



FIN-TECH INNOVATIONS AND FINANCIAL PERFORMANCE IN THE PAKISTANI BANKING SECTOR: THE MEDIATING ROLE OF KNOWLEDGE ASSETS

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DOI: <https://doi.org/10.63544/jbii.v5i7.86>

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Article History:

Received: 15.06.2026

Accepted: 29.06.2026

Published: 11.07.2026

Abstract

This research examines the influence of Fin-tech Innovation alongside the role of Knowledge Assets as mediators upon the Financial Performance of the banks in Pakistan. The banking environment is speedily evolving. Within this evolution, digital transformation has become an integral part of the workflows, marking it essential for boosting efficiency, encouraging profitability and competitiveness. This study comprises the data set of 13 banks over a period of 10 years, having a total of 130 observations. Earnings per share was used as a proxy for the dependent variable Financial Performance, while Digitalization Score was used as a proxy of independent variable Fin-tech Innovation. Quantitative approaches were applied in order to test our hypotheses results. The finding revealed that Fin-tech innovations have a statistically significant and positive impact on Financial Performance in the banking industry. Additionally, the mediation analysis results portrayed a partial mediation where Knowledge Assets partially mediated the relation between Fin-tech Innovation and Financial Performance of the banks. Hence, the study concludes that through strengthening Fin-tech adoption and developing strategies along with utilizing the Knowledge Assets, the Pakistani banking sector can sustain growth and gain competitive advantage in the fast paced and evolving markets.

Keywords: Fin-tech Innovation, Financial Performance, Knowledge Assets, Intellectual Capital, Banking Sector, Pakistan.

1. Introduction

In today's digital economy, the race for financial performance is no longer won by capital alone but by the use of invisible engines of innovation. The applications of Fin-tech are diverse, they include not only digital payments or mobile banking but also robot advisors, lending platforms and blockchain-based apps (Rastogi, 2015). Fin-tech refers to the operationalization of innovative technologies to deliver advanced financial services. Moreover, it signifies the growth of financial revolution to improve efficiency, lowering transaction costs and improving service accessibility (Gomber et al., 2018). Additionally, in an organization for smooth application of Fin-tech, the utilization of knowledge assets, particularly measured through MVAIC is necessitated as it emphasizes the capabilities of an organization's human capital, skills and relationships (Abdur, 2014).



In addition to this, existing literature measures financial performance of banks through the use of ROA and ROE while literature measuring EPS as a financial performance index is limited. EPS of an organization highlights the firm's profitability by demonstrating the amount of profit associated with each outstanding share of the firm (Subhani et al., 2022). In Pakistan, research conducted on these effects is particularly limited, hence, creating a gap. Addressing offers both theoretical contributions and practical implications in the banking sector (Rahaman, 2011). The role of Fin-tech innovation allows firms to increase operational efficacy and enhance service delivery however, the impact of Fin-tech on EPS remains inconclusive with respect to emerging economies. EPS is not a widely utilized proxy for financial performance as previously mentioned but if we want to understand the competitive positioning of a firm within the industry, the evaluation of its stocks and the confidence of its investors, we need to analyse the EPS of the firm (Saleem et al., 2024).

The following research study explores the convergence of financial technology with intellectual capital of the firm and R&D expenses, and its impact on the financial performance of Pakistani banks. This is timely for the Pakistani banking industry which stands at a point of convergence for Fin-tech as a driving force of efficiency, yet experiences fragmentation with its adequate integration. By analysing how banks innovate, integrate intellectual capital, and adopt research and development practices in their financial framework, we can investigate why they succeed or underperform within the industry. Examining this relationship offers valuable insights into how financial institutes can become accustomed to technological evolution and how employing Fin-tech innovations in a well-established competitive environment can enhance their performance and sustainability.

