



The Implications of Green Finance on Credit Risk in Banking Sector of Pakistan

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Abstract: In 21st century the environmental change has turned into a significant issue for organizations as well as investors. Thus, to lessen fossil fuel byproduct, monetary establishments offer green funding to organizations to manage the issue of environmental change. But the real question is how much the risk of financial institutions, especially banks, is impacted by the availability of green financing. Examining how green finance affects Pakistani banks' credit risk is the goal of this study. The study has employed a panel dataset that encompasses green finance data from 2014 to 2020. The findings showed that the credit risk of the banks is significantly impacted by green finance proxies overall. The study's conclusions could have a real-world impact on bank managers, regulators, and lawmakers who want to create green finance laws that will help banks lower their exposure to credit risk. This study fills a gap in the literature on green financing, especially for poor nations, and adds empirical evidence to support its findings.

Keywords: Banks, Credit risk, Green finance.

1. Introduction

The people, infrastructure, and economy of Pakistan have faced serious difficulties as a result of catastrophic weather events over the past several years. Pakistan has seen the environment's fury on several occasions, from dreadful earthquake to terrible floods and recurrent droughts, which have put its ability to adapt and respond appropriately to the elements to the test. These catastrophes highlight the critical need for effective disaster planning and mitigation techniques since they not only cause right away as well as widen the socioeconomic disparities presently prevalent. "Unexpected urban and sudden floodwaters, landslide, with unusually heavy monsoon rains are occurring in Pakistan at a rate that is 10 to 15 times greater than usual (Hussain, M. A., et al., 2023). It is challenging to get a complete view of the disaster's magnitude because several impacted locations are still unreachable because of flooded and destroyed transportation systems. Over 1500 people perished, and over 35 million were impacted, altogether (Otto, F. E., et al., 2023). According to experts, Pakistan has seen variable weather as a consequence of climate change, and rivers are swelling as a result of glaciers melting (Mumtaz, H., et al., 2023).

The amount of CO₂ in the atmosphere has been gradually increasing (Raza, M. Y., & Dongsheng, L. I. 2023). The very first instance that CO₂ levels in the air surpassed 400 PPM was in 2016, and according to estimates, they will rise to a level of 500-1000 PPM in coming decade (Lee, H., et al., 2023). Governments, intergovernmental organizations, and companies from all over the world have taken notice of this issue, which has sparked a surge in

interest in green initiatives. Based on the project conduct itself, which is categorized in financial sets of data as "use of funds," it is feasible to determine whether a project is green (Petrov, M. V., et al., 2023). In the larger framework of environmentally responsible development, the major projects should contribute to the environment. Cutbacks in carbon dioxide (GHG) emission, the use of clean energy sources instead of conventional fossil fuel-based resources, including efficient use of energy while exploiting the natural resources that exist are a few examples of these eco - friendly materials

Banking firms typically are more interested in fossil energy initiatives than in green ventures, mostly since these technological advances usually carry a number of risks and provide a lower return on investment (Randjelovic, J., et al., 2003). In order to attain the objectives of environmental sustainability, we must create a separate section just for green initiatives and increase funding for projects that help the environment, by using new financial instruments and new regulatory measures, such as "green finance," which refers to a variety of financial products and practices, including financial products, ecofriendly financial institutions, carbon trading devices, fiscal and monetary policy, green central banking, financial innovations, community-based green financing, and so on.

Through innovative services and goods, the banking industry has aimed to significantly contribute to a sustainable future (Weber 2021). From electronic bills to co-branded credit and debit cards, the major financial institutions are marketing innovative goods and services that cater to customer desire for environmentally friendly options. For example, banks strive to promote green institutes and activities across the nation's cities and towns. Climate change have been tackled for thirty years by voluntarily standards of ethics by banks and other stakeholders, such as the Financial Initiative of the United Nations Environment Programme (UNEP 2017); When combined with more openness and high standards, involvement in such voluntary initiatives aids participants in managing their risk and improving their public perception and reputation.

The banking sector plays a vital role for promoting societal stability (Pham, T. H. A., et al., 2024). Because most of these financial firms are focused on making an income and sponsor initiatives that have negative environmental protection effects (Nelson, 2022). Due to the provision of necessary financial services, risk management, and encouragement of financial accessibility for those with limited resources, the financial services sector is vital to maintaining the integrity of society.

