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ACADEMIC PAPER

From Inclusive Finance to Efficiency: The Transformative Role of Artificial Intelligence in Pakistan's Fintech-Enabled Banks

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ABSTRACT

This study investigates the relationship between fintech-based inclusive finance (FBIF) and banking efficiency (BE) while assessing artificial intelligence (AI) as a mediating variable within the banks of Pakistan. A quantitative research design and a positivist philosophy were employed while collecting primary data through a structured questionnaire from banking employees, and then analyzed using partial least squares structural equation modelling (PLS-SEM). Our findings indicate that FBIF enhances BE, and that the relationship becomes stronger when AI is a mediating factor to assist in better decision-making while enhancing the customer experience and increasing risk management as a result of the resource-based view (RBV). The study is located within the banks of Pakistan, but provides implications for financial institutions, policy-makers, and formal financial and banking operations to promote AI as a means of maximizing decision-making across various aspects of inclusive finance while maximizing the overall performance of the financial sector. Finally, the authors are unaware of other empirical studies in this emerging economy context that have explored AI as both a mediating and moderating variable in its proposed relationship with FBIF and BE to show how digitalization enhances banking efficiency.

KEYWORDS

Fintech-Based Inclusive Finance, Banking Efficiency, Artificial Intelligence, PLS-SEM, Pakistan.

INTRODUCTION

Banks' abilities to deliver services at a lower price point and boost output are crucial in economic development (Olawale, 2024). Pakistani banks have several challenges, including high operating costs, low levels of financial inclusion, and failure to adequately budget credit, particularly in areas with limited banking (Chowdhury & Chowdhury, 2024). Traditional banking struggles with inclusive finance and claims to provide very low-cost monetary services to individuals who have very little access to banking



because traditional banking is resource-heavy, and practitioners use outdated paradigms (Kehr, Tonkin, & Bihler, 2017). Fintech is considered a significant opportunity to alleviate inefficiencies in traditional banking, deploying banks' services to society, in most cases through modern mobile and electronic payments, including blockchain (Zeidy, 2022). While previous studies (Chowdhury & Chowdhury, 2024; Zhu & Guo, 2024) have examined the relationship between inclusive finance and the increased financial access it provides, less attention has been given to how fintech innovations may use technology to enhance the efficiency of banks to drive inclusive financing. This research seeks to fill this research gap and examine the perceived impact of the innovations of fintech with artificial intelligence in enhancing the efficiency of banks in the case of inclusive financing in Pakistan.

AI has emerged as a revolutionary force across various industries, including banking (Oroy & Tao, 2024). Banks that utilise AI-enabled decision making are a boon in the timelines and accuracy of availing loans, assessing risks, and providing customer engagements (Liu & Anderson, 2024). The enhanced customer experiences enabled by AI to adopt features such as chatbots and the unprecedented personalised service offering are likely to enable banks to retain and attract customers, which lowers the rate of churn while increasing customer satisfaction (Naeem et al., 2025a; Naeem et al., 2024). In addition, banks have begun systematically incorporating risk enablement capabilities that are facilitated by AI, which correlate to increased modelling of predictive risk analytics, thereby improving their operational efficiencies (Carter & Anderson, 2024; Naeem et al., 2025b). The premise and assumptions of this research relate to the RBV theory, which depicts unique resources to leverage competitive advantage. Furthermore, FBIF, which uses AI as a strategic resource for operational efficiency, allows Pakistani banks to develop proactive and a wide range of proactive financial services. This study examined AI dimensions related to mediating the outcome of FBIF on operational efficiency and as such, provides another dimension to the previous literature.

The financial system in Pakistan has very low levels of financial inclusion, limiting economic progress (Ediagbonya & Tioluwani, 2022; Kemal, 2019). As Pakistan transforms into a digital economy, it will be interesting to see how fintech and AI can drive efficiencies in banks and create a more inclusive and accessible financial system. The World Bank (2020) found that in Pakistan, only 21% of adults are able to use formal financial services, contrasted with 69% worldwide. The results of this paper could make it possible for millions of individuals to access credit, savings and insurance. The present study has the potential to add to the literature and also make suggestions to policymakers and bank executives who are interested in achieving financial inclusion and efficiency in digitization.

