Research Article

Nexus of Artificial Intelligence, Green Finance and The Banking Industry of Pakistan

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Abstract:

Artificial Intelligence (AI) is a magnificent stride in the digitalization and transformation of businesses all over the globe. AI can be interpreted as the computer/machine's capability to function without human interaction to provide optimized results. AI technologies imitate human cognitive skills and can yield decisions made on data inputs. AI typically performs the human mind's capable activities. It also refers to developing machines capable of mimicking human behavior AI has revolutionized the banking sector globally. However, according to research conducted by Noreen et al. (2023), the adoption of AI in the banking sector of Pakistan has not reached its full potential. The banking sector in Pakistan has embraced AI acquisition at a growth rate of 12.2 percent. The AI adoption in Pakistani banks is somehow restricted to optimizing risk management, improving customer services, digital identity management, biometric verification and detection of fraud. However, the role of AI goes far beyond the ordinary procedures of automation. AI inclusion has the power to transform the structure of financial services. It can help lay the basis for data analysis to forecast new market trends and constitute the advanced course of action for decision-making. AI, therefore, increases the efficiency of the financial sector leading towards economic sustainability and achieving sustainable goals associated with green finance.

1. Introduction

Artificial Intelligence (AI) is a magnificent stride in the digitalization and transformation of businesses all over the globe. AI can be interpreted as the computer/machine's capability to function without human interaction to provide optimized results. AI technologies imitate human cognitive skills and can yield decisions made on data inputs (Kok et al., 2020). AI typically performs the human mind's capable activities (Boden, 2018). It also refers to developing machines capable of mimicking human behavior (Ottoson and Westling 2020).

Green finance is a terminology that refers to financial investment to ensure environmental protection (Höhne et al., 2012). It refers to eco-friendly business models for the development concerned with clean renewable energy, water reservoirs, sustainable infrastructures, reduced carbon emissions, disposable plastic, etc. Green finance is a center of attraction for many researchers and, is under rapid growth in recent years. It is related to economic activities that reinforce environmental protection, climate change, and efficient utilization of resources. Green finance ought to have a significant impact on the environment, society and firms (Scholtens & Dam, 2007). Capital allocation can be done efficiently using green finance. Green finance ensures that the capital enters the green and environment protection industries. Hence green finance can play a vital role in adjusting industrial structure and industrial upgradation (Haipeng et al., 2020). The environmental protection policies taken into consideration by the government must emphasize the implementation of green finance (Popeanga & Holt, 2014).

Artificial Intelligence facilitates experts dealing with green finance to make optimized decisions. It also helps in data analysis regarding climate patterns and market segments affecting investment choices. The decision-making therefore can mitigate the risk with

environmentally friendly projects. Renewable power is well comprehended with the emergence of AI. It expedites sustainable businesses by aligning a firm's profitability with environmental and social responsibility (Moşteanu, 2023). The landscape of green financing is evolving in Pakistan. However certain constraints are restricting the initiatives of green finance in the country and it signifies the importance of a comprehensive analysis to comprehend the present situation. According to Kumar et al. (2022), policy uncertainty along with financial illiteracy are the impediments to poor mechanisms for green finance in Pakistan. However, the banks in Pakistan are showing a strong commitment to the applicability of green banking guidelines initiated by the State Bank of Pakistan (SBP).

Dobrescu and Dobrescu (2018), the adoption of AI differs from industry to industry. The financial sector especially banks is usually an early adopter of IT opportunities. AI is no longer discretionary for modern day-to-day banking. Instead, AI has become a necessity for banks to operate in a highly competitive market where customer expectation is at its apex. Channelized daily banking activities are somehow a product of AI. Some of the widely used AI-driven technologies in the Banking sector include ATMs (Automated Teller Machines), Mobile banking, Voice recognition, chat boxes, online banking, AI investment advisors, and Robo advisors for full automation of asset management. AI intelligence is also being used in real-time fraud detection as credit card fraud remains one of the prevailing cybercrimes. AI processes are employed for the verification and identification of clients.