By promoting trust among depositors, investors, and stakeholders via responsible lending methods, open activities, and ethical conduct, it also acts as a foundation of trust and confidence in the nation's financial system. Both advancement in society and general financial wellness are facilitated by these responsibilities. In practice, green financing is a fairly new phenomenon in Pakistan (Khan & Szegedi, 2019). Therefore, it's imperative to re-evaluate the role of green financing in Pakistan. The preponderance of Pakistani enterprises and manufacturers utilize a common involvement in environmental system but develop economically at the price of human beings (Rehman, et al. 2021). Industries have a significant role in environmental catastrophe (Mehmood, S., et al., 2024). Many businesses and industries depend on bank services and financing. Several elements that cause global warming, either directly or indirectly, have been connected to the financial sector (Afridi, F. E. A., et al. 2021). The financial structure of a state may both stimulate and cause instability (Su, C. W., et al., 2023). Banks, for example, may determine whether lend to relatively green sectors. The alternatives available to both investment and consumers are changing. Pakistan needs react promptly and effectively (Mumtaz, 2023). On the other side, environmental issues constantly top the list on the priority list. As part of its worldwide green financial potential, the current regime is apparently working on the issuing of green bonds.

Since 2014, the credit markets have expanded rapidly (Greenacre, J. 2020). In addition, there has been an increase in interest from the public sector and financial market participants in figuring out whether it is necessary to categorize and in what way to advance these tools in order to give all market participants clear guidance. Sustainable financial instruments have spread throughout the world. The revenues from the EU categorization stimulated the global discussion concerning classification characteristics (Park and Kim. 2020).

The younger age group has developed necessary regulations and suitable legislation for green lending, going beyond informal standards of ethics (Al-Qudah, et al. 2022). The Sustainable Banking Network (SBN) is in control of countries with strong businesses, while the International Capital Market Association (ICMA, 2021) and IFC(2021) have created worldwide criteria for Green and Sustainable Finance. (Weber, O., & Imam, A. 2024). In 2017, the Central Bank of Pakistan published the Green Banking Guidelines. They are the first of several projects meant

to safeguard the environment from various impacts brought on by the bank's activities and transactions.

The question then arises as to whether the risk of green credit may be reduced or avoided via the use of finance. In this regard, past research' findings on how to increase lending to customers who are more environmentally conscious while lowering financial credit risk simultaneously are mixed. One of these studies is in response to Hill's claim that the banking industry is devoted to limiting the environmental and social repercussions of the projects it finances. It even implies that if environmental and social criteria are not followed, a loan may be withdrawn, and other international institutions have uniform policy (Hill, 2014). Similar to this, Zhang et al. (2011) concluded that China's green credit rules have not been completely implemented when they examined the use of green finance at both the local and regional levels. The research effort conducted by Jiguang and Zhiqun (2011) exposed the necessity of legal rules, tactical preparation, and collaboration for the expansion of emission funds in low carbon finance.

In accumulation to the prior research, Lalon (2015) argued that a commercial bank can be green by focusing its operations on environmental improvement. They also concentrated on the green financing activities of Bangladesh's financial institutions, explored the causative factors behind the adoption of this strategy, and compared the investment banks' various green sources of finance. This study aims to theoretically fill a gap in the literature that interacted also with Non-performing loans (NPL) in Pakistani banks. It's because some earlier research conducted around the world have focused on lending practices rather than credit risk, whereas others have taken into account the possibilities and difficulties of green finance. However, while some context green financing in viewed of financial constraints, cost sharing agreements, and possible foundations of sustainable finance for poor nations, we were unable to locate a single prior research that specifically addressed credit risk in Pakistan. Therefore, the scarcity of research on the NPL ratios in the context of green finance in Pakistani banks in the literature served as a major impetus for us to carry out the latest research.

As a result, on a more pragmatic level, we think that the findings of the present study can offer an evidence based outcome which could remain helpful in regards to lowering risk of credit in Pakistan's banks and can also be applied generally to all emerging economies as they all share the very same capital market. However, whenever we look at the key objectives of the Pakistani economy, one among them is to profit out of a resilient, adaptable, and varied economic system by using innovative econometric techniques and worldwide financial alliances to assure long-term success for the present and future generations of Pakistanis. Because of this, we think the study's findings will be helpful in creating banking sector policies in Pakistan that would provide funding for businesses and startups, placing green finance just at peak of the financial industry's hierarchy.

The goal of this study's research is to examine the risk factors related to green financing. Therefore, our key inquiry concerns whether a rise in green financing would lower the NPL percentage of Pakistani banks. This research used a regression approach that contains regression model, random-effects and fixed-effects model regression analysis to evaluate regardless of whether Pakistani banks' green finance practices lower financial risk. The sample for this research comprises 29 Pakistani banks. Every nation's long-term success depends on the state of the ecosystem and effective environmental governance (Yu, C., et al., 2023), and Pakistan is no different. The research is being taken into consideration as a consequence, especially how to promote further green financing as well as scholars investigate the effect of green funding on Pakistani loan risk through an examination of statistical methods and practical instances, with an emphasis on eco-friendly enterprises. Following are the five main components that make up this study: Introduction was the first section we covered, and "Literature review and hypothesis building" included both the literature review and the creation of the study's hypotheses. The study design was described in the "Research Design" part, along with the technique, empirical models, and sample choice. The data were then examined in the "Results" section, and the paper's conclusion was delivered in the "Discussion and conclusion" section.