This quantitative research collects data from the staff of banks in Pakistan with a structured questionnaire aimed at employees' experiences using the areas of fintech, inclusive finance, and AI technology. The data is analyzed with PLS-SEM, while several tests of measures are applied to evaluate the criteria of FBIF, AI, and BE. Overall, the results of the study show that fintech has a positive and significant effect on BE, supporting the notion of FBIF being useful for banking operations and enhancing financial conduit. AI has the greatest effect on BE, particularly in relation to decision-making and risk reduction. In addition, the current study found that AI fully mediates BE and FBIF, indicating that fintech areas, without processes of AI, may not be relevant without process enhancements and therefore achieves usable outcomes for optimization.

This study contributes to the current literature in several ways. First, it expands the literature on inclusive finance, in terms of fintech dimensions, and adds to the understanding of the possible contributions of digital technology for advancing BE. Second, it presents a mediating relationship with AI and identifies the significance of AI as an alternate pathway or strategic resource for modifying traditional bank activities into customer-focused and more efficient activities. Third, while the study's implications are substantial for theory, they also extend to practice. From a theoretical perspective, this study adds to RBV



literature in terms of positioning AI as a strategic resource for banks attempting to enhance efficiency. Study implications may also affect stakeholders, managers, and policy makers of Pakistani banks in terms of implications for investing in fintech and AI for improving operational efficiency and financial inclusion.

LITERATURE REVIEW

The literature review section provides the theoretical background, an overview of FinTech, and hypothesis development.

Theoretical Background

RBV is a strategic management theory that highlights an organization's inner resources and abilities as critical factors that determine its competitive advantage (Ali et al., 2022; Anser et al., 2025; Farooq & Ahmad, 2023). Anser et al. (2024) state that an organization must develop and utilize various resources and capabilities that are valuable, unique, and cannot easily be copied by rival firms, if it is to sustain a competitive advantage (Farooq, Noor, & Naeem, 2023). This includes resources which can be information, relationships, organizational capabilities, and both tangible and intangible assets. The RBV approach involves looking at the resources and capabilities of a firm, including its resources and capabilities of traditional banks and Islamic banks. RBV supports a thorough estimation of how these internal components maintain each banking model's global efficiency, ingenuity, and success (Farooq & Ahmad, 2023). Additionally, RBV can benefit from figuring out how AI integration fits in with the exclusive resources of conventional and Islamic banks, as well as how these features affect the banks' capability to encourage financial inclusion.

FinTech

FinTech is the combination of technology and finance. It contains the application of technology to deliver developed financial services. FinTech, as well-defined by the Financial Stability Board, is technically focused innovation in the financial services industry that has the potential to impact financial markets, institutions, and service delivery from end-to-end new business models, apps, procedures, or products (Morgan & Huang, 2022). According to Qiu et al. (2024), fintech is divided into seven categories: peer-to-peer (P2P), blockchain, data analytics, cybersecurity, mobile transactions, robo-advising, and the Internet of Things (IoT). These technologies can be used in the financial services industry. According to Lee et al. (2021) technologies such as robo-advising have effects on the public with big data, AI, and machine learning. FinTech innovations use innovative technologies to considerably enhance financial services' functioning efficacy. All these included transfer to branchless banking, real-time credit and transaction monitoring, credit scoring and approval, and revolutionary adjustments to customer acquisition and retention. Consider how alternative financing and payment methods are overturning recognized financial systems through possible by the FinTech Revolution. However, there are unpredictable views; the academic literature currently in publication describes three distinct stages in the evolution of FinTech revolutions. Three major FinTech revolution ways are: blockchain, smart contracts, and mobile payments. These are adjusted to obtain real-time data, credit rating changes, and quick communication.

Hypotheses Development

Fintech-based Inclusive Finance and Bank Efficiency

Fintech has attracted increasing attention as studies show its potential to improve BE. Fintech is an innovation that has the potential to decrease transaction costs, simplify a bank's banking activities, and reach larger populations, resulting in speedier transactions, better quality data, and enhanced customer service, all contributing to a major advancement in how fast and effectively many banks can operate (Kemal, 2019). In fact, research conducted in developing countries seems to suggest that financial inclusion through fintech could generally ameliorate operational costs and financial institution (FI)



competitiveness in the delivery of services (Aduba, Asgari, & Izawa, 2023). In short, this amounts to fintech being an entirely realistic aspect of banking that has every possibility to improve the BE of banks as an alternative to traditional banking, even in populations that may be financially excluded, where traditional banks do not seem to reach enough (Njoroge, 2023).