AI has revolutionized the banking sector globally. However, according to research conducted by Noreen et al. (2023), the adoption of AI in the banking sector of Pakistan has not reached its full potential. The banking sector in Pakistan has embraced AI acquisition at a growth rate of 12.2 percent. The AI adoption in Pakistani banks is somehow restricted to optimizing risk management, improving customer services, digital identity management, biometric verification and detection of fraud. However, the role of AI goes far beyond the ordinary procedures of automation. AI inclusion has the power to transform the structure of financial services. It can help lay the basis for data analysis to forecast new market trends and constitute the advanced course of action for decision-making. AI, therefore, increases the efficiency of the financial sector leading towards economic sustainability and achieving sustainable goals associated with green finance.

2. Literature Review and Hypotheses Development

The revolutionized digital businesses are a byproduct of AI such as data mining, machine learning, natural language processing (NLP), big data analytics, cloud computing deep learning and social media. These advancements have been ingrained into the daily lives of people constituting modern-day society. Technological advancement contributes to operations enhancement and paves the way for future businesses (Tekic and Koroteev, 2019). The AI's application enhances the working, first as AI can predict the ongoings via audio processing and computational linguistics in the existing environment. Secondly, it can assist humans by allowing machines to work on algorithms based on AI. Thirdly, AI-driven software systems are based on self-learning ability due to which they can function without any human assistance (Purdy and Daugherty, 2016; Rao and Verweij, 2017; Táckacs et al., 2018; Ottoson and Westling 2020; Öztemel and Gursev, 2020).

Nowadays, the banking industry uses chatbots extensively. Chatbots are based on utilizing natural language processing to solve the client's problems (Hwang and Kim, 2021). Customer satisfaction and reliance on banking services are enhanced due to chatbots being operational 24/7 (Sanny et al., 2020; Eren 2021; Nguyen et al., 2021). The process of decision-making has been simplified by using AI techniques (Han et al., 2020). Banks have introduced data mining, machine learning, genetic programming, and fuzzy logic to minimize fraudulent processes (Raj and Portia, 2011). Moreover, extensive use of data management can lead to speed and accuracy in bank's processes (Soni 2019). Banks are using SSL (Secure Socket Layer) for predictive analytics which can be instrumental in halting fraud in online transactions, device fingerprinting, token passwords, and encryption data storage (Kikan et al., 2019).

AI techniques have been found constructive towards financial institutions especially the banking sector (Green et al., 2009; Bughin et al., 2017). The collaboration of employees with technology like machine learning can escalate the revenue of banks by 34% (Shook and Knickrehm, 2018). Global Surveys Series 2004 conducted by AI McKinsey showcases that AI adoption is proliferating globally at a rigorous pace. Researchers tend to have a keen interest in investigating the elements responsible for increased or decreased financial performance (Agarwal 2020). Technological advancement allows the firm to increase its value as well as performance by introducing new products and services (Rogers, 1998). Technological advancement enables the firm

to improve the product quality by enhancing the process which gives rise to sales hence increasing the profits (Leiponen, 2002). Technological advancement also increases a firm's absorptive capacity to new technologies which in return increases growth opportunity for the firm. It is a common observation that technological advancement increases firm value (Yang & Chen, 2003). Technological advancement is a term that covers a vast umbrella and fintech falls right under it. Fintech refers to solutions used to recondition and automate the use of financial services. Fintech acts as an interceder not only in the finance industry but every other industry since finance is a crucial part of every business.

The implementation of AI enhances contentious edge by upgrading a firm's efficiency through enhancing productivity, and cost reduction, hence steering higher profitability. The caliber of financial services and quality of products offered to customers is amplified by the inception of AI-driven techniques, therefore resulting in higher financial performance (PwC 2020). AI is favorable for financial institutions as it yields profitability, stability, and reduced systematic risk. Autonomous AI processes are taking over monotonous bank activities reducing the need for less skilled staff which improves the operational efficiency of the bank (Kaya 2019). The increased employee productivity is accomplished through speed-enhancing processes (Plastino and Purdy, 2018). Prior research is evident that banks have accomplished reduced costs and enhanced quality of their operations increasing revenue generation (Burgess 2017; Kaya 2019; Ryll et al., 2020). Moreover, customers are offered wealth management techniques including customized investment strategies through robots (Wheeler 2020). These results propose that AI implementation is instrumental for shareholders as well as stakeholders. AI can play a significant role in the increased profitability in the financial sector leading to extensive economic benefits.