2. Literature Review

2.1 Relation between Fin-tech Innovation and Bank's Financial Performance

It is observed that a firm's success is multidimensional and is contingent upon many factors. The performance of a company is shaped by its stakeholders, the heterogeneity of its resources and the efficiency with which the stakeholders utilize it over time. Hence, it is as crucial for a firm to capitalize on its equity as it is on assets to improve efficiency across the firm. This ultimately results in generating high profits through the reach of organizational objectives (Richard et al., 2009). EPS has conventionally been considered a significant indicator of managerial effectiveness and corporate performance (Stern, 1970). Notably institutes which have integrated financial technology show better financial performance. The evidence shows that these firms profit from the advantages of electronic platforms, which improve competence, scalability, and customer reach, eventually leading to enhanced financial results (Najaf et al., 2022). Fin-tech innovations are observed to have a significant positive impact on financial performance of the firm. The level of innovation and technological development of a firm can be measured by using the DIG score (Baig et al., 2024). While EPS remains, a significant measure reflecting shareholder returns, it is influenced by several strategic and financial factors, as well as investment strategies, capital structure decision and market expectation. These highlight the need for evaluating EPS along with broader performance measures in the era of Fin-tech (Stern, 1970).

2.2 Mediating Relation of Knowledge Assets (MVAIC) between Fin-tech Innovation and Bank's Financial Performance

Knowledge assets such as human, structural and relational capital, as measured through MVAIC, contribute to a firm's financial performance, as non-commonality in earnings is found to be positively associated with intangible asset intensity. The MVAIC framework adopted within this research is appropriate to correctly measure intellectual capital and the impact it carries on performance for it rigorously tests intellectual capital and helps organizations to understand financial performance in a better way (Bontis et al., 2007). It is also observed that in high, medium and low-tech firms, there exists a positive impact of the efficient use of intellectual capital contributing to the non-linear relationship of growth opportunities and financial performance (Sardo & Serrasqueiro, 2018).

Literature suggests that the role of knowledge assets is critical in supporting Fin-tech innovation. Knowledge assets including information technology capability, which serves as an intellectual resource, positively impacts knowledge processes as well as knowledge stock, consequently improving firm



performance. Studies also indicate that there exists a significant positive impact of Fin-tech development and financial performance (Wang et al., 2024). In the context of Pakistani firms, effective knowledge management practices include efficient knowledge adaptation, application and conversion of it into fruitful outcomes. This feature allows firms to adapt and improve organizational output quality. Additionally, allowing them to make better informed decisions and therefore, gain competitive advantage (Ahmad & Ahmad, 2016).

2.3 Mediating Relation of Knowledge Assets (R&D) between Fin-tech Innovations and Bank's Financial Performance

Within existing literature, the effect of R&D is found to be varied regarding the impact it carries on profitability yet the association of R&D with innovation capacity, market capitalization and productivity cannot be ignored. Additionally, it was discovered that R&D investments are positively associated with financial performance as they reaped two times higher gains than that of investments with respect to market capitalization in tangible assets by corporate firms, association of R&D with revenue growth, profitability and market value was deemed positive (VanderPal, 2015). Research conducted on the banking sector of Pakistan suggests that effective use of knowledge resources allows organizations to efficiently utilize the information collected from customers as well as employees, therefore improving operational efficiency. The findings from this study suggest that knowledge assets provide a significant mechanism which allows the firms to transform organization competencies and technological advancement into improved financial performance (Ahmed et al., 2015).

While studies suggest a positive impact of R&D on firms' financial performance, it is worth noting that investments in R&D increase immediate costs in the firm. Therefore, if the company is not able to capture the benefits by a balanced approach, the risk of failure increases (Erdogan & Yamaltdinova, 2019). This impact is further confirmed by the significant negative impact of R&D investments on current profitability as initial costs rise (Çilingir Kara, 2025).

2.4 Underpinning Theories

Resource Based Theory. The understood approach of obtaining a competitive advantage across this field has been to utilize the internal resources while grasping the opportunities that the environment creates. This proves to be even more fruitful when a firm also aims to tackle the threat of its competitors and maintain a sustainable advantage over them (Barney, 1991). This research aligns with the resource based theory as it corresponds to the idea that for a firm to have a competitive advantage, it must also have heterogeneity across its resources thereby allowing it to utilize a heterogeneous competitive advantage over its competitors (Pereira & Bamel, 2021).

Endogenous Growth Theory. Within the context of the Pakistani Banking sector, endogenous growth theory provides a strong theoretical framework as it suggests that economic growth owes significantly to endogenous factors such as human capital, knowledge assets, R&D and innovation, rather than exogenous factors. The foundational work on this theory suggests organizational learning, intellectual capital as well as R&D boost productivity hence impacting financial performance in a positive manner (Romer, 1986).