However, not all studies have shown that FBIF enhances BE. Ediagbonya and Tioluwani (2022) state that fintech adoption may not result in rapid efficiency gains, especially in areas lacking developed digital infrastructures. Murinde, Rizopoulos and Zachariadis (2022) discuss the idea that banks incorporate fintech, which represents a notable expense, as banks must incur potentially high costs to invest in any new technology to improve security compliance, with additional regulatory compliance required. In the short run, for institutions with limited capital to invest, those costs may outweigh the short-run benefits. In addition, according to Ediagbonya and Tioluwani (2022), gaps in technology knowledge and infrastructure failures can prevent achieving necessary levels of financial inclusion, blocking increases in BE (Thomas et al., 2019). Chen, You and Chang (2021) also cite serious concerns of no connection between fintech and operational efficiency, especially when looking at the institutional context of stable traditional banks that have deep-rooted presence and resistance to digital change. Such contradictory findings indicate factors associated with fintech-based inclusive finance and BE vary by geography and digital maturity.

Although researchers have become increasingly interested in exploring the relationship between fintech-based inclusive finance and BE, the literature is still lacking, particularly in the context of Pakistan. Most of the existing studies (Chen et al., 2021; Kehr et al., 2017; Zhu & Guo, 2024) either examine the impact of fintech on financial inclusion or the impact of BE in developed economies, without examining the possible relationship between these variables. The RBV theory gives a good foundation for understanding how fintech might be a strategic tools that help BE. According to the RBV, organizations obtain a competitive edge by exploiting valuable, scarce, and difficult-to-replicate resources and competencies (Barney, 1991). In this study, fintech represents such resources, providing banks with tools to improve operational efficiency and extend financial inclusion. On the basis of the above literature and the identified gap, we propose this hypothesis.

H1: FinTech-based inclusive finance has an impact on bank efficiency.

Fintech-based Inclusive Finance, Artificial Intelligence, and Bank Efficiency

The additional major strength behind FinTech modernization is AI, which is designated as technology that can accomplish actions that need human intelligence (Boukherouaa et al., 2021). AI supports automation and efficacy advances in the financial division through tools such as digital brokers, trading algorithms, and robot advisers (Naeem et al., 2024). It's predicted that in 2030, deep learning and other developments in AI will have a major influence on the world economy (Mhlanga, 2021). One instance of AI-driven invention that is considerably overturning the financial and wealth management industries is robo-advisory services (Bagby & Reitter, 2019). These services deliver cost-effective and client-focused resolutions by presenting automated portfolio distribution and investment recommendations provided to specific clients. Robo-advisors encounter recognized financial advisory businesses, embarrassed by their infrastructure, utilizing automation to achieve spread portfolios according to predetermined specifications. When collective with blockchain-enabled rapid settlement and undersized trading prospects, as well as social media information involvement, the growth of Robo-advisors is especially substantial.

Three significant AI-related features are introduced by the implementation of FinTech-based inclusive finance (Kok & Siripipatthanakul, 2023), and they have an abundant amount of potential to increase bank effectiveness. Firstly, AI can evaluate large amounts of data, and it is a troublesome force in decision-making. This qualifies banks to advert understated patterns and trends that a human predictor might omit, subsequent in better-informed and effective decision-making processes. Secondly, the personalization of collaborations that AI-enhanced customer experience nurtures enhances consumer pleasure and loyalty.



This valuable effect on consumer interactions can advance BE as a whole. Thirdly, the important constituent is AI-powered risk management, which progresses risk assessments by inspecting big datasets. This capability decreases the probability of costly blunders and increases overall BE by enabling the detection of potential risks and the recommendation of practical modification techniques. All of these factors together answer how AI enhances the bank's capabilities and banking procedures with FinTech. It's important to conduct a study on this and investigate the mediating role of AI between fintech-based inclusive finance and BE in Pakistan. On the basis of the above discussion, we formulated the following hypotheses.