Nazareno and Schiff (2021), the implementation of AI technologies expedited fintech, blockchain and automation. The present-day banking system in Pakistan is integrated with AI technology comprising on ATMs, mobile banking, short message services and cash deposit machines. This integration has excessive uses ranging from data analytics to strategizing future goals and visions for banks in Pakistan. In Pakistan financial offerings related to AI are at a very preliminary stage so it is very important to educate customers regarding AI-driven financial transactions. Moreover, the infrastructure for AI-driven technology in Pakistan is yet to flourish (Noreen et al., 2023). Though the opportunities and benefits offered by AI are immense, its exposure is still left entirely to the prudence of the companies. There is no mutual and common practice for the disclosure of AI. Since AI application is a new paradigm there is a lack of international standards for reporting AI disclosure (Sætra, 2021). The lack of reporting and regulatory practices in this domain has left a huge literature gap that needs to be sermonized. Hence the following hypothesis is suggested:

H$_1$: AI implementation has a significant impact on a bank's financial performance.

The implementation of policies and strategies based on Green Finance is rapidly growing at an epidemic rate. Instruments like Initial Public Offerings (IPOs), Private Equity (PE), green bonds, venture capital (VC) and other loans, streamed an amount of $720 billion. Green bonds surged beyond $522.7 billion in 2021. Green loans have reached beyond $135 billion while IPOs, VC and other green acquisitions surpassed $63.2 billion (Barry 2022). Therefore, a significant rise has been observed in the allocation of green bonds which reflects an escalated interest of funders to combat global warming (Zheng et al., 2021). Green regulations can inculcate a mutually beneficial situation for both communities and organizations (Porter 1991). Environmental regulations that are poorly designed serve as a room for innovations and advancement in services and products (Porter and Van der Linde, 1995). Enhanced green performance can lead to high profits and increased revenue growth as firms try to penetrate new segments (Ambec and Lanoie, 2008). Moreover, firms enhanced green performance reduces the operational costs (Orsato, 2006; Ambec and Lanoie, 2008; Porter and Van der Linde, 1995). Firms should not only emphasize their overall performance but also their social, economic and environmental impacts. The enterprise, board of directors, creditors, shareholders, management and the government generally fall under the bracket of stakeholders (Sirgy 2002). Satisfactory environmental results and positive environmental management can lead to improving stakeholder's corporate image, reputation and expectations (Jones 1995). The Equator Principles (EPs) can assist in the implementation of sustainable environmental and social development procedures (Eisenbach et al., 2014; Finger et al., 2018). The impact of social responsibility on the bank's performance has been studied by many scholars based on the Economic, Social and Governance (ESG) valuation system (Zhou et al., 2021; Del Gaudio et al., 2022). The Difference in Differences (DID) method has been used to quantify the effects of policy implementation in banks (Luo et al., 2021; Del Gaudio et al., 2022).

Eisenbach et al. (2014) studied the difference between the financial performance of 44 financial firms across the globe revealing that EP adopters had a significant share growth, but the EPs decelerations listed by banks do not amplify their returns to stock markets. According to data gathered from 78 mercenary banks across the world EPs tend to magnify total share loans along with net interest income of the bank in developed countries but in developing countries, these variables are suppressed (Finger et al., 2018). The authors also managed to observe that the performance of banks is affected by green credit policies. According to them, green credit policies have a significant positive impact on the bank's long-term performance. Green credit is a way for banks to represent social responsibility (Cornett et al., 2016; Hueske et al., 2019). According to a study conducted by Luo et al. (2021) China's 2012 green credit policy has improved the competitiveness of urban banks in contrast to agricultural banks. Song et al. (2019) utilized a dynamic panel model to observe the effect of green credit policies on a bank's financial performance. The study was based on seven international commercial banks and 12 commercial banks in China from year 2008 to 2015. The results suggested that green credit policies supplement the profitability of banks in developed countries but inhibit the profitability of banks listed in China. According to another study based on 217 green facilities across the globe, the higher the propensity for green lending lower the profitability along with lower credit risk and moderate default risk (Del Gaudio et al., 2022). Capital markets welcome and support information symmetry provided by firms on green performance. Prior studies are evident that firm reputation and image improves with increased green performance (Prior et al., 2008; Diouf and Boiral, 2017). Disclosure of particulars on green banking initiatives reduces information asymmetry attracting oblivious investors towards the capital market (Brown and Hillegeist, 2007). Cost of equity capital tends to decrease due to information asymmetry (Hughes et al., 2007). According to research conducted by Clarkson et al. (2011) firms with higher environmental performance experience more profitability. Enhanced green performance leads to higher market value and more revenue (Clarkson et al., 2004; Griffin and Sun, 2013). According to Del Gaudio et al. (2022), green credit can offset profitability by enhancing risk in commercial banks. A study conducted by Brogi and Lagasio (2019) revealed that ESG disclosures and return on assets have a significant and positive association. Hence suggesting the following hypothesis:

H₂: Green Finance have a significant impact on a bank's financial performance.

3. Research Methodology:

The study used the Pooled Least Squares (PLS) panel regression analysis. It has analyzed the performance of 19 commercial banks from 2017 to 2022 (A list of Banks can be seen in Annex B). The data has been collected from the annual reports of banks. SPSS and STATA have been used to analyze the data. All the assumptions of the regression have been fulfilled. All the variables are normally distributed. There are no outliers in the data. Independent variables are not too highly correlated with each other depicting no multicollinearity. The variance of error terms (residuals) is consistent across all levels of the independent variables hence, no heteroscedasticity and the chosen dataset is not autocorrelated.

3.1 Regression Model and Variable Description:

The regression model used to measure the impact of green finance and AI on the financial performance of the banks is as follows:

$$BP_{it} = \beta_0 + \beta_1 AIRT_{it} + \beta_2 GF_{it} + \beta_3 BoardSize_{it} + \beta_4 WOB_{it} + \beta_5 Debt_{it} + \beta_6 ETA_{it} + \beta_7 BankSize_{it} + \beta_8 BankAge_{it} + \varepsilon_{it}$$

It shows that Bank performance (BP) is a dependent variable and the Artificial Intelligence-related technique (AIRT) along with Green Finance (GF), Board Size (BoardSize), Women on Board (WOB), Debt (Debt), Capital Edequacy (ETA), Bank Size (BankSize) and Bank Age (BankAge) are independent variables.

3.1.1 Variables Description:

1. Bank Performance (BP): Where performance represents bank financial performance. We have taken Return on Assets (ROA), Return on Equity (ROE) and Net Interest Income (NII) as accounting measures of performance. We have also taken market performance indicators (P/E, Price-Earnings Ratio) in our basic analysis. Literature is evident that a firm produces revenue from its assets and shareholder's equity thus constituting that the higher return on assets and equity of a firm, the higher the overall performance of the firm (Almustafa et al., 2023; Hassan et al., 2023). Moreover, total expense (TEXP) has been also taken into consideration. Net Interest Income is directly related to increased revenue and decreased cost. Overall prior studies have employed them as indicators of financial performance (Hagel et al. 2013; Heikal et al. 2014).

2. Artificial Intelligence-related technique (AIRT) is the proxy developed to measure the adoption of AI in banks. It is the sum of all the AI-related techniques (mentioned in Annex A) implemented in a bank. The AI disclosure and AI practices vary from bank to bank. According to prior literature, technological advancements contribute to operations enhancement which may lead to better financial performance (Tekic and Korteev, 2019).

3. Green Finance (GF) has been measured by creating a dummy variable which indicates the value 1 when the bank's policies are aligned with green initiatives and 0 otherwise (Marietza and Hatta, 2022). According to a study conducted by Brogi and Lagsio (2019) ESG disclosure and financial performance are significantly positively associated.

4. Board Size (BS) as a control variable is contemplated to be the fundamental internal corporate governance indicator (Agarwal 2020; Nguyen et al., 2021; Nguyen 2022). Board Size is measured as the total number of boards of directors.