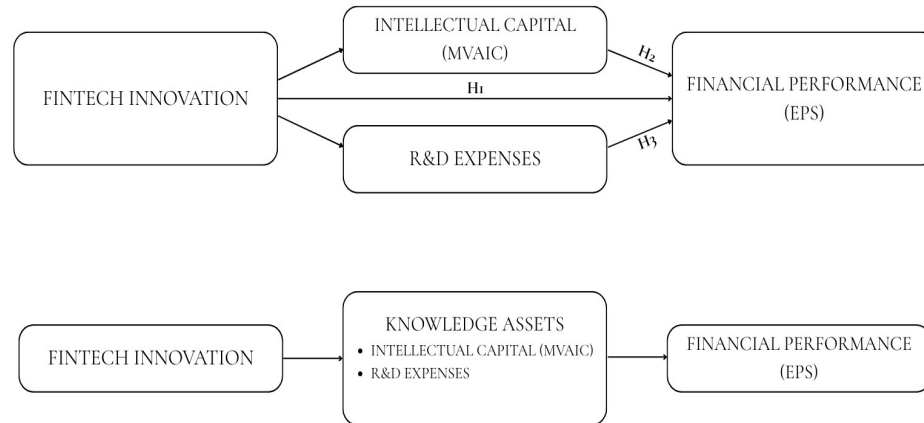
Dynamic Capabilities Theory. In this rapidly evolving era, the possession of infrastructural assets alone cannot aid firms in developing a competitive advantage, what they need is the ability to integrate, reconfigure and transform their resources thus optimizing the mechanism which will then serve as a profitability booster for future use. This concept is well explained by the Dynamic Capabilities theory, the foundational work of which suggests that firms must utilize the capabilities its value chain possess and transform them into a revenue generating mechanism that supports growth in the long term (Teece et al., 1997).



2.5 Conceptual Framework

Figure 1

Conceptual Framework of the Study



Note. This figure illustrates the hypothesized relationships among Fin-tech Innovation (DIG), Knowledge Assets (MVAIC and R&D), and Financial Performance (EPS).

3. Methodology

This study adopts a quantitative research design to examine the impact of Fin-Tech innovation on the financial performance of banks in Pakistan with knowledge assets as the mediating variable. The analysis is based on secondary data collected from banks regulated by the State Bank of Pakistan. The target population comprises all Digital, Conventional and Islamic banks operating in Pakistan regulated by the State Bank of Pakistan. A purposive sampling technique was employed, selecting the following 13 banks with sufficient data related to the study. The selection was based on the availability of complete and consistent data over a 10-year period to ensure reliability and comparability of the panel dataset used in the analysis.

Table 1

Sample of Banks Included in the Study

Bank Name	Bank Name	Bank Name
Allied Bank Limited	Bank Al Habib Limited	Bank of Punjab
Samba Bank Limited	Dubai Islamic Bank Limited	JS Bank Limited
United Bank Limited	Bank Alfalah Limited	Habib Bank Limited
Faysal Bank Limited	MCB Limited	Askari Bank Limited
Meezan Bank Limited		

3.1 Statistical Techniques

The study employed a range of statistical techniques to analyze the relationship between the independent variable (fin-tech innovation), mediating variable (knowledge assets), and the dependent variable (financial performance). All statistical analyses were conducted using Python, utilizing libraries such as NumPy, Pandas, Statsmodels, Linear models and Pingouin for econometric modeling and statistical testing, along with Matplotlib and Seaborn for data visualization.

3.2 Study Variables

Independent Variable: Fin-tech Innovation. Fin-tech innovation was measured using the Digitalization Score (DIG; Chhaidar et al., 2023; Kriebel & Debener, 2019). It measures the degree of digitalization by determining how frequently words like 'digital', 'mobile', 'internet', 'cyber', 'fin-tech', 'crowdfunding', 'blockchain', 'big data', 'hack', 'social media', 'artificial intelligence', 'robotic', 'online',



'information technology', 'information system', 'computing', 'programming', and 'computer science' are included in bank's annual report.