2. Review of the Literature and Formulation of Hypotheses

Green financing includes factors like climate-friendly financial process design and environment, risk management for environmental and climate finance firms, and more, thus it goes beyond simply funding green investments (Raberto, et al. 2019). Green finance is a concept that combines the use of commercial procedures with awareness of environmental problems. The actions of all those individuals involved in producing and delivering goods and

services throughout the supply line are influenced by a number of significant elements. Participants at the level of financial institutions include, but are not limited to, those who make products and services, buy them, and use them, as well as those who provide monetary funds (Al-Okaily et al. 2021). However, in this instance, what matters most is whether or not the Green Credit Policy was successful in achieving its declared environmental goals. This matter will continue to be up for debate. There has been a lot of study on this issue over the past five years, particularly in the EU, China, and the United States, but there hasn't been much written about it in relation to developing nations (Al-Sheryani and Nobanee 2020). Among the more well-known examples of the possibilities and concerns with green finance is the Falcone and Sica (2019) study, which provided experimental data in view of fiscal troubles that could influence the investment decisions of green firms. It shows that in order for financial institutions to reduce risk perceptions when funding initiatives, aggressive policy actions must ensure that goals are focused on the long-term perspective. In addition, Zheng et al. (2021) claimed that the notion of green finance is theoretically unclear, with no definitive consensus on its definition among scholars, when they sought to determine bankers' perspectives of numerous aspects of green funds and classify the key obstacles preventing its adoption. According to an investigation by Peng et al. (2018), the advancement of green finance could be attributed to two major factors: the financial firms' perception of social obligation that needs to be embraced to ensure the growth of green banking firms, as well as the sustainability of green finance. For instance, China began comparatively later than financial institutions in wealthy nations, and this will be seen in the environment's failure to improve. According to Miroshnichenko and Mostovaya (2019), one of the crucial components of green loans is green finance; such a loan is made for agricultural purposes in ecofriendly industries, eco - conscious businesses, and sources of renewable energy; the elastic terms intended for the situation which delivery and obtainability have led them to the conclusion that the green loan will grow quickly. Furthermore, Banga (2018) found that the green bond market in emerging economies is still in its infancy and that its maximum capabilities appears to be underutilized. Additionally, there are no suitable provisions in the organizations that approved green bonds, and identified the main obstacles to a development of environmentally friendly bonds as high costs of deal as well as the concern of least magnitude. According to several analyses, green financing enhances banks' potential losses. Park and Kim (2020) provided additional concept on the transformation framework at the institutional, systemic, and sectorial levels as a component to identify barriers to green banking and assess operations that are necessary to remove those obstacles and meet the study's objectives. The United Nations Environment Programme (UNEP 2017) stated that all financial firms must play an important role in resources allocation along a sustainable and environmentally friendly economy and afterwards prevent trying to introduce financing to the operations which may damage the economy and environment in light of the enormous investments required to achieve a transition to green financing. As a result, Hock et al.'s (2020) study examined how conservation efforts affected European institutions' credit risk management. They examined whether a bank's credit requirement had an influence on the relationship between both the sustainability in ecological implications and the high price of credit risk. The analysis revealed that the more ecologically responsible institutions will experience lower credit premium rates if those who also have a strong credit suitability. Green financing is among the main characteristics of green finance that focused to modify the bank's credit arrangement, according to Zhang (2018), who also confirmed that under the government's encouragement, green finance in China is steadily developing and prospering. The main target market for green finance is eco sustainable SMEs. By focusing on three key areas, Abdul Razak et al. (2020) investigated the correlation between sustainability measures and credit risk using financial dimensions across multiple industries, corporate default swaps as a market-based measure, and context-dependency. The outcomes of previous research on the exchange of bank credit risk and financing to green clientele have just been mixed, mostly focused on the green financing's substance or the financial effects of greener financing abroad of the each nation; there are few empirical research examining the financial risks of green credit, and all of the outcomes in this area have been mixed; this creates a gap that must be fulfilled by providing a response to the crucial inquiry: Would a decrease in credit risks result from a higher green credit ratio? Furthermore, some of the preceding publications chastised financial firms for disregarding foreign initiatives and applying green lending criteria primarily to domestic enterprises, while others praised them. A few of these discussed emission fee structures that seem to be consistent with the Green Credit Policy. Likewise, other research addressed credit policy accomplishment concerns. We observe that almost all existing literature in the banking industry from various nations have determined a link with

green financing and credit risks. Accordingly, it is important to consider if green credit may lower risks in the banking system while also increasing green credit in Pakistan. As a result, we propose the following hypothesis:
 H₁: Increased green finance will reduce credit risk (the non-performing loans ratio) in Pakistani banks.