5. Women on Board (WOB) depicts the number of women on board. According to Kirsch (2018), women tend to be better at monitoring management leading to reduced agency costs thus women on board impact the financial performance of the firm. Therefore, we listed WOB as a control variable.

6. Debt (Debt) as a control variable is essential as the literature suggests that the bank's debt ratio affects its financial performance (Almustafa et al., 2023; Gander 2012; Shiyyab et al., 2013). Therefore, we have a control for debt measured as the ratio of long-term debt to total assets.

7. Capital adequacy (ETA) of banks also impacts the bank's financial performance (Athanasogloue et al., 2008; Dietrich and Wenzenried, 2011; Garcia and Guerreiro, 2016; Talavera et al., 2018). Thus, including this is a control variable in our analysis. Capital adequacy is a measure of the ratio of total equity to total assets.

8. Bank Size (BankSize) has been incorporated as a control for bank-specific characteristics. According to Almustafa et al. (2023) bank size and complexity of operations have a direct impact on managerial activities and bank performance. Hence having a control for bank size (BankSize) which is measured as the natural logarithm of total assets.

9. Bank Age (BankAge) refers to the total number of years a bank has been in operation. Bank age provides a competitive edge by creating long-term ties with clients leading to reduced loan loss and increased profits (Almustafa et al., 2023; Nguyen 2022; Coad et al., 2018).

3.2 Data Sources

Data analysts observe both accounting and non-accounting information to gain insight into a company's profile in terms of performance. An annual report is one of the core sources utilized by investors in the decision-making process (Júnior et al., 2014; Zhou et al., 2017). This research has been conducted on the analysis of 114 yearly reports of 19 banks listed as commercial banks in Pakistan from the year 2017-2022. Data for all the variables has been extracted from the annual reports of the banks. All the annual reports can be easily found in PDF format on the bank's official website or PSX Portal.

4. Finding and Discussion

4.1 Correlations

Table 1 shows the results of correlations. Overall correlation among the variables is low and low correlations among the independent variables predict that multicollinearity is not the problem in the basic regression model. However, some of the coefficients are vindicating special attention. Correlation analysis provides particulars regarding the association between AI Related Techniques (AIRT), Green Finance (GF) and bank-specific variables. Associations vary between AIRT, GF and bank-specific variables. It helps to recognize which bank attributes are more conducive to AIRT practices and green finance initiatives. AIRT is mildly associated with GF. However, it is not correlated with bank-specific variables such as bank age, bank size, Board size, etc. Negative but a little correlation with debt shows that AI-powered solutions can limit the risk of debt default. While, GF apart from AIRT, has little association with Women on Board (WOB), Bank Size, and Bank Age. GF is negatively associated with Debt (-.183). According to a study conducted by Li et al. (2023) the People's Bank of China initiated a Green Finance Policy (GFP) in the year 2017 which integrated green finance in the MPA (Macro-Prudential Assessment) framework developed to evaluate commercial banks. The study revealed that firms having higher ESG ratings experienced a decline in debt following the declaration of that policy. Another noticeable positive association of 0.73 is between bank age and bank size (0.73) which is

because older banks are usually well established and have great reputation which leads to the attraction of huge number of customers, increasing the firm size in terms of assets and deposits. Moreover, a highly negative correlation 0f 0.963 between capital adequacy measured through ratio of total equity to total assets (ETA) and Debt. Higher capital

adequacy indicates that a bank is more likely to absorb losses when incurred. This is the reason of high negative correlation because such banks do not depend upon debts to take care of losses. This is generally a part of bank's risk management strategy which stabilizes a bank in case of financial stress.

Table 1. Correlations

	AIRT	GF	Board-Size	WOB	Bank-Size	Bank-Age	Debt	ETA
AIRT	1							
GF	.467***	1						
Board-Size	.017	.179**	1					
WOB	-.001	.353***	.182**	1				
Bank-Size	.132*	.430***	.363***	.301***	1			
Bank-Age	.178**	.355***	.159**	.198**	.730***	1		
DEBT	-.146*	-.183**	-.075	-.230***	-.116	-.347***	1	
ETA	.120*	.161**	.094	.219***	.106	.317***	-.963***	1

$P<0.10$, **$P<0.05$, ***$P<0.01$.