H2a: The integration of AI-driven decision-making mediates the relationship between inclusive finance based on FinTech and bank efficiency.

H2b: The integration of AI-enhanced customer experience play a mediating role between inclusive finance based on FinTech and bank efficiency.

H2c: The integration of AI-powered risk management mediates the relationship between inclusive finance based on FinTech and bank efficiency.

Conceptual Framework

The conceptual framework which shows the relationship between variables and consists on independent, dependent and mediator is given in Figure 1.

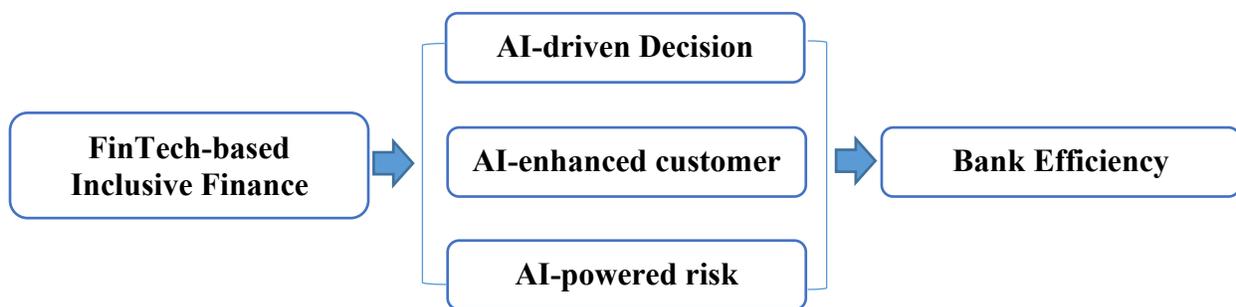


Figure 1:

RESEARCH METHODOLOGY

Sample Size

This study used a survey questionnaire on FBIF, AI, and BE to collect data about the perception of employees of Pakistani banks. We circulated 431 questionnaires, and 385 employees gave complete and valid responses to the questionnaires. The data collection period was from April 2, 2024, to August 14, 2024.

Research Design

For data collection and analysis positivist research philosophy and a cross-sectional design with a quantitative approach are used. Smart PLS 4 is used to analyze the data, and PLS-SEM is employed. According to Khattak et al. (2024), the PLS-SEM technique is better suited for investigations involving unobservable latent variables measured by questionnaires. Moreover, PLS-SEM is also suited for extending existing structural theories, which is consistent with the intention of this investigational research study.

Measures of Instruments

The survey is taken from Chen, Esperança and Wang (2022) and Schepman and Rodway (2020). It is divided into two main sections. The first section includes demographic information regarding gender, age, and title of post. In the second section, questions investigate FBIF, AI, and BE. The study employs a five-point Likert scale.



RESULTS

Demographic Result

Table 1: Demographic Statistics.

Demographics	Frequency	Percentage
Age		
18-24 years	73	18.96
25-34 years	51	13.25
35-44 years	67	17.40
45-54 years	76	19.74
55-64 years	53	13.77
65 or older	65	16.88
Gender		
Male	227	59.42
Female	158	41.03
Designation		
Bank Manager	110	28.57
Cashier	99	25.71
Auditor	92	23.90
Loan Officer	84	21.82
Total	385	100.0

Demographic results are shown in Table 1 for 385 respondents. The highest proportion of respondents is in the 45-54 age category, and just under the highest were those aged 18-24. There is a non-equivalent gender distribution, with 59% male respondents and 41% females. The designation distribution shows that bank managers are the largest group were followed by loan officers (21.82%), cashiers (25.71%), and auditors (23.90%).

Measurement Model Estimation

The study measures the model through factor loadings, in which all items were above the acceptable threshold of 0.70 (Henseler, Ringle, & Sarstedt, 2015). The reliability of each scale was evaluated and determined using Cronbach's alpha and composite reliability (ρ_c), both of which exceeded the cutoff value of 0.70 for all constructs (Hair et al., 2017). With respect to internal consistency, composite reliability values exceeded Cronbach's alpha values in all cases (Table 2). We established convergent validity for the measures using AVE values for each construct, where all AVE values were greater than the required threshold of .50 (Hair et al., 2017). We established discriminant validity for the measure via the HTMT criterion under the suggested cut-off of 0.85, with all values located well below the threshold (Table 3). Overall, the measurement model meets the levels of reliability and validity criteria.