3. Design of the Study and Selecting the Samples

To investigate the influence of Green Financing on Credit Risk in Pakistan, we employ the technique of Cui et al. (2018), who chose the major Chinese banks (24 Chinese banks) using a five-year database. Financial institutions were chosen for this investigation using at least one of inclusion conditions. Earlier, just the financial institutions regarded to be "banks" in Pakistan were listed. Second, we evaluated public listed banking institutions in the dataset. Initially, 56 banks satisfied at least one of the two requirements. Due to a lack of evidence or the bank's inability to be registered on the stock market, 17 of the institutions were excluded in the sample, so thus chose the sample of 29 Pakistani banks, all of which are local banks.

3.1 Methods

As previously stated, the present study's approach was derived from the study of Cui et al (2018). This is why researchers chose the "NPL ratio," which has previously been extensively utilized as a major variable to indicate the risk that a lender carries at a certain time period (Krugman 1999). A non-performing loan is one for which the customer has been unable to pay the monthly payment for the at least three months (ECB 2016). When a loan is labelled non-performing, the likelihood of repayment is extremely low. In general, a non-performing loan is one of two circumstances: a credit is in fail payback or is on the verge of becoming in failure reimbursement; in both cases, financial institutions would trigger warning signals (Ferri 2009). Researches revealed that even a bank's NPL ratio has been influenced by two main issues: financial institution factors that influence as well as macro - economic factors, and empirical studies revealed that low economic expansion is the primary cause of higher NPLs, implying that improved banking regulations and effective management are needed for a consistent economy and financial system stability (Koju, et al. 2018). To calculate the NPL ratio, we first must determine the number of non-performing loans in relation to everyone credit in either banking institution. The NPL ratio will be consistent with several previous research across most regions when analysing credit risk to banks in Pakistan. World Bank policy notes suggest loan rearrangement is a modification to loan terms for unnoticed repayment issues, while NPL ratio is used to foresee financial crises, comparing to restructuring loan proportion (World Bank 2020). Regression analysis was used in this study to examine the impact of green finance on Pakistani banks' credit risk. The Hausman specification test was used to figure out one of the models (random-effect model and Fixed-effect model) seems to be more efficient (Hausman, 1978). The method will assess an estimator's consistency when compared to a less effective substitute, but it must be assumed that alternative is previously reliable. This procedure can aid in determining whether model is in line with the data. According to William (2011), independent variable in the model might occur as a result of continuity, misspecification, or ignoring some factors and/or measurement mistakes. Finally, using the aforesaid criterion, the endogenous variable is utilised to regress the dependent variable, as shown in Eqs. (I & II):

$$NPLGAR = \beta_0 + \beta_1 PL_{it} + \beta_2 DL_{it} + \beta_3 RL_{it} + \beta_4 OL_{it} + \beta_5 AT_{it} + \beta_6 Size_{it} + \beta_7 Liq_{it} + \beta_8 lev_{it} + \epsilon_{it} \dots \dots \dots (I)$$

$$NPLSER = \beta_0 + \beta_1 PL_{it} + \beta_2 DL_{it} + \beta_3 RL_{it} + \beta_4 OL_{it} + \beta_5 AT_{it} + \beta_6 Size_{it} + \beta_7 Liq_{it} + \beta_8 lev_{it} + \epsilon_{it} \dots \dots \dots (II)$$

3.2 Study Variables

The eight primary variables discussed in the previous part and utilised in the model (Eq. I & II) will also be specified in this part as continues to follow:

3.3 Dependent Variable

The NPL ratio, which gauges a bank's asset and loan portfolio health, is the dependent variable in the model. It assists in determining how sensitive shareholders are to non-performing loans (NPLs), especially in DFIs and

MFBs.

3.4 Independent Variables

This study examines green finance, a financial strategy aimed at controlling environmental impacts on finance and investment. The independent variable "Agricultural Loans (Green Credit)" is considered a core variable, as proposed by Cui (2017). Lipper et al., 2014, Bal et al., 2014 and Qin, L., et al., 2024, have highlighted the potential of green finance in promoting climate-smart agriculture, particularly in the agriculture sector and welfare dependency, and its potential for massive agricultural expansion. In Ghana, households involved in agriculture utilize financial services substantially less frequently, according to Mohammed et al. (2020). It was argued that offering green financing opportunities to these farming households would improve their standard of living and the environment. More than 90% of green financing goes into agricultural credit in today's corporate agriculture organizations, which are more expansive in scope, employ more sophisticated production techniques, and prioritize being green (Lin & Qiang, 2021). Nawaz, et al. 2021, study on green finance in Pakistan uses agricultural loans as a proxy, examining the impact of green financial development on economic growth. This study uses various sub-proxies to measure green finance.

Agricultural loans are a crucial component of green finance, with various sub-variables and indicators serving as sub-proxies, depending on the availability of individual bank data. Banks provide agricultural loans for production purposes and development. Recovering these loans can enhance capacity for green credit availability. Outstanding agricultural loans may harm future green credit availability. The target achieved indicates whether the provided loans meet the set goals.