4.2 Regression Model
A Panel data technique is used to find the impact of AIRT and GF on banks' financial performance. Findings of models 1,2,3,4 and 5 comprised of financial performances the Return on Assets (ROA), Return on Equity (ROE), Net Interest Income (NII) Price-Earnings ratio (P/E), and Total Expense (TEXP) are incorporated in Table 2 respectively. R-Square represents the predictive capacity of the dependent variables ranging from 0.1 to 0.7 and F-values remain significant for all the models.

As per models 1 and 2, AIRT has a positive and significant effect on bank performance concerning ROA and ROE. This implies that the integration of AI-related techniques has a positive effect on a bank's profitability and shareholder's equity. These findings are aligned with the study conducted by Leiponen (2002) which states, that technological advancement powered by AI enables the firm to improve the quality of their product or service, causing a rise in sales and hence increasing profits. In the swiftly progressing prospect of the banking sector, the implementation of AI detains a remarkable potential for improving financial performance and enhancing decision-making processes (Shiyyab et al., 2023). Model 3 indicates that AIRT has a negative significant impact on a bank's financial performance concerning NII. These findings are consistent with prior literature that found technological advancement creates barriers to retaining existing customers and

generates challenges for traditional banks in expanding into new market segments. These challenges can lead to reduced portfolio diversification, contraction in the loan portfolio and decreased net interest income. Substitution of fintech platforms driven by AI negatively impacts financial performance due to a lack of profits through lower interest income (Ben Naceur et al., 2023).

Model 4 indicates a significant negative impact of AIRT on P/E which supports a dominant view of AI adoption on P/E (Finkenwirth 2021). Low P/E ratios indicate that investor has low confidence in the growth prospects of a firm whereas, in the case of high P/E ratios investors expect rapid growth of the firm (Gill 2003). However, technological acquisitions like AI, machine learning, big data analytics, etc. may lead to lower confidence from investors. Whereas, traditional banking follows a regulated set of guidelines offering transparency which certainly lags in the case of AI adoption. This risk of security issues, difficulties in tracking transactions, and high probability of technology failures also suggest low P/E ratios (Bartel 2022). Model 5 indicates a negative but insignificant impact of AIRT on TEXP. Although it is widely accepted that AI adoption reduces cost leading to higher financial performance. But cost saving is not the highlighted feature of AI integration however, efficiency holds a significant potential in terms of AI (Adoption Generative AI Report, 2023).

Table.2 *Regression Analysis*

	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5
	ROA	ROE	NII	P/E	TEXP

AIRT	0.235*** (2.608)	0.247*** (2.952)	-0.150*** (-2.488)	-0.292*** (-2.687)	-0.077 (-1.050)
GF	-0.015 (-0.147)	-0.092 (-0.889)	0.007 (0.104)	0.373*** (3.077)	0.111 (1.359)
Board-Size	0.190** (2.307)	0.216*** (2.555)	-0.014 (-0.247)	0.055 (0.552)	-0.041 (-0.611)
WOB	-0.062 (-0.690)	-0.046 (-0.496)	0.072 (1.192)	-0.129 (-1.188)	0.037 (0.512)
DEBT	-0.008 (-0.036)	0.051 (0.212)	0.568*** (3.602)	-0.091 (-0.320)	-0.98 (-0.513)
ETA	0.332 (1.422)	0.072 (0.299)	0.626*** (4.004)	-0.192 (-0.684)	-0.411** (-2.169)
Bank-Size	0.466*** (3.214)	0.550*** (3.685)	0.533*** (5.475)	-0.249 (-1.483)	0.560*** (4.938)
Bank-Age	-0.066 (-0.471)	-0.121 (-0.842)	0.321*** (3.431)	0.142 (0.871)	0.144 (1.307)
N	114	114	114	114	114
R^2	0.395	0.360	0.728	0.119	0.600
Adjusted R^2	0.347	0.310	0.707	0.050	0.568

*$P<0.10$, **$P<0.05$, ***$P<0.01$. t statistics in parentheses.*

Green finance has a positive significant impact on P/E ratios of banks. While it has an insignificant impact on the rest of the banking performances such as ROA, ROE, NII and TEXP. The incorporation of green initiatives and ESG factors into the business model provides valuable information for investors. Operational efficiency, risk management and stock performance are enhanced through sustainable green practices signaling better quality and a strong reputation. It provides the firm with a competitive edge fostering long-term success and profitability (Dor and Lania, 2023). Green initiatives are important for a company to survive in constantly changing dynamics.