Formula:

$$DIG = \sum_{m=1}^M (tf/nt)$$

Where:

- tf = term-frequency for each keyword
- m = keyword in the investigated report
- nt = number of total words in the examined report
- M = total number of keywords tested in the examined report

Mediating Variable: Knowledge Assets. This study used two proxies for identifying knowledge assets. The first one is based on the intellectual capital (MVAIC), while the second proxy is based on R&D expenditure (Bosworth & Rogers, 1998; Marr & Schiuma, 2001; Smith, 2003).

Intellectual Capital - MVAIC (Modified Value-added Intellectual Coefficient). MVAIC is a comprehensive measure of intellectual capital efficiency, capturing the effectiveness of value creation through intangible resources. The calculation follows three main steps (Pulic, 2000; Rehman et al., 2021; Zhang et al., 2021; Xu & Li, 2022):

Step 1: Value Added (VAF)

$$VAF = \text{Total Revenue (OUTF)} - \text{Total Expenses (INF)}$$

Step 2: Intellectual Capital Efficiency (ICEF)

ICEF is the sum of Human Capital Efficiency (HCEF) and Structural Capital Efficiency (SCEF):

$$ICEF = HCEF + SCEF$$

Where:

$$HCEF = VAF / HC \quad \text{and} \quad SCEF = (VAF - HC) / VAF$$

HC = human capital, measured as employee salaries and wages

Step 3: Additional Efficiencies

Innovation Capital Efficiency (INNCE):

$$INNCE = \text{R\&D Expenses} / VAF$$

Capital Employed Efficiency (CEEf):

$$CEEf = VAF / CE$$

Where:

CE = total assets - liabilities

MVAIC Model to calculate intellectual capital:

$$MVAIC = ICEF + INNCE + CEEf$$

R&D Expenditures. R&D expenses represented the direct financial investments made by banks in innovation and knowledge creation. The data was extracted from annual reports and financial disclosures of banks. The expenses are calculated through natural logarithm:

$$R\&D = \ln(\text{R\&D Expenses})$$

Dependent Variable: Firm Performance. Financial performance of the banks was measured through Earnings Per Share, reflecting the profitability imputable to each outstanding share as well as serving as a key indicator of firm performance (Khan et al., 2024).

4. Data Analysis

4.1 Descriptive Statistics

Table 2

Descriptive Statistics

Variable	N	Mean	Std Dev	Min	Max	Skewness	Kurtosis
DIG	130	0.0011	0.0011	0.0000	0.0048	1.3028	1.1927
MVAIC	130	4.0148	4.9870	-15.3140	32.4000	2.8182	15.9946
RD	130	14.5404	1.0899	8.2654	16.8261	-1.4822	7.4937
EPS	130	12.5778	13.2662	-0.4200	65.7800	1.7131	3.0801



Table 2 highlights the descriptives of the study variables (N = 130). DIG has a relatively low mean of 0.0011 and standard deviation of 0.0011, indicating the low levels of digitalization among the banks along with some variation in the observations. MVAIC exhibits a mean of 4.0148 and standard deviation of 4.98, reflecting substantial variability in the intellectual capital efficiency of the banks. R&D marks the highest stability with a mean of 14.54 and standard deviation of 1.08, suggesting a relatively consistent resource allocation across the sampled banks. EPS has a mean of 12.577 and a standard deviation of 13.226, which indicates substantial variation in profitability across banks.

The relatively high variability in EPS is consistent with prior studies showing that earnings fluctuate due to firm-specific economic and accounting conditions (Dichev & Tang, 2009), as well as structural characteristics such as firm size, industry and financial policies (Frankel & Litov, 2009). This variation reflects the underlying differences in financial reporting outcomes (Kim & White, 2004). Moreover, the presence of high variance is common in financial datasets, which are often characterized by non-normality, skewness and outliers.

4.2 Pearson Correlation

Table 3

Pearson Correlation Matrix

Variable	DIG	MVAIC	RD	EPS
DIG	1.0000	0.19**	0.26***	0.39***
MVAIC	0.19**	1.0000	0.41***	0.44***
RD	0.26***	0.41***	1.0000	0.40***
EPS	0.39***	0.44***	0.40***	1.0000

Note. *** $p < .01$ (Highly Significant), ** $p < .05$ (Significant), $p < .10$ (Marginally Significant).