3.5 Control Variable

A control variable in a research project is one that is maintained constant or under restriction. This variable is controlled even though it has no bearing on the study's goals because it might affect the outcomes (Sobral et al., 2020). According to Nielsen and Raswant (2018), control factors enhance the internal validity of research findings by mitigating the effects of auxiliary factors and interference.

Bank size is often determined by the gross money stores of the bank (Tran et al., 2020). A bank's total annual holdings of assets also serve as an indicator of its size (Parvin, et al. 2019). There may be a negative correlation between a company's size and efficiency. According to Haryanto (2020), the size of banks has an adverse effect on production. When a firm grows larger, complexity arises, which ultimately results in strong opposition and reduces the advantage (Ilaboya and Ohiokha, 2016). Alternatively, observers have identified the complete opposite, which highlights the positive impact of an organization's size on productivity (Menicucci and Paolucci, 2016). Bank size significantly impacts their record and credit possessions, reducing capital acquisition costs and influencing various bank tasks, making it a critical factor in determining financial performance. Larger banks have lower capital proportions due to better value market openness. Bank size influences investment choices, resource allocation, image, and capital access. The normal proportion of firm resources is the intermediary of bank size. Zhou, et al. (2023), Nastiti, et al. (2022) and Baines & Hager, (2021) have all contributed to the understanding of leverage as a control variable in financial analysis. Leverage is a crucial financial metric that assesses a company's ability to pay its debts, and when properly utilized, it enhances firm returns. It is also used to quantify credit risk, as demonstrated by the debt to total assets ratio. The knowledge of liquidity ratios—a critical financial metric that assesses a debtor's capacity to fulfill debt commitments without outside funding—and its significance in foretelling credit risk and financial performance has been aided by the works of (Sivanandam & Shalini, (2021), MacCallum, (2021) and Umar, et al., (2021).

4. Results

4.1 Descriptive Statistic of Variables

The least and greatest readings of NPLGAR are 0.001 and 0.236, respectively, with a mean of 0.077 and standard deviation of 0.056. The same reduced number of indicators was indicated by the NPL average and SD values. NPL (M = 0.430, SD = 0.312) with a maximum value of 1.09 and a little value of 0.003. The value of the Production loans (PL) ranges from 1025.92, the smallest, to 39795.53 (M = 14907.31, SD = 12728.41). The minimum and maximum

values of Developmental Loans (DL) are 1000 and 3413.45, respectively, with (M=1785.29, SD= 649.40). The Recovery of Loans (RL) stated has a minimum value of 1151.84 and a maximum value of 35618.72 (M = 12079.23, SD = 11340.3). M=12361.28 and SD= 10089.03 are displayed for the Outstanding Loans (OL), with low and high values of 1044.85 and 37140.19, respectively. The minimum and maximum values are .62 and 1.32, respectively, whereas the Achieved Targets (AT) are specified (M=.987, SD=.153). The control variables for bank size are M = 375.71 and SD = 56.23, with the lowest and higher values being 237.24 and 484.71, respectively. There was liquidity (M=.086, SD=.025). .021 is the lowest and .153 is the highest point. Leverage is the final control variable, with statistics of M=.084 and SD=.040. The values are .1913 for the lower value and .0325 for the upper value.

4.2 Correlation Analysis

The explanatory factors for green finance include PL, DL, RL, OL, and AT, along with control variables Size, Liquidity, and Leverage. Credit risk serves as the explained variable in this scenario. The positive and significant correlation between DL and OL and NPLGAR indicates that rising production and developmental loan levels will be accompanied by rising NPLGAR. Likewise, there is a notable and negative correlation between NPLGAR and AT, Liqi, and Levq, indicating that rising levels of these variables are linked to divergent declines in NPLGAR. The remaining factors and NPLGAR are not significantly correlated. The VIF average is 2.28, indicating that NPLGAR is used, with most of the parameters having VIF values below 5.25 and no value exceeding the threshold of 10. As a result, there are no worries regarding the dataset's multicollinearity. The homoskedasticity null hypothesis has been accepted when the Breusch-Pagan test has a p-value greater than 0.05. Therefore, the model's heteroskedasticity poses no significant issues. As a result, the OLS model's key tenets of heteroskedasticity and multicollinearity are upheld.

4.3 Relationship between Green Finance and Credit Risk

The research paper looks into the link between credit risk and green finance in financial institutions, analyzing the possible trade-offs between risk and return related to green financing initiatives and how those trade-offs affect the credit risk profile as a whole. The selection of a pool for analyzing the impact of green finance indicators on credit risk (NPLGAR) will be based on the Breusch and Pagan Lagrangian multiplier test. The analysis summarizes regression results assessing independent variables' impact on dependent variables, providing beta coefficients and p-values for each predictor variable.

