. In Pakistan studies indicate that green lending can positively influence bank performance, especially when supported by government policies and regulations. Growing green credit can reduce credit risks and strengthen the overall stability of banks (Feng et al., 2024).

Research from China shows that green credit has a positive effect on bank performance (Fata & Arifin, 2024). Emphasize how government policies play a fundamental role in encouraging banks to adopt green finance practices. In developing countries, understanding how green lending affects bank performance is especially important. Umar et al. (2021) discovered that bigger banks got benefit from economies of scale, which support them earn better spreads. Agoraki et al., (2010) looked at Greek banks and found that larger banks tend to be more efficient. Identical results have been reported in Europe, where found that medium-sized and large banks tend to be more efficient in managing costs (Marwa & Aziakpono, 2016). Furthermore, Nodeh et al. (2016) investigated how bank size influences the relationship between a bank's board structure and its financial performance. Their research indicates that larger banks often have a stronger positive effect on how green lending impacts overall financial results. Countries with limited financial deepening, the quality of the banking system (financial inclusion and bank competition) may be as important in promoting firm performance as its overall size (Boachie et al.,2023).

However, Banks that focus more on green investments sometimes see lower profits because green projects can be costly and take longer to pay off. Billio et al. (2024) warned that investing too heavily in environmental initiatives might deplete financial resources and pose risks to stability. Some studies in Nawaiseh, (2015), found that when banks disclose environmental issues, it doesn't necessarily increase their financial performance. China has quickly embraced strong policy framework for successfully integrating green initiatives into banking operations as well as to tackle environmental problems. Green lending doesn't have a significant impact on bank profitability and its outcomes can vary depending on a country's economic system and regulations (Andaiyani et al., 2023) in Indonesia. They imply that sharing environmental information can be costly, which might reduce the bank's profits. Hrazdil et al. (2024) argue that green lending's impact on profitability is not solely determined by bank size but also by institutional commitment to sustainability. Given that developing economies often lack robust green performance metrics, banks struggle to assess borrowers' sustainability practices effectively. Moreover, the size of a bank matters. Larger banks tend to have more resources, which allows them to develop comprehensive green lending programs and better manage environmental risks (Mangwa & Jagongo, 2022).

3.1. Hypothesis

The performance and sustainability of the bank can be enhanced by increasing the proportion of green lending (Yin et al., 2021). There is proof that banks have a direct and indirect role in the deterioration of the environment (Bukhari et al., 2020). International banks are now incentivized to provide environmentally and socially sustainable services (Hanganu, A. C. 2023). To determine the connection between green finance and financial performance, (Chinavicharana et al., 2024) looked through the literature. Although they came to differing conclusions, most of them indicated that the environment had a beneficial effect on financial

performance. Some studies did not find significant correlation between green finance and firm performance (Halimi et al., 2022). Government policy and support play a critical role in green financing initiatives. Different findings from an Indonesian study (Setiawan et al., 2021) suggest that green credit has no appreciable effect on the profitability of banks. Financial performance is negatively impacted by green financing (Ulwiyah et al., 2023). Eco-friendly loan distribution strategies negatively affect bank profitability and have little effect on return on assets (ROA) (Sarker et al., 2025). Most bank performance studies have measured performance through the ROA (Islam & Sufian, 2019).

According to Viverita (2024), environmentally friendly credit distribution methods negatively affect bank financial performance. By focusing on the environment and long-term sustainable growth, banks can preserve ties with their stakeholders and address their growing concerns about environmental challenges (Kılıç & Kuzey, 2019). Growth and bank performance have a positive and significant relationship, according to research by (Ullah et al., 2019). Green lending methods significantly improve bank performance, according to (Deb et al., 2020). This is consistent with (Indriastuti & Mutamimah, 2023) assertion that a company's financial performance benefits from the use of green accounting, as it enhances positive consumer perceptions. Green credit borrowers need high upfront expenditures, such the initial price of green technology installment loans (Xie & Lin, 2025). As a result, it may lower bank operating income, which could harm the bank's financial performance. According to earlier studies, banks' financial performance is negatively impacted by green credit (Galan & Tan, 2024). Due to pressure from stakeholders to take environmental balance into account in every business decision, banks can fulfill their obligations and uphold their relationships with them by issuing green credit. This will gain the trust and support of stakeholders and increase the profitability of the bank (Zhang, 2025).

