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Effectiveness of Mobile Payment Apps on Financial Performance of Commercial Banks in Moshi Municipality

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Abstract: ***The financial performance of commercial banks in Moshi Municipality has become increasingly unstable, with periodic fluctuations and inconsistencies that undermine the financial system and hinder overall economic growth. Guided by Bertalanffy's (1937) systems approach theory, the study adopted a convergent parallel mixed-methods design to provide a comprehensive understanding of the phenomenon. The study population comprised 138 respondents, including 133 bank employees and 5 bank managers from 16 commercial banks operating in Moshi Municipality. The study used census sampling for employees and purposive sampling to select bank managers. The study collected primary data through structured questionnaires and key informant interviews. The study ensured data validity and reliability through expert reviews and Cronbach's alpha ($\alpha > 0.826$). The study analysed quantitative data using descriptive and inferential statistics in SPSS version 26, and analysed qualitative data through thematic analysis, presenting findings using direct quotations. Descriptive statistics showed consistently high mean scores, indicating strong agreement among respondents that mobile payment apps positively influence the financial performance of commercial banks in Moshi Municipality. The regression analysis also showed that the predictors, interbank transfer mpa (p-value 0.002), airtime mpa (p-value 0.007), telecom-based mpa (p-value 0.016), and wallet systems mpa (p-value 0.019), are statistically significant in enhancing financial performance measured by ROA. The study concluded that statistical and operational evidence converged to affirm the strategic value of mobile payment frameworks in enhancing commercial banks' financial performance, while also revealing specific operational and cost-related frictions that currently temper this contribution and warrant managerial attention. The study recommends that banks invest in expanding mobile payment infrastructure, strengthen regulatory collaboration, and intensify staff and customer training to maximise adoption of digital platforms.***

Keywords: Mobile Payment Apps, Financial Performance, Commercial Banks, Return on Assets

Nomenclature:
SMS: Short Message Service
ATMs: Automated Teller Machines
FNBT: First National Bank Tanzania
SMEs: Small and Medium-Sized Enterprises
NMB: National Microfinance Bank
NBC: National Bank of Commerce
EXIM: Exim Bank Tanzania
BOA: Bank of Africa Tanzania
TCB: Tanzania Commercial Bank
MWANGA: Mwanga Hakika Bank
MKOMBOZI: Mkombozi Commercial Bank
DTB: Diamond Trust Bank
KCB: Kenya Commercial Bank Tanzania
ABSA: Absa Bank Tanzania
STANBIC: Stanbic Bank Tanzania
AKIBA: Akiba Commercial Bank
AZANIA: Azania Bank
EQUITY: Equity Bank Tanzania
MWECAU: Mwenge Catholic University
MPA: Mobile Payment App
VIF: Variance Inflation Factor
ROI: Return on Investment
ROE: Return on Equity
VHE: Very High Extent
HE: High Extent
ANOVA: Analysis of Variance
K–S: Kolmogorov–Smirnov
VIF: Variance Inflation Factor

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I. INTRODUCTION

Mobile payment applications have emerged as one of the most transformative components of financial technology in the modern banking landscape. These platforms let users complete financial transactions on mobile devices, including money transfers, bill payments, purchases, and account management, fundamentally changing how banks interact with customers and generate revenue (Dahlberg et al.) [1]. Mobile payment applications have evolved over several decades, from the rudimentary short message service (SMS)-based transactions of the early 2000s to the sophisticated, real-time digital payment ecosystems that define contemporary banking. Such evolution has reshaped financial service delivery, particularly in regions where traditional banking infrastructure has historically been limited (Abad-Segura et al.) [2].

Before the widespread adoption of mobile payment applications, commercial banks in Moshi Municipality relied heavily on manual, paper-based systems and physical branch visits to facilitate financial transactions (Assibey) [3]. Customers had to appear in person during prescribed operating hours to make deposits, withdraw cash, and transfer funds between accounts. Early automated teller

machines (ATMs), while offering some degree of convenience, remained unintegrated with broader banking systems and were largely inaccessible to rural and semi-urban populations (Beck) [4]. These legacy approaches were characterized by high operational costs, significant processing delays, and vulnerability to human error, which constrained the financial performance of commercial banks operating in environments such as Moshi Municipality.

Globally, traditional banking systems relied on centralized, in-branch service models that restricted efficiency and limited customer access, particularly in developing economies (Kot et al.) [5]. As of 2011, only 51% of adults in developing countries held formal bank accounts, with considerably lower penetration in rural and semi-urban areas. Branch-based transaction processing was estimated to cost up to ten times more than equivalent digital channel transactions (World Bank & McKinsey) [6] [7]. These structural inefficiencies propelled the global growth of mobile payment technology, with Europe investing US$26 billion in financial technology in 2018 and China achieving near-cashless status by 2024 (Slotta) [8].