The Pearson correlation test results highlight that DIG is positively and significantly associated with EPS ($r = 0.39$, $p < .01$), providing preliminary evidence that digitalization of banks contributes to its improved financial performance. Correspondingly, both MVAIC ($r = 0.44$, $p < .01$) and R&D ($r = 0.40$, $p < .01$) indicate significant positive relationships with EPS, suggesting that knowledge assets enhance financial performance of the banks. Furthermore, DIG is positively correlated with MVAIC ($r = 0.19$, $p < .01$) and R&D ($r = 0.26$, $p < .01$), indicating that digitalization is associated with the development of intellectual capital and investments in financial technology.

4.3 Panel Data Estimation Model

Table 4

Hausman Test Results

Model	Hausman Decision	Estimator to Use
H1: EPS ~ DIG	RANDOM EFFECTS	Random Effects (RE)
H2: EPS ~ DIG + MVAIC	RANDOM EFFECTS	Random Effects (RE)
H2: EPS ~ DIG + RD	RANDOM EFFECTS	Random Effects (RE)
H3: Mediator: MVAIC ~ DIG	RANDOM EFFECTS	Random Effects (RE)
H3: Mediator: RD ~ DIG	RANDOM EFFECTS	Random Effects (RE)

The Hausman test results favored the random effects model in all specifications. Therefore, random effects estimation was used for hypothesis testing, as bank specific effects were found to be uncorrelated with the explanatory variables.

4.4 Regression Analysis

Table 5

Regression Results (Direct Relationship)

Variable	Coefficient	Std Error	t-statistic	p-value	Sig.
DIG	4208.2899	969.9536	4.3387	0.0000	***
Const-Model Fit	7.6509	2.0912	3.6586	0.0004	***



Note. $R^2 = 0.1426$, $N = 130$.

*** $p < .001$.

Model 1 examined the direct effect of fin-tech innovations on a firm's financial performance. The results show that DIG has a positive and highly significant impact on EPS ($\beta = 4208.2899$, $p < .001$), indicating that greater digitalization enhances the bank's profitability.

Table 6

Regression Results (Mediation - MVAIC)

Variable	Coefficient	Std Error	t-statistic	p-value	Sig.
DIG	3460.3713	935.8134	3.6977	0.0003	***
MVAIC	0.9371	0.2222	4.2173	0.0000	***
Const-Model Fit	4.8051	1.8621	2.5805	0.0110	**

Note. $R^2 = 0.2648$, $N = 130$.

*** $p < .001$, ** $p < .05$.

Mediation Effects of MVAIC. After incorporating the knowledge assets's first proxy, MVAIC into the model, both DIG ($\beta = 3460.3713$, $p < .001$) and MVAIC ($\beta = 0.9371$, $p < .001$) remained positive and significant predictors of EPS. This reduction in the DIG coefficient from 4208.2899 to 3460.3713 suggests that MVAIC partially mediates the relationship between both variables.

Table 7

Regression Results (Mediation - R&D)

Variable	Coefficient	Std Error	t-statistic	p-value	Sig.
DIG	3972.4433	1334.2208	2.9774	0.0035	***
RD	1.6802	3.3590	0.5002	0.6178	n.s.
Const-Model Fit	-16.4961	48.2921	-0.3416	0.7332	n.s.

Note. $R^2 = 0.1604$, $N = 130$.

*** $p < .01$.

DIG is positively and significantly associated with EPS ($\beta = 3972.4433$, $p = 0.0035$), indicating that fin-tech innovation contributes to improved financial performance of the bank. Whereas R&D expenditure is not statistically significant ($\beta = 1.6802$, $p = 0.6178$), there is no measurable impact on EPS in this model. This model also explains the moderate portion of variation in EPS ($R^2 = 0.1604$).

Table 8

Regression Results (Path a - MVAIC ~ DIG)

Variable	Coefficient	Std Error	t-statistic	p-value	Sig.
DIG	797.7539	306.4646	2.6031	0.0103	**
Const-Model Fit	3.0378	0.7408	4.1009	0.0001	***

Note. $R^2 = 0.0341$, $N = 130$.