Green lending has several financial issues. The higher borrowing cost is one of the main problems. Green projects can be highly costly due to the high upfront costs associated with them and the high interest rates associated with loans. It becomes more difficult for people and businesses to afford the funds they require for these projects if interest rates are high. Given its substantial beneficial effects on the economic environment, political stability is seen as a necessary condition for a nation's sustainable growth (Masry, 2015). In addition to reducing uncertainty, which encourages increased investment and the nation's economic growth, Political stability is crucial for maintaining community stability and confidence in the government (Singh & Sharma, 2022). The danger of green loans is another issue from a financial standpoint. Numerous green initiatives are creative and use novel methods or technologies. Because of this, lenders may be put off by them being riskier than more conventional investments. Projects that investors and banks perceive as unpredictable or unlikely to yield rapid returns may cause them to hesitate to offer funding. Notwithstanding the significant environmental advantages that green lending provides, it finds it difficult to get traction due to these financial issues. Pakistan's economic growth rate is adversely impacted by political unpredictability (Mehmood et al., 2021; Akhtar and Malik, 2024). Abbas et al. (2023) claim that Pakistan's political unpredictability has been an unpleasant reality for the past many decades and has slowed the nation's rate of economic progress. It is also clear that Pakistan's economic growth rate has always been high under dictatorships and low under political regimes (Hossain, 2024).

H1: Green lending is negatively related with bank performance in Pakistan

Compared to smaller banks, larger banks usually have more financial resources, knowledge, and market reach (Muhindi & Ngaba, 2018). This makes it possible for them to make larger investments in green lending and other sustainable finance efforts, which may have a greater beneficial effect on performance measures. Large banks have a network of multiple stakeholders in comparison to small banks. According to stakeholder theory, involving stakeholders in decision-making processes can result in cost savings, a positive environmental impact, less environmental uncertainty, and enhanced bank performance (Ontita et al., 2020). Firm size is an important element that influences bank performance. Large-scale businesses can be classified as having a firm size based on their total assets, or large assets, as determined by calculating the total asset logarithm value (Kirimi et al., 2022). Wang et al. (2021) measured the performance of Chinese banks through asset growth research.

The profitability performance of a commercial bank is more heavily influenced by its size than by other factors. One metric used to gauge a company's profitability is its bank size. Tharu & Shrestha, (2019) suggested that size is a key factor in determining a company's profitability. Numerous studies examining the relationship between these two come to the conclusion that size can have either a beneficial or negative impact on profitability (Dalci et al., 2019). Due to the nature of green credit borrowers and the lengthy profit-generating process involved in the distribution of green credit, major banks are therefore more likely to experience cost constraints from the issuing of green credit (Trkanjec, 2024). Ishtiaq et al. (2024) research elucidate the positive and noteworthy impact of company size on financial performance. Big banks are thought to be more equipped to handle sustainability projects because they have defined goals and procedures for keeping an eye on their operations (Chytis et al., 2024).

According to Buallay et al. (2021), a large bank may be able to better respond to stakeholder demand, which improves the bank's financial performance. Bank size strengthens the relationship between green credit and bank financial performance (Fukuyama & Tan, 2022). Studies also found a strong positive correlation between green financing and company performance (Taneja & Özen, 2023). Based on the above arguments we propose the following:

H2: The relationship between green lending and bank performance is favorably moderated by bank size

4. METHODOLOGY

4.1 Data Collection

Data is collected from all public & private banks listed on State Bank of Pakistan website from year 2017 to 2022. All five public sector banks provide financing for green projects. Only One of the four special banks offers loans for Green Project. Eleven of the twenty domestic banks provide loans to finance green projects. Green Project is not offered by any of the four foreign banks. Furthermore, only one of the eleven microfinance banks provides loans for Green Project. We used annual data (income statement, balance sheet, and annual report) from the State Bank of Pakistan website for empirical investigation.