Africa has undergone a profound financial transformation driven by mobile payment applications, which have given individuals and small businesses efficient, cost-effective ways to conduct transactions. These platforms have connected formal financial institutions with previously underserved populations (Fernandes) [9]. In Nigeria, strengthening cybersecurity investment, modernising technological infrastructure, and fostering collaboration with financial technology partners are critical steps to advancing mobile payment adoption (Lottu et al.) [10]. Across East Africa, mobile payment platforms have rapidly reshaped the financial landscape by enabling millions of individuals to access financial services through mobile devices (Mwatosya) [11].

China has led the global mobile payment revolution, with a mobile payment market valued at US$12.77 trillion. Tencent's WeChat Pay and Alibaba's Alipay collectively account for about 90% of this market (Shao) [12]. Kenya became a continental pioneer in mobile money through M-Pesa, transforming financial inclusion across the country (Armstrong) [13]. Uganda has similarly leveraged mobile payment technology to drive economic empowerment, enabling users to send and receive money, pay bills, and purchase goods and services directly from their mobile devices (Olupot) [14].

The financial performance of commercial banks in Tanzania, particularly in Moshi Municipality, has become increasingly unstable in recent years. This instability is characterised by periodic fluctuations, inconsistency, and, in some cases, the complete collapse of banking institutions, undermining the financial system and posing a significant threat to the country's overall economic growth (Limaro) [15]. As a baseline for this instability, the Bank of Tanzania's supervisory review of the sector, culminating in its 2017/2018 Annual Report, recorded the acquisition, merger, or licence revocation of six institutions within a single review cycle, establishing the point from which subsequent bank-level performance in Tanzania, including in Moshi Municipality, is compared in this study (BoT) [16]. One key initiative to address this instability has been the adoption of mobile payment applications to streamline banking operations, improve customer access, and enhance overall competitiveness (BoT) [17].

Despite these efforts, many commercial banks still struggle to implement mobile payment applications effectively. This has contributed to adverse outcomes including bank collapses, mergers, reported losses, and persistent liquidity challenges. For instance, EXIM Bank acquired First National Bank Tanzania (FNBT) due to severe liquidity problems. At the same time, the Bank of Tanzania (BoT) revoked the licenses of five other institutions: Covenant Bank, Efatha Bank, Njombe Community Bank, Meru Community Bank, and Kagera Cooperative Bank (BoT) [16]. This study does not present mobile payment applications as a direct cause of these collapses; rather, the two are linked through an intervening operational-cost and revenue-generation mechanism. Where a bank incurs high upfront technology-implementation and cybersecurity costs without a corresponding, timely increase in non-interest fee income and low-cost mobile deposits, its short-term liquidity and capital position may be strained, compounding pre-existing vulnerabilities such as non-performing loans and weak corporate governance rather than causing failure on its own (Lottu et al.) [10].

Moreover, commercial banks in Moshi Municipality have become increasingly unstable, experiencing periodic fluctuations and inconsistency, and, at the national level, outright collapse, all of which undermine the financial system and hinder overall economic growth. The Bank of Tanzania (BoT) has made several efforts to address performance issues in the banking sector by promoting mobile payment applications to help banks streamline operations, expand customer reach, and remain competitive. In this context, mobile payment apps are best understood as one operational strategy among several that banks can use to reduce costs and expand fee income, rather than the sole determinant of institutional survival. However, despite these efforts, banks still struggle to implement mobile payment solutions effectively. This operational shortfall coexists with, rather than directly causes, consequences such as bank collapse, mergers, losses, and capital and liquidity challenges more directly attributable to credit risk, governance weaknesses, and liquidity mismatches (Ally et al.) [18].

Recent studies observed that low liquidity, losses, and inadequate capital have caused some banks to collapse. Among those affected were First National Bank Tanzania (FNBT), which EXIM PLC acquired due to severe liquidity problems; Covenant Bank, Efatha Bank, Njombe Community Bank, Meru Community Bank, and Kagera Cooperative Bank, whose business licences were revoked by the BoT; Bank M Tanzania, which was merged with Azania Bank; and Twiga Bancorp Bank, which was merged with TPB Bank (BoT) [16]. These cases are national in scope and establish the wider Tanzanian banking environment within which the sixteen commercial banks operating in Moshi Municipality function, including several of the affected and acquiring institutions, including EXIM Bank and Azania Bank, maintain active branches within Moshi Municipality, so that municipal-level performance cannot be separated from the

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national instability described above. The present study therefore treats Moshi Municipality as the specific urban case through which this wider Tanzanian banking-sector struggle, and the mobile-payment response to it, can be examined empirically.