*** $p < .001$, ** $p < .05$.

DIG exhibits a significant positive effect on MVAIC ($\beta = 797.7539$, $p = 0.0103$), indicating that stronger digital integration improves the overall intellectual capital efficiency in banks. This supports the view that fin-tech innovation enhances the value derived from knowledge-based resources.

Table 9

Regression Results (Path b - R&D ~ DIG)

Variable	Coefficient	Std Error	t-statistic	p-value	Sig.
DIG	145.1855	66.3078	2.1896	0.0304	**
Const-Model Fit	14.3680	0.2483	57.8709	0.0000	***

Note. $R^2 = 0.0266$, $N = 130$.

*** $p < .001$, ** $p < .05$.

DIG has a significant positive effect on R&D expenditure ($\beta = 145.1855$, $p = 0.0304$), indicating that integration of fin-tech is associated with higher investment in research and innovation in banks.



4.5 Mediation Analysis

H2: MVAIC (Intellectual Capital) as Mediator — DIG → MVAIC → EPS

Table 10

Mediation Analysis of the Effect of Intellectual Capital on Financial Performance

Path / Statistic	Estimate	p-value	Sig.
Total Effect (c)	4541.6651	0.0000	***
Path a: DIG → Mediator	841.7561	0.0278	**
Path b: Mediator → EPS	1.0155	0.0000	***
Direct Effect (c')	3686.8525	0.0001	***
Indirect Effect (a × b)	854.8127	—	
z-statistic	2.0351	0.0418	**
Mediation Type	Partial Mediation	—	

Note. ***p < .001, **p < .05.

The indirect effect of DIG score on EPS through MVAIC is significant ($\beta = 854.8127$, $z = 2.0351$, $p = 0.0418$), which indicates partial mediation, suggesting that fintech innovation improves profitability both directly and indirectly by enhancing intellectual capital efficiency.

H3: R&D Expenses as Mediator — DIG → R&D → EPS

Table 11

Mediation Analysis of the Effect of Intellectual Capital on Financial Performance

Path / Statistic	Estimate	p-value	Sig.
Total Effect (c)	4541.6651	0.0000	***
Path a: DIG → Mediator	243.1683	0.0034	***
Path b: Mediator → EPS	3.9087	0.0001	***
Direct Effect (c')	3591.1827	0.0002	***
Indirect Effect (a × b)	950.4825	—	
Sobel z-statistic	2.4012	0.0163	**
Mediation Type	Partial Mediation	—	

Note. ***p < .001, **p < .05.

The indirect effect through R&D is significant ($\beta = 950.4825$, $z = 2.4012$, $p = 0.0163$), indicating partial mediation. This implies that fin-tech innovation influences EPS both directly and indirectly by increasing R&D investment of the organization.

4.6 Hypotheses Testing

Table 12

Hypotheses Summary

Hypotheses	Statement	Test	Key Statistic	P-value	Decision
H1	Fin-Tech Innovation (DIG) has a direct impact on Financial Performance (EPS)	RANDOM Regression	$\beta = 4208.2899$	0.0000	Supported
H2	MVAIC (Intellectual Capital) mediates the relationship between DIG and EPS	Baron & Kenny + Sobel	Indirect = 854.8127 Sobel z = 2.0351	0.0418	Supported
H3	R&D Expenses mediate the relationship between DIG and EPS	Baron & Kenny + Sobel	Indirect = 950.4825 Sobel z = 2.4012	0.0163	Supported



5. Discussion

This study examines the impact of Fin-Tech innovation on the financial performance of Pakistani banks by exploring the mediating roles adopted by (knowledge assets) intellectual capital (MVAIC) and R&D expenses. Using panel data from 13 major Pakistani banks over the period of 2015–2024, the findings support all three proposed hypotheses.

Digital transformation within the banking industry has adopted the role of a critical driver for value creation, emphasizing the pivotal need for cojoining Fin-Tech innovation and financial performance. The integration of Fin-Tech has been indicative of improving operational efficiency by reducing transaction costs, enhancing customer service, expanding financial accessibility, and consequently contributing towards stronger profitability and shareholder returns (Isaac et al., 2023; Rios-Vazquez & Portela-Maseda, 2026). Consistent with previous literature, these underpinnings stress how digital financial innovations through improving resource utilisation and enabling efficient business models strengthen bank performance (Awan & Parveen, 2023; Wang et al., 2024). Moreover, from the Resource-Based View (RBV), it can be understood that Fin-Tech capabilities are strategic organizational resources which when effectively deployed, are providers of competitive advantages (Barney, 1991).