4.2. Variable Measurement

4.2.1 Dependent variables

The company's financial performance is measured through accounting-based methods. The methodologies used in this study are valid and reputable sources of information obtained from financial statements. As a result of this, they can be dependent upon assessing a company's

profitability and how its share price performs. Return on Equity (ROE) and Return on Assets (ROA) are common techniques to measure a company's financial performance. ROA exhibits how profitable a company is relative to its total assets and computed by dividing the company's net income by its average total assets, providing an idea of how efficiently the company uses its assets to generate profit (Choiriyah et al., 2020). However, ROE calculates how much profit a company makes for its shareholders & is computed by dividing net income by shareholders' equity and it is useful indicator of a company's profitability and how effectively it turns investments into profits (Affandi et al., 2019).

For evaluating a company's overall financial health (Shaverdi et al., 2016) accounting-based methods are used which are most appropriate. This study depicts financial performance as the main variable that we aim to explain. Studies indicated that a classical indicator for the evaluation of Banks' performance is the Return on Assets (ROA) is used for financial performance (Kumar & Sharma, 2023).

4.2.2 Independent variables

Green Lending environmental elements would be included as independent variables in this study. The independent variables are a representation of Pakistani banks' sustainable investing practices, demonstrating their dedication to social responsibility, environmental conservation, and robust governance structures. such as paper and printing expenses, and energy use, such as gasoline prices, are examples of environmental indicators that are related to the natural environment. Green finance / Green Lending (GL) is defined as the core explanatory in this study.

Green credit is the most important part of green finance. However, since green financial products are diversified, green credit is not the sole indicator to measure green finance. Based on the research of Cusano et al. (2024), green credit refers to funding environmentally friendly projects. It entails making loans or providing funding for initiatives meant to preserve or lessen damage to the environment. Green credit can be measured in different ways.

The ratio of green credit to total loans comes first. This ratio is calculated by dividing the total amount invested over a given time by the amount of money allocated to green projects. The second approach is banks assign 1 to a dummy variable if they take the environment into account when making decisions about green lending; otherwise, they assign 0 (Suhrab et al., 2024). Due to the non-availability of green lending data from the financial statements of banks, we used a dummy variable to measure Green Financing.

4.2.3 Moderating Variable

Bank size is measured by taking of log of total assets, an accurate measure of a Bank's size is its total asset value. For this reason, the logarithm of total assets is frequently used as a proxy for firm size (Rahman et al., 2023)

4.2.4 Control variables

Green finance is not the only factor influencing corporate performance. Following the prior literature (Zhu et al., 2024), we include the following control variables, Non-Performing Loans to Gross Advances (NPLGA), Spread Ratio (SR), Total Liabilities to Total Assets (TLTA), Liquidity Ratio (LIQ), Cost to Income Ratio (CIR).

Table I: Variable Measurement

Sr. No	Variable Type		Description	Source
1	Dependent variables	i. Return Assets (ROA)	Return on assets is the ratio firm net income and by average of total assets. ROA tells how profitable a firm is in connection to its total assets.	(Choiriyah et al., 2020).
		ii. Return on equity (ROE)	Return on equity is the ratio of a company's net income and its shareholders' equity. ROE is a measuring scale of a firm profitability and how efficiently it makes profits.	(Affandi et al., 2019).
2	Independent variables	Green Lending (GL)	Green lending is the practice of making financial loans according to the environmental standards for which the borrower intends to use the funds. Such lending seeks to support businesses at every stage of development, from start-ups to well-known international corporations, by helping them lay the groundwork for sustainable initiatives and operations.	(Cusano et al., 2024)
3	Moderating Variable	Bank size	Bank size is measured by taking of log of total assets, an accurate measure of a Bank's size is its total asset value. For this reason, the logarithm of total assets is frequently used as a proxy for firm size.	(Rahman et al., 2023)
4	Control variables	i). Non-Performing Loans to Gross Advances (NPLGA)	The ratio of non-performing loans to gross advances represents the proportion of a bank's total loan portfolio that is considered non-performing. It the total value of non-performing loans divided by the total value of all loans outstanding.	(Chun et al., 2024).
		ii). Spread Ratio (SR)	A ratio spread is a nuanced options trading strategy that falls under the category of neutral strategies. This approach involves an investor holding an unequal number of long and short (written) options. The name "ratio" is derived from the specific proportion between short and long positions.	(Sinclair, 2020).
		iii). Liquidity Ratio. (LIQ)	A class of financial metrics used to determine a debtor's ability to pay off current debt obligations without raising external capital.	(Lisa, 2016)
		iv). Cost Income Ratio. (CIR)	The cost-to-income ratio is one of the efficiency ratios used in financial management through the relationship between the cost and income of an entity. It is used to evaluate a company's performance, and the fundamental role is to validate the profitability of the company.	(Ayinuola & Gumel, 2023)