Bank-specific characteristics also provide a supplementary insight into the performance of banks. For instance, bank size exhibits a significant positive impact on ROA, ROE and NII. This result is aligned with prior studies that indicate larger banks are more efficient, profitable and safer compared to smaller banks in size of their assets. Whereas bank age has a positive significant impact on NII, while insignificant to RAO and ROE. Banks with larger asset sizes perform better in terms of ROA, NPAs (Non-Performing Loans/Advances) and NII (Acuite Ratings & Research, 2015). The bank size also has a positive significant impact on TEXP. However, bank size is insignificant with E/P and these findings are supported by previous studies stating larger banks do not possess any sort of cost advantage over smaller banks (Ojeyinka and Akinlo, 2021).

As per results stated in models 1 and 2, Board Size exhibits a significant positive impact on ROA and ROE. These findings are aligned with the results that found, a larger Board-Size provides a broader set of expertise, knowledge in diverse fields and higher monitoring capacity which drives the performance of a firm (Topal and Dogan, 2014). The impact of board size on other performances is not significant.

ETA holds a significant positive effect on NII. These results are consistent with the findings of Tan et al. (2017) suggesting that banks translate into higher profitability if they maintain adequate level of capital. Another study reports a positive impact of capital adequacy (ETA) on a bank's performance in terms of net interest margins (Tan et al., 2020). ETA exhibits a negative significant impact on TEXP implying the banks with higher capital adequacy tend to have low expenses. This view is supported by Alnajjar and Othman (2021) suggesting that higher capital adequacy results in lower costs.

Model 3 predicts that debt has a significant positive impact on NII. Debt can amplify a firm's profit by generating greater returns on its investments. Returns that are greater than the cost of debt result in a positive leverage boosting net interest income of banks (Piper and Wolf, 1982). Bank-Age indicates a positive significant impact on NII. Older banks have stable and established relationship with customers resulting in predictable streams of interest revenue generated form loans and interest-bearing assets. Older banks tend to have a more diversified asset portfolio which helps in mitigating risks associated with certain loans and investments. A well-diversified portfolio serves the basis for stable net interest income (Berger and De Young, 1997).

5. Conclusion

This paper analyzed whether AI-related techniques and Green Finance could be considered to explain the financial performance of the banks in Pakistan. As per information based on the annual reports of banks, it can be deduced that the frequency of AI implementation has increased over the years. However, the application of green financing remains unperceptive through the years demonstrating that banks in Pakistan may yet be at a preliminary stage concerning green initiatives. It also reveals that green finance may not significantly contribute to banking financial performance. Still, it is a vital source for attracting uninformed investors to the capital market for increasing the social prospects of the banking industry. Though the positive outcome of the application of green finance in banking sector is not the primary concern of the study but further research in this area will be a great contribution. Based on the results, AIRT has a positive and significant effect on bank performance concerning ROA and ROE. This implies that the integration of AI-related techniques has a positive effect on a bank's profitability and shareholder's equity. Technological advancement has also made it tougher for the banks to retain existing customers making it almost impossible for traditional banks to excel into new market segments which explains the negative impact of AIRT on Net Interest Income (NII). Findings of the study exhibits a significant negative impact of AIRT on P/E. This is because the difficulties involved in tracking online transactions, machine learning, chatbots and issues related to cyber security and cyber fraud has caused customers to have low confidence in the whole artificially intelligent paradigm. Green finance has a positive significant impact on P/E ratios of banks. While it has an insignificant impact on the rest of the banking performances such as ROA, ROE, NII and TEXP. This indicates that although green financing is a great tool for investors to navigate throughout investing procedures it has no impact on firm's profitability in terms of Return on assets, equity, Net Interest Income and Total expenses of the firm.

Author Statements:

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