Furthermore, the research demonstrates how the relationship between Fin-Tech innovation and financial performance is significantly mediated through intellectual capital, measured via MVAIC. Suggesting that the financial benefits of digital technologies are dependent not only on the adoption of technology itself, but also on an organization's ability to develop and utilize human, structural and relational capital, adequately. Thereby, the successful implementation of Fin-Tech initiatives is incumbent to effective knowledge management systems and supportive organizational structures capable of leveraging technological resources and skilled employees (Rehman et al., 2021). Prior studies are also supportive of how intellectual capital serves as a valuable organizational asset which enhances productivity, profitability, and long-term value creation within financial institutions (Alhassan & Asare, 2016; Asutay & Ubaidillah, 2023). Therefore, the findings not only reaffirm generation of stronger financial outcomes through Fin-Tech investments and well-developed knowledge resources, but also support the argument that intellectual capital is a key mechanism through which technological innovation can be aptly translated into shareholder value (Aslam et al., 2023).

Similarly, the study is conducive to the significant mediating role of R&D expenditure. While Fin-Tech acts as the provisionary technological foundation for transformation, R&D investments not only facilitate knowledge creation and experimentation but also a continuous approach towards innovation, allowing organizations to substantially exploit the benefits of emerging technologies (Rahman & Howlader, 2022; Wang et al., 2023). Consistent investment in R&D is key to strengthening innovative capabilities and supporting development of new products, services and operational processes, which are contributive to long-term financial performance (Vanderpal, 2015). As per findings, while Fin-Tech adoption alone may not guarantee improved earnings performance, firms must complement technological investments with sustained innovative efforts to realize meaningful financial gains (Adiguzel, 2025).

Overall, the findings suggest the relationship between Fin-Tech innovation and financial performance to be a convergence of direct and indirect. While digital technologies improve performance independently, their impact is significantly enhanced through intellectual capital development and sustained R&D investment. These results support the argument that technological advancement, knowledge resources and innovation capabilities, are long-term contributors of financial growth and competitiveness within the banking sector.

6. Conclusion

Conclusively, the above research contributes to growing Fin-tech literature by showcasing how Fin-tech innovation enhances financial performance, directly and indirectly, through intellectual capital and R&D expenditure. The findings indicate how digital technologies generate greater value when supported by strong knowledge assets and innovation-driven investments, highlighting the significance of integrating technological advancement with intellectual capital development and continuity in innovation for improved



bank performance. Overall, banks can achieve sustainable financial gains by adopting a balanced strategy which combines digital transformation with knowledge management and R&D orientation.

However, the study is subject to limitation by its sample of 13 Pakistani banks, which constrains the generalizability of the results, and by its reliance on annual report data, where image-based reporting had posed extraction challenges. Future research should incorporate moderating factors like digital financial literacy, organizational absorptive capacity, cybersecurity capabilities, AI readiness and bank size, to better explain variations in Fin-tech outcomes (Raza & Khan, 2024; Hermuningsih et al., 2023). Moreover, the integration of ESG considerations would further provide insight into sustainable digital transformation (Usman et al., 2026). Alternative Fin-Tech measures can also be utilised by future studies for banks, such as mobile banking usage, digital transaction volumes, Fin-Tech startup activity and Fin-Tech involved patent data, to develop a comprehensive and enduring understanding of innovation and the impact it carries (Haddad & Hornuf, 2019; Frost et al., 2019).

Acknowledgments

The authors would like to thank the participants and the respective universities for their support and cooperation in conducting this study.

Contribution of Authors

All the authors participated in the ideation, development, and final approval of the manuscript, making significant contributions to the work reported.

Conflict of Interest Statement

The authors declare no conflicts of interest.

Funding Statement

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Informed Consent

Informed consent was obtained from all individual participants included in the study.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of 1964 Helsinki declaration and its later amendments.

Data Availability

The datasets generated during and analysed during the current study are available from the corresponding author on reasonable request.

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