4.3. Model

$$BP_{it} = \beta_0 + \beta_1 GL + \beta_2 BS_{it} + \beta_3 (GL * BS)_{it} + \beta_4 NPLGA + \beta_5 SR_{it} + \beta_6 TLTA_{it} + \beta_7 LIQ_{it} + \beta_8 CIR_{it} + error$$

BP = return on asset (ROA)

BP= return on equity (ROE)

GL = Green Lending

BS= size of the assets

NPLGA= non-performing loan to gross advances

SR =   Spread Ratio

TLTA= Total Assets to Total Liability Ratio

LIQ = Current assets/current liabilities

CIR= Cost Income Ratio

β = regression coefficient of the explanatory variable

i = ith Banks

t = tth specific year

4.4. Generalized Method of Moments

We use the Generalized Method of Moments (GMM) technique which is very helpful when working with panel data that may include problems like endogeneity, autocorrelation, and heteroskedasticity (Arayssi & Jizi, 2024). This gnerates accurate and efficient parameter estimates by using moment conditions that are derived from the data (Ullah et al., 2023). Without making rigid assumptions about the distribution of the error terms. Amadi et al. (2024) use of the Generalized Method of Moments (GMM) estimator is particularly suitable for this study. A straightforward GMM model is used for analyzing the impact of green lending on bank performance also weighing the moderating effect of bank size. Generations of robust results and accounts for any endogeneity provide a solid framework through these methods. Bank performance & green lending operations may be influenced by unobserved factors at the same time or may affect one another overtime.

Panel dataset comprises multiple banks observed over several years, individual bank attributes may introduce dynamic correlations and omitted variable bias. Findings from fixed/random effects models or traditional Ordinary Least Squares (OLS) may be biased by giving these situations. GMM is selected because it effectively manages the data's dynamic character, accounts for endogeneity, and considers unobserved heterogeneity. This assurance that the outcomes are trustworthy and dependable for managerial policy decisions and correlation between green lending, bank size, and bank performance is precisely recorded.

5. RESULTS

5.1 Descriptive Statistics

Table II shows the descriptive statistics for the study variables. The main dependent variables, Return on Assets (ROA) and Return on Equity (ROE), have mean values of 0.001 and -0.04, respectively, indicating that on average, banks achieved low profitability during the study period. The independent variable, Green Lending (GL), shows a mean value of 0.41, suggesting that approximately 41% of the banks' portfolios are associated with green lending activities. The moderating variable, Bank Size (measured by the natural logarithm of total assets), has a mean value of 18.85, indicating considerable variation in bank sizes across the sample. These statistics are aligned with the study's hypotheses, where Green Lending is expected to influence Bank Performance, and Bank Size is hypothesized to moderate this relationship.