Table 1: Relationship between green finance and credit

	NPLGAR	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
PL		-1.5406	6.6307	-2.33	0.021	-2.8506	-2.3607
DL		.0000105	6.4806	1.62	0.108	-2.3106	.00002
RL		-5.4708	6.7507	-0.08	0.936	-1.3906	1.2806
OL		1.2906	5.6307	2.30	0.023	1.8207	2.4006
AT		-.0581	.02528	-2.30	0.022	-.10805	-.00829
Size		.00475	.00297	1.60	0.112	-.00111	.01061
Liqi		-.2932	.15209	-1.93	0.055	-.59327	.00668

Levg	-.1877	.10791	-1.74	0.084	-.40056	.02511
_cons	.07383	.06439	1.15	0.253	-.053168	.20084

* Significant at the 0.05 level, Probability > F = 0.0000, R-squared = 0.1706, Adj R-squared = 0.1364

According to the study, there is a substantial correlation between green finance indicators and bank credit risk; the most important relationships are found between size, liquidity ratio, outstanding loan balance, and OT. Other metrics, like leverage ratio, RL, DL, and loan recovery, do not demonstrate appreciable effects. $R^2 = 0.17$ indicates that the predictor variables may account for 17% of the variation in the NPLGAR, with the remaining variation presumably resulting from factors not included in the model and reflected by the error term. The study reveals a significant association between green finance indicators and enclosed banks' credit risk (NPLGAR). The predictor variables account for 17% of the variation in the NPLGAR, with the remaining variation likely due to factors not included in the model and reflected in the error term. When a dependent variable is predicted using the independent variables, the model has a substantial predictive potential, as indicated by the F-statistic p-value of less than 0.05.

PL a substantial but negative relationship between NPLGAR and Production Loans was shown by the ordinary least square regression model ($\beta = -1.54$; P, 0.021). The adverse measurement shows that the lending efficiency of Pakistani banks was reduced by 1.54 units for every unit increase in the PL. The Developmental Loans (DL) show a positive but negligible correlation with NPLGAR. Furthermore, it has been established that DL contributes the least to credit risk. The results show that there is a substantial and favorable influence. The NPLGAR indicated that OL had a favorable and significant effect. For every unit rise in green finance, the credit risk increased by 1.29 units. These positive outcomes suggest that lengthy procedures are necessary for outstanding agricultural loans. Additionally, the management needs to give this issue top priority. AT: The findings indicate a weak and negative correlation with NPLGAR ($\beta = -0.5$; P=0.22), suggesting that AT is a passive factor in bank credit risk programs. A one-unit rise in AT corresponds to a little 0.05-unit drop in NPLGAR. Size: Based on the value of the beta coefficient, the results show that the bank size has a very small but positive and inconsequential impact on the NPLGAR ($\beta = 0.004$; P=.112). The positive effect suggests that larger banks are probably going to take greater precautions to protect their credit risk than smaller financial institutions. Liquidity: The outcomes further demonstrate that liquidity significantly and negatively affects the NPLGAR ($\beta = -0.029$; P= 0.05). Nonetheless, it is also discovered that a component of the green financing support that influences bank credit risk is liquidity. Leveg: Because of its impact on the NPLGAR, leverage was deemed significant ($\beta = -.18$; P, 0.08). The NPLGAR is negatively and negligibly impacted by the beta coefficient value, meaning that for every unit increase in leverage, the NPLGAR (credit risk) decreases by 0.18 units.

4.4 Green Finance and Credit Risk

The Non-performing loans to Shareholders' equity (NPLSER) proxy of credit risk was assessed for Pakistan's banking industry from 2014 to 2020. The findings of the correlation analysis show that while PL, RL, AT, Liquid, and Levg have negative correlations with the NPLSER, the green finance indicators, such as DL, OL, and Size, have favorable correlations with it. The only variables that are strongly correlated with NPLSER are size and leverage; all other variables have no discernible relationship with NPLSER. Since all of the individual variable VIF values are less than 05.50 and the threshold value of 10, there are no multicollinearity issues. Given that the Breusch-Pagan/Cook-Weisberg test's p-value is above 0.05 (Prob > chi2 = 0.604), the null hypothesis of homoskedascity may be accepted. Because of this, the model does not have a heteroscedasticity problem.

4.5 The Connection with the Risk of Credit (NPLSER) and Green Finance

NPLSER, or non-performing loans to shareholders' equity, is regressed using green finance measure proxies. The model's results indicate that $R^2=0.19$, indicating that the green finance indicators and control variables may account for 19% of changes in the credit risk (NPLSER). The remaining variation can be attributed to the error, which is a proxy for other variables outside the model that may also impact the credit risk. Additionally, a strong F-statistic

indicates that the model has a significant amount of predictive potential.