Table 2: Construct Reliability and Validity.

	Cronbach's alpha	Composite reliability (ρ_a)	Composite reliability (ρ_c)	Average variance extracted (AVE)
AIDDM	0.722	0.730	0.801	0.576
AIECE	0.795	0.743	0.820	0.603
AIPRM	0.705	0.721	0.818	0.531
BE	0.719	0.572	0.738	0.586
FBIF	0.734	0.736	0.850	0.655



Table 3: Heterotrait-monotrait ratio (HTMT).

	AIDDM	AIECE	AIPRM	BE	FBIF
AIDDM					
AIECE	0.727				
AIPRM	0.632	0.857			
BE	0.733	0.749	0.574		
FBIF	0.869	0.766	0.638	0.855	

Structural Model Estimation

Table 4: Path Coefficients.

	Original sample	Sample mean	Standard deviation	T statistics	P values
AIDDM -> BE	0.884	0.886	0.022	39.563	0.000
AIECE -> BE	0.048	0.045	0.039	2.702	0.007
AIPRM -> BE	0.077	0.075	0.034	2.287	0.022
FBIF -> AIDDM	0.590	0.591	0.039	15.133	0.000
FBIF -> AIECE	0.846	0.847	0.018	45.805	0.000
FBIF -> AIPRM	0.474	0.479	0.039	12.183	0.000

Table 4 provides the direct relationship among the latent constructs in the SEM. T-statistics and p-values were used to evaluate statistical significance. The results show that AIDDM has a significant and strong effect on BE. There is also a significant positive effect of AIECE on BE. The third AI dimension, AIPRM, also indicates a significant positive contribution to BE and describes how AI can aid in risk management as a response to reduce financial uncertainty. AI shows a positive and significant outcome for BE. Additionally, FBIF is also indicated to have highly significant effects on AIDDM, AIECE, and AIPRM, indicating that a higher level of FBIF would help increase these AI variables.

Table 5: Total Indirect Effects.

	Original sample	Sample mean	Standard deviation	T statistics	P values
FBIF -> BE	0.526	0.526	0.042	12.589	0.000

Table 5 presents the indirect effect of FBIF on BE. The effect is positive and significant. Higher levels of FBIF are indirectly linked to better BE.

Table 6: Specific Indirect Effects.

	Original sample	Sample mean	Standard deviation	T statistics	P values
FBIF -> AIDDM -> BE	0.522	0.524	0.037	14.016	0.000
FBIF -> AIECE -> BE	0.041	0.038	0.033	2.64	0.005
FBIF -> AIPRM -> BE	0.036	0.036	0.017	2.200	0.028

Table 6 presents the full model result, mediating role of AIDDM, AIECE, and AIPRM in the nexus of FBIF on BE. The findings demonstrate that FBIF has a statistically significant positive effect on BE, fully mediated by the three AI constructs. The implications of this research suggest that the integration of FBIF with AI data-driven decision making, AI-enhanced customer experience, and AI-powered risk management increases BE. In turn, the greater emphasis on FBIF and AI adoption, the better the operational performance and the bank's profitability.



Hypotheses Result

The hypotheses summary is presented in Table 7.

Table 7: Hypotheses Summary.

Sr. No.	Hypotheses	Decision
H1	FinTech-based inclusive finance has an impact on bank efficiency	Accepted
H2a	The integration of AI-driven decision-making plays a mediating role between inclusive finance based on FinTech and bank efficiency.	Accepted
H2b	The integration of AI-enhanced customer experience plays a mediating role between inclusive finance based on FinTech and bank efficiency	Accepted
H2c	The integration of AI-powered risk management plays a mediating role between inclusive finance based on FinTech and bank efficiency.	Accepted

DISCUSSION

The results suggest that FBIF positively affects BE in Pakistan. The implication from this relationship is that financial technology is developing access to some financial services, which will allow banks to serve some previously underserved clients. With inclusive finance, banks can increase transaction volume on an operational level and increase access for clients, which will, in turn, lead to enhanced efficiencies overall. This corresponds to the findings of Sajid et al. (2023), which demonstrate that fintech will offer efficiency gains in the outreach and improve operational tasks around the given RBV of the entities articulate here and banks in the financial service-offering industry taking advantage of the fintech space to have a sustainable competitive advantage in resource and deliver a financial service.