Table II: Descriptive Statistics

	Banks Performance (ROA)	Banks Performance (ROE)	Green Lending (GL)	Bank Size (BS)	Non-Performing Loans to Gross Advances (NPLGA)	Spread Ratio (SR)	Total Liabilities to Total Assets (TLTA)	Liquidity Ratio (LIQ)	Cost to Income Ratio (CIR)
Mean	0.001	-0.04	0.41	18.85	0.13	0.47	1.02	2.23	2.08
Median	.008	0.11	-	19.16	0.06	0.48	0.92	0.77	0.78
Maximum	0.05	19.49	1.00	22.38	1.00	1.00	7.05	3.66	3.49
Minimum	-0.27	-9.78	-	13.60	-	-0.61	0.01	0.08	-8.43
Std. Dev.	0.04	3.34	0.49	2.00	0.20	0.25	0.94	9.64	4.40

5.2. Correlation Analysis

Table III shows the results of the correlation analysis among the key variables. The correlation between ROA and Green Lending is positive ($r = 0.147$), indicating that an increase in green lending is associated with improved bank profitability.

Similarly, ROE also shows a positive, though weaker, correlation with Green Lending ($r = 0.039$). Bank Size is positively correlated with both ROA ($r = 0.195$) and Green Lending ($r = 0.573$), supporting the moderating hypothesis that larger banks may better leverage green lending practices.

Notably, Non-Performing Loans to Gross Advances (NPLGA) show a negative relationship with ROA and ROE, implying that higher loan defaults adversely impact bank performance. Overall, the correlation results are consistent with the hypothesized relationships and provide initial support for further regression analysis.

Table III: Correlations Analysis

	Banks Performance (ROA)	Banks Performance (ROE)	Green Lending (GL)	Bank Size (BS)	Non-Performing Loans to Gross Advances (NPLGA)	Spread Ratio (SR)	Total Liabilities to Total Assets (TLTA)	Liquidity Ratio (LIQ	Cost to Income Ratio (CIR)
Banks Performance (ROA)	1								
Banks Performance (ROE)	0.069	1							
Green Lending (GL)	0.147	0.039	1						
Bank Size (BS)	0.195	0.007	0.573	1					
Non-Performing Loans to Gross Advances (NPLGA)	-0.174	-0.088	-0.138	-0.288	1				
Spread Ratio (SR)	0.317	0.024	-0.160	-0.365	-0.159	1			
Total Liabilities to Total Assets (TLTA)	0.168	0.001	-0.087	-0.181	0.702	0.144	1		
Liquidity Ratio (LIQ	0.011	0.003	-0.135	-0.245	-0.071	0.147	-0.092	1	
Cost to Income Ratio (CIR)	-0.056	0.012	-0.072	-0.084	-0.054	-0.123	-0.026	0.048	1

5.3. Generalized Method of Moment (GMM)

We use Generalized Method of Moments (GMM) technique which is very helpful when working with panel data that may include problems like endogeneity, autocorrelation, and heteroskedasticity (Ali et al., 2018). Without making rigid assumptions about the distribution of the error terms, GMM generates accurate and efficient parameter estimates by using moment conditions that are derived from the data (Ullah & Jadoon, 2024).

We explore how green lending impacts bank performance using a simple GMM (Generalized Method of Moments) model and also look at how the size of the bank might influence this relationship. This is a reliable method because it helps us account for potential issues like endogeneity-situations where factors that we haven't observed could be affecting both green lending and bank performance. Our results are more accurate and trustworthy by utilizing this technique. It's viable that factors could be influencing both green lending activities and how well banks perform haven't been measured directly. This method provides clearer insights for handling these problems.

Demiraj et al. (2024) advocate that Generalized Method of Moments (GMM) estimator is suitable for our study. Since our data includes multiple banks observed over several years, it can create complex relationships and lead to omitted variables that we didn't measure. Individual differences between banks like unique characteristics prevail in this study. In these circumstances, traditional methods such as fixed or random effects models, or ordinary least squares (OLS), might give misleading or biased results. GMM is more appropriate because it effectively handles the accounts for potential endogeneity & dynamic nature of the data. This considers unobserved factors that differ between banks.

We confirm that we accurately capture the relationship between green lending, bank size, and bank performance by using GMM. These results provide valuable insights for managers and policymakers making important decisions because these are reliable and trustworthy.