Table 2: The connection with the risk of credit (NPLSER) and green finance

	NPLSER	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
PL	-.0000117	3.62e-06	-3.24	0.001	-.0000189	-4.58e-06	
DL	-5.86e-06	.0000354	-0.17	0.869	-.0000757	.000064	
RL	-1.21e-06	3.69e-06	-0.33	0.744	-8.49e-06	6.08e-06	
OL	9.54e-06	3.08e-06	3.10	0.002	3.47e-06	.0000156	
AT	.1187299	.1382851	0.86	0.392	-.1540054	.3914651	
Size	.0731713	.01626	4.50	0.000	.0411022	.1052403	
Liqi	.8055195	.8316803	0.97	0.334	-.8347766	2.445816	
Levg	-1.842815	.5900908	-3.12	0.002	-3.006632	-.6789985	
_cons	-.932349	.3521234	-2.65	0.009	-1.626831	-.2378674	

* Significant at the 0.05 level

The independent variable PL has a coefficient (β) of -0.000, indicating a very small negative effect on credit risk. The p-value associated with this coefficient is 0.001, suggesting that the relationship is statistically significant. The independent variable OL has a coefficient of 9.54, indicating a significant positive effect on credit risk. The p-value associated with this coefficient is 0.002, suggesting statistical significance. The control variable Size has a coefficient of -0.073, indicating a negative effect on credit risk. The p-value associated with this coefficient is 0.000, indicating statistical significance. The control variable Leverage has a coefficient of -1.84, indicating a negative effect on credit risk. The p-value associated with this coefficient is 0.002, suggesting statistical significance. The independent variable DL has a coefficient of -5.86, indicating a negative effect on credit risk. However, the p-value associated with this coefficient is 0.869, indicating that the relationship is not statistically significant. The independent variable RL has a coefficient of -1.21, indicating a negative effect on credit risk. However, the p-value associated with this coefficient is 0.744, indicating that the relationship is not statistically significant. The independent variable AT has a coefficient of 0.118, indicating a positive effect on credit risk. However, the p-value associated with this coefficient is 0.39, indicating that the relationship is not statistically significant. The control variable Liquidity has a coefficient of 0.80, indicating a positive effect on credit risk. However, the p-value associated with this coefficient is 0.334, indicating that the relationship is not statistically significant. Overall, the analysis suggests that variables such as OL, Size, and Leverage have statistically significant effects on credit risk, while other variables like DL, RL, AT, and Liquidity do not show statistically significant relationships with credit risk.

4.6 Discussion

Cui, 2017 research focuses on the impact of green finance on credit risk, using Agricultural Loans (Green Credit) as a core proxy. The study analyzes banks' credit risk using various sub-proxies, including Production loans,

Developmental Loans, Recovery of loans, Outstanding Loans, and Achieved Target, using panel data from 2014-2020. This quantitative study set out to determine how credit risk was impacted by green funding. The main findings of the literature are covered in this section.

4.7 Relationship between Green Finance and Credit Risk

Moudud-UI-Huq et al., 2020, highlights the importance of green finance in the banking system, focusing on reducing credit risk and adhering to regulatory regulations. The study found that higher green lending percentages reduce non-performing loans, while factors like production loans, bank size, and leverage also impact credit risk. NPLGAR and NPLSER have a substantial and negative relationship with PL, according to the results of the Ordinary least square regression model. These outcomes are explained in full above. The NPLSER negative coefficient has minimal effects, however the negative coefficient for the PL shows that a unit rise in the PL decreased the NPLGAR by 1.54 units, indicating the credit efficiency of Pakistani banks. OL significantly impacted both NPLGAR and NPLSER. Both of the credit risk proxies show noteworthy and encouraging results. In contrast to an increase in OL of one unit, the credit risk (NPLGAR and NPLSER) increased by 1.29 and 9.54 units, respectively. This indicates that outstanding loans have a negative impact on financial institutions' credit risk in Pakistan. As a result, these institutions are unable to generate new green advances because they lack sufficient funding. Since AT is significant and negatively correlated with NPLGAR, an increase of one unit in AT will result in a corresponding fall in NPLGAR. Included as control variables, size is significant and beneficial for NPLGAR but liquidity is substantial and negative. The size data show that changes in NPLSER occur at a rate of .07 units for every unit increase in size. Leverage significantly and adversely affects NPLSER. According to these findings, a single unit of lev_g lowers the NPLSER by 1.84 units. Overall, the credit risk proxies showed that size, leverage, liquidity, PL, OL, RL AT, and other aspects are important in green financing. The findings corroborate previous claims made in the literature (Al-Qudah et al., 2022; Cui et al., 2018; Dhruva, 2018; Islam & Das, 2013; Zhang, 2018; Zhou, et al., 2022; Taghizadeh-Hesary & Yoshino, 2020) that green finance influences banks' risk.