Furthermore, the adoption of AI in the banking industry seems to have a productive effect on BE and contribute to productivity while reducing costs. In summary, AI will, in turn, offer banks improved exactness of data-driven decision-making, forecasting customer needs, and a preferable method for managing risk exposure. Therefore, the previous findings to support studies (Ashta & Herrmann, 2021; Naeem et al., 2025a; Naeem et al., 2025b) on AI in financial service institutions confirm that the implementation of AI generates a higher degree of efficiency. This is especially important from the RBV position because AI is considered a strategic resource as banks can measure their returns on data analytics and prediction based capabilities for (central) sustained competitive advantage.

The results suggest AI acts as a complete mediator within the FBIF and BE associations while confirming AI's significance in effective operations of fintech. Complete mediation means that FBIF intervention matters, if it incorporates AI in the decision making, such that it efficiently allows for customized, and automated interactions with customers/contacts, as well as improved risk-based operational processes. Overall, AI fosters effectiveness in financial operations at the fintech activity of banking practices. From the resource-based view, AI, as a technological resource, can act as a mediator, and intermediary that could convert, or enhance the effective functionality of FBIF in reallocating either human or financial resources into more optimized operative applications. In short, the results imply that applying theoretical applications of both fintech and AI algorithm/technology resource will provide a synergized effect for sustained effectiveness in the banking sector of Pakistan.

CONCLUSION

The study assesses the effect of FBIF on BE in Pakistan, involving AI as a mediator. The study employed a quantitative method and gathered data through structured questionnaires among 385 banking industry employees. The study is connected to the RBV framework, utilizing it as the theoretical basis for establishing a relationship between fintech and AI as strategic resources that improve BE. The study showed that FBIF and AI have a direct effect on BE and that AI fully mediated this relationship- creating an even greater effect for fintech.



This research contains several contributions to the literature on fintech, AI, and BE. First, this study contributes to an examination of evidence from a developing economy which illustrated the effect emerging financial technologies can foster BE in Pakistan. Second, this study's core contribution was documenting that AI is a mediator by identifying that when FI is adopted with AI it leads to improvements in operational efficiency, customer service and risk management. Third, the application of RBV theory allows this study to make an additional assertion that Fintech and AI can be considered valuable resources as organizations to generate competitive advantage through enhanced banking methods and processes. Overall, the research advanced the understanding of the relationship between fintech and AI, as a synergy, and can lead to improvements in banking efficiency, and revolutionise banking in developing countries.

IMPLICATIONS

The study's results hold practical and social significance. For practitioners, the results illustrated the opportunities of using financial systems that are augmented with AI-based systems to improve operations and services, along with efficiencies and cost-savings. This is highly relevant to bank leaders and policy makers who will see technology as a mediator for facilitating greater financial services for underserved communities and, therefore, it will subsequently enhance the advancement for greater financial inclusion for communities lacking financial services. From a societal place, the findings aided in illustrating how fintech-driven inclusion finance can be transformative for the lives of various socio-demographics excluded from financial inclusion through enhancing economic viability and accessibility to banking services for these socio-demographics. This presents the role for regulators to encourage banks to leverage fintech and sometimes AI, to enhance banking services and improve the banking experience for customers traditionally excluded from banking services, and as a result, promote more inclusive banking.

LIMITATIONS AND FUTURE RECOMMENDATIONS

Although this research provides valuable insight, there are also several limitations that future studies might best address. The first is the study's cross-sectional design, which itself limits our understanding of the possible causal links between fintech, AI, and BE. A longitudinal study may allow for a more responsive investigation of how fintech, AI, and BE might occur together. The study is also based on self-reported evidence from banking employees, which could raise concerns about response bias in assembling evidence. Future research could look for evidence from other parties, such as clients and regulators, to triangulate the findings. While the study investigations are on banks in a developing country, it would add value to investigate other developing countries to develop comparable insight and generalizability of finding.

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