Table IV: Generalized Method of Moment (GMM)

Dependent Variable: ROA		
Variable	**Coefficient**	**Std. Error**
C	7.832	4.054
Green Lending (GL)	-3.924***	3.150
Bank Size (BS)	0.725***	0.246
Bank Size (BS)* Green Lending (GL) (BS*GL)	2.000***	0.757
Non-Performing Loans to Gross Advances (NPLGA)	-0.026	0.125
Spread Ratio (SR)	-0.042	0.630
Total Liabilities to Total Assets (TLTA)	1.073***	0.375
Liquidity Ratio (LIQ)	-0.036	0.201
Cost to Income Ratio (CIR)	-2.819***	0.630
J-statistic	0.578	
Prob(J-statistic)	0.447	

These results depict that larger banks tend to have higher returns on assets (ROA), with a positive and significant coefficient of 0.725. This argues that larger banks can spread out their operational costs more effectively, which increase their profitability through economies of scale. These findings found that larger banks are generally more efficient and better at managing costs is consistent with earlier studies by (Berger et al., 2021)

We also seemed at how bank size interacts with green lending. Bank Size and Green Lending (BS*GL) is significant and positive relationship, with a coefficient of 2.000. This shows that bigger banks are better equipped, helping to lessen any negative impact on their profitability and handle the financial challenges that come with green lending. Essentially, bigger banks have more resources and capabilities to successfully incorporate green finance into their operations. Geen financial initiatives is effectively implementing in scale matter (Abd-Mutalib et al., 2023).

Shifting to return on equity (ROE), the constant term is positive at 6.619 but not statistically significant, meaning other factors in the model are more important in explaining variations in ROE. The coefficient for green lending (GL) is -2.992 and is significant at the 10% level. This suggests that higher levels of green lending may reduce ROE, likely because green initiatives often involve upfront costs and initial financial strain, which can temporarily cut into short-term profits. This aligns with research by (Benlemlih & Cai., 2020), who noted that while green lending aligns with sustainability goals, the associated costs can offset gains, especially early on. Regarding the bank size effect on ROE, larger banks again performed better, with a positive and significant coefficient of 4.984. This result is compatible with earlier research that emphasized the importance of size in maintaining profitability. This reflects that larger banks can better manage expenses and benefit from economies of scale even when investing in green initiatives also maintain strong profitability.

Lastly, In the ROE model the interaction between bank size and green lending is significant & quite large with a coefficient of 13.836. This recomend that larger banks have greater resources and capacity to absorb costs, especially effective at offsetting the potential downsides of green lending. Similarly, Lee and Hong (2021) support the idea that scale plays a vital role in successfully adopting green finance.

Table V: Generalized Method of Moment (GMM)

Dependent Variable: ROE		
Variable	Coefficient	Std. Error
C	6.619	50.430
Green Lending (GL)	-2.992*	168.489
Bank Size (BS)	4.984*	2.877
Bank Size (BS)* Green Lending (GL) (BS*GL)	13.836*	8.560
Non-Performing Loans to Gross Advances (NPLGA)	0.613	0.896
Spread Ratio (SR)	-6.303*	3.347
Total Liabilities to Total Assets (TLTA)	-1.428	2.757
Liquidity Ratio (LIQ)	0.423	1.027
Cost to Income Ratio (CIR)	-4.035	2.980
J-statistic	0.010	
Prob(J-statistic)	0.920	

6. DISCUSSION AND CONCLUSION

This study focus on how green lending affects the performance of banks in Pakistan, specifically considering how the size of the bank effect this relationship. Bank size plays a crucial role in this relationship and makes contributions for financial institutions. Bigger banks seem better equipped with green projects to handle the costs associated with matters. We establish that the positive link between bank size and green lending has greater resources and

achieve economies of scale because larger banks can absorb costs more easily. Particularly in an emerging economy like Pakistan. This discrimination we have gained highlights the challenges and opportunities banks face when trying to adopt eco-friendly financing. Banks might experience short-term financial pressures because green projects often come with higher risk and costs. Banks face financial burdens in the initial stages of green lending findings are in line with previous research (Park & Kim, 2020) and allows them to follow eco-friendly initiatives without severely damaging their profits.