Our results indicate that banks have a lower risk of nonperforming loans (NPLs) when their green financing percentage is higher. Additionally, it has been noted that credit risk is mostly impacted by production loans. Previous empirical research (Goss et al., 2011; Bauer & Hann, 2010) that demonstrated positive correlations between green finance and creditworthiness in a variety of international countries lends credence to the conclusion. Through an analysis of an in their natural state firm-level data set from Pakistan, our work contributes to the growing body of knowledge regarding the effects of green finance. The key finding we have is that banks' credit risk is decreased when the share of green loans increases.

5. Conclusion and Future Research Direction

The misuse and overuse of land and resources has made the state of the ecosystem worse worldwide (Orsatti et al., 2020). Global warming and COVID-19 make green financing essential and necessary. This extreme soil pollution creates a significant and pressing necessity to employ green finance as an institutionalized force to minimize environmental problems. In order to improve environmental quality and reduce negative environmental footprints, the primary objective is to facilitate trade between the developing and green economic sectors. Pakistan's environmentally conscious and progressive prosperity depends on its green finance sector. A need for sustainable growth is one that could have positive economic effects without jeopardizing the ecosystem's health. Standardization, procedures, and rules are constantly evolving, thus systematic research investigations need to be carried out on a regular basis. By offering new perspectives into the relationships between green finance and credit risk in various contexts, future scholars may contribute to the corpus of knowledge. Analysis on the role of financial specialists today has demonstrated how difficult it is for them to go beyond traditional financial techniques and diagnose using information that is not financial, especially data related to the environment and sustainability (Crifo, & Mottis, 2016). The financial industry should use a systems viewpoint to build banking system treatment methods that address current issues, rather than reacting to eco-friendly policies that impact industry risks and performance (Weber, 2014). The study's findings are consistent with the SRI theory. Financial success is significantly impacted by socially conscious investing (Scholtens, 2007). Nilsson (2008) draws additional conclusions about the advantages of SRI. The degree of SRI success is correlated with the empirical

choices made by academics looking into this matter or even the ability of SRI investment enterprises to generate performances. However, the idea of SRI is still evolving and growing swiftly in Pakistan, and there are still a wide range of ways available (Irfan. M. et al., 2022). Excessive differences in viewpoints or actions solely across related groups could be interpreted as a clear sign of a transitional phase. Still, supposing one had to guess at the next step, sticking with ongoing dissemination may not be such a bad idea.

Pakistan is currently experiencing a serious shortage of energy for both residential and business use. Banks are encouraging innovation in preserving energy, pollution reduction, and natural resource preservation by offering accessible loans and incentive packages. I suggest that financing for renewable energy and carbon programs offers the banking sector business opportunities. In order to get a first-mover advantage (FMA), banks are willing to lend money, especially in the initial stages of an enterprise. Such new business possibilities may help banks achieve a win-win situation for their financial and environmental success. The nation still needs more infrastructure to protect the environment, despite the government's efforts to address environmental issues. Banks benefit from the opportunity to grow their lending operations because of the sizable market for green loans this creates. The result of the dependent variable shows that an increase in the proportion of green financing to credit risk has a negative effect on non-performing loans as well since an increase in green advancing lowers the ratios of non-performing loans. In light of this conclusion, banks should enhance their risk assessment performance by incorporating more sustainable or eco-friendly assets into their loan facility. Pakistan's green finance strategy should involve government, financial institutions, businesses, and civil society. Key steps include developing a clear policy framework, enhancing capacity through training programs, and encouraging the development of green financial products like bonds, loans, and insurance to finance green projects. Pakistan can promote green finance by integrating environmental factors into financial decision-making, fostering partnerships between government agencies, financial institutions, businesses, and international organizations, developing standardized data reporting standards, offering investment incentives, prioritizing green infrastructure development, establishing risk mitigation mechanisms, and implementing monitoring and evaluation mechanisms. These steps will create an enabling environment for green finance growth and accelerate the transition towards a more sustainable and resilient economy.

Green finance is increasingly recognized as crucial for sustainable development, especially in Pakistan, where environmental issues like pollution, deforestation, and water scarcity are significant. Pakistan's green finance landscape is underdeveloped, requiring further research to understand its potential impact and effectiveness. Research on green finance in Pakistan can inform policy, develop innovative financial products, and unlock new investment sources for sustainable projects. Comparative studies of Islamic and conventional banks may also be conducted focused on specific issues or involving multiple nations in order to get more varied and comprehensive facts. Research on green finance can enhance stakeholder awareness, promote collaboration, and enhance understanding of the benefits and risks of green investments, ultimately contributing to environmental sustainability goals. Finally, to provide more precise insights, data for this study was gathered from financial institutions; larger sample sizes could be used for future research. Reexamining this matter would be very beneficial when more details regarding green finance become available. Stronger evidence will also arise from the discovery of significant findings across longer time periods.

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