This indicates that green lending tends to reduce profitability in terms of ROA and ROE. Although smaller banks could limit their ability to participate in environmentally sustainable financing and may strive with the financial strain of green lending. In Pakistan larger banks can leverage their resources to support green finance also imply they could play a dominant role in promoting sustainable finance as emphasized by (Cheung & Hong, 2021), mostly in Asian markets. Larger banks are generally better at managing costs and risks (Berger et al., 2021). Since that green lending appears to negatively impact profitability, specifically for smaller banks, Regulators like the State Bank of Pakistan (SBP) could consider offering incentives such as tax breaks, subsidies or other forms of assistance to encourage more banks to engage in green finance. Central banks have a significant role in promoting green finance, but additional support mechanisms are likely needed to ensure smaller banks aren't left behind.

6.1. Implications

This model evolved offers important insights into how financial innovation can influence the relation between green finance activities & environmental performance. Green banking practices can enhance both environmental efforts and overall sustainability in industry also provide guidelines for decision-makers. indicating how to combine innovative financial instruments. The practical takeaways from this study are relevant for investors, policymakers, and banks alike

Such as increasing green loans credit and adopting prudent strategies for funding environmental-friendly projects, banks have already made significant progress in supporting green finance. Especially in the early stages of green projects predicting the risk of loans turning non-performing remains difficult. To manage these uncertainties banks often need extra guarantees or support. Targeted incentives are crucial to motivate banks for sustainability. By providing the specific support of government, especially to smaller banks, it can help these institutions get more involved in green finance. This not only gets benefits from a broader economy and society but also strengthens their performance.

When more firms have access to financing, they're more likely to adopt eco-friendly methods supporting smaller banks engage more actively in green lending can spark a wider move toward cleaner, more CSR business practices. Promoting renewable energy and other green initiatives is essential for meeting global sustainability goals, especially given the rising emissions from emerging economies. By enabling banks to support these transitions, the financial system can play a key role in advancing environmental sustainability and creating a better future for all.

6.2. Limitations and Future Research Direction

While this study offers some useful insights, it also has a few limitations. First, since the research only looked at banks in Pakistan, it's hard to say whether the findings apply to other countries with different financial systems, rules, and economic conditions. Future studies could investigate other developing countries to see if the link between green lending and bank

performance holds elsewhere. Another point is that we didn't have detailed data on green loans from the Pakistani banks' annual reports. Because of that, we had to use a simple indicator in our model, which might not fully capture the complexity and variety of green lending practices. Having more specific information about different types of green loans and the sectors they serve could give us a clearer understanding of how these loans impact bank profitability.

The study's short timeframe is also a limitation. Green projects often take years to show benefits, so the short-term financial pressures we observed might turn into improved profits over time as banks and markets get more comfortable with sustainable finance. Additionally, the research mainly relied on quantitative data numbers and statistics which are helpful but might miss some important environmental or social factors that influence how well banks perform. Using qualitative methods, like interviews or case studies, in future research could provide richer insights into how green lending truly supports sustainability goals. Since the study focused specifically on Pakistan, its findings might not be relevant for countries with different regulations or banking practices around green finance. Looking ahead, future research should examine how policymakers can create incentives, especially for smaller banks to encourage more green financing. This can help support economic growth and tackle climate issues in countries like Pakistan.

Sustainable practices can improve competitiveness, financial stability, profits over time and study the long-term effects of green finance on bank performance. Specific types of green loans like renewable energy or energy efficiency, help investors understand their financial and environmental benefits better. Initial challenges of green lending eventually led to positive outcomes once banks adapt their strategies can determine in long-term studies. Analogy of different countries can reveal regulatory approaches & best practices that developing markets might adopt. In addition, understanding how accessible green finance is for small and medium-sized businesses could show how it helps sustainable economic growth.

Finally, qualitative research like talking to industry experts, regulators and policymakers can disclose the real challenges and opportunities in promoting green finance. While ensuring financial health and stability It's important to evaluate how government policies and regulations can best support sustainable banking.

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