The current unsatisfactory performance of commercial banks in Tanzania has raised questions about whether mobile payment applications adopted to improve financial performance and expand customer access are being implemented effectively. This unsatisfactory performance is reflected in the sector's asset-quality trend over the past decade including the ratio of non-performing loans to total gross loans among Tanzanian commercial banks rose from 5.4% in 2011 to a peak of 11.5% in 2017, before easing to 9.3% by 2020, with the mean ratio across the 2011–2020 period standing at 8.34%, a level that exceeds the 5% threshold generally regarded as acceptable for banking-sector stability (Budotela et al.) [19]. Specifically, it remains unclear whether their four principal operational dimensions, interbank transfer, airtime, telecom-based, and wallet system, contribute to financial performance to the same extent. Therefore, to fill the identified gap in the shortage of empirical, bank-level evidence on how effectively mobile payment apps are actually driving financial performance within a specific municipal commercial banking environment, as opposed to untested assumptions about their benefits, the current study examined the effectiveness of mobile payment apps on the financial performance of commercial banks in Moshi Municipality.

II. LITERATURE REVIEW

This study was guided by the Systems Approach Theory, proposed by Ludwig von Bertalanffy in 1937. The theory views an organisation as interrelated components that work together to achieve common goals. It states that an organisation functions as a unified, interdependent system composed of subsystems such as people, processes, technology, and structures that work together to convert inputs into outputs through defined processes. The theory focuses on three main elements: inputs (resources such as technology and labour); processing activities that transform inputs; and outputs (final products or services). The theory assumes organisations operate as open systems that continuously interact with their external environment, that subsystems are interconnected and mutually dependent, and that organisational effectiveness depends on proper coordination, adaptation, feedback mechanisms, and the efficient flow of resources and information among system components. It also assumes that changes in one subsystem affect the entire system's performance and that organisational success occurs when all parts work together toward common objectives.

The Systems Approach Theory is highly relevant to this study because it emphasises that all components of a financial system are interconnected. It provides a useful framework for examining how financial institutions process digital inputs such as mobile payment applications to produce outputs such as improved operational efficiency, increased customer numbers, and enhanced return on assets. By applying this theory, the study offers a clearer understanding of how different mobile payment components must work together as an integrated system to enhance commercial banks' overall financial performance in Moshi Municipality. The theory's strength lies in promoting a holistic view of operations and encouraging coordination across subsystems, supporting evidence-based decision-making through continuous feedback.

A. Empirical Literature Review

Li [20] investigated the impact of mobile payments on the financial management efficiency of Small and Medium-Sized Enterprises (SMEs) in China. The study found that mobile payment technology significantly enhances SMEs' financial management efficiency, suggesting that as the user base expands and user experience improves, businesses can enhance their market competitiveness. However, the study addressed the overall market without providing a detailed analysis targeting commercial banking institutions. This creates a functional and contextual gap in the literature, as it offers limited insight into how commercial banks can optimise mobile payment apps and how these platforms affect financial performance across different economic and regulatory settings, especially in developing regions like Moshi Municipality, Tanzania. The study did not adequately address factors such as the competitive landscape, regulatory environment, and economic conditions that affect mobile payment uptake and effectiveness.

Mande [21] investigated the impact of mobile money services on the value chain, including mobile network operators, banks, and end users. The study found that introducing mobile money positively affected the performance of the entire value chain. While mobile money services consistently improved outcomes over time, adding bundled services such as credit payments had mixed effects, enhancing banks' performance but reducing profits for mobile network operators. However, the study did not employ advanced analytical tools such as regression models, which are important for providing robust empirical evidence of the relationship between mobile payment apps and bank financial performance. Therefore, the proposed study addressed this gap by adopting regression models as a core analytical approach.

Neelam and Bhattacharya [22] found that men use mobile payment apps more often and that key factors influencing usage include security, convenience, and technical conditions. The study also found that banks and technology firms should improve privacy measures and simplify app usability to support inclusive financial growth. While the study provides meaningful insights into user behaviour and demographic factors, it lacks a strong policy perspective. This creates a policy and institutional gap in the literature, limiting the practical relevance of the findings for regulators, financial institutions, and policymakers, especially in developing countries like Tanzania. The study does not examine how existing financial regulations, digital infrastructure policies, or consumer protection frameworks impact mobile payment adoption and financial performance. Therefore, the proposed study incorporated a policy analysis dimension to suggest targeted interventions and regulatory improvements that

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can enhance the security, accessibility, and inclusivity of mobile financial services.

Suu et al. [23] examined the factors affecting commercial banks' net interest margin in Vietnam from 2008 to 2018. The results showed that operating expenses and credit risk positively affect net interest margin. In contrast, risk aversion, management quality, trading income, and the proportion of deposits negatively affect it. Although the study offers valuable insights for bank supervision and policy formulation in Vietnam, it has a geographical gap because it limits its analysis to a single country. The findings may not be generalized to other regions with different economic conditions, regulatory frameworks, or banking structures. Therefore, the proposed study addressed this gap by exploring how mobile payment applications influence financial performance indicators in commercial banks in Moshi Municipality.

Zubairu et al. [24] investigated the role of financial technology in financial inclusion in Ghana through a comparative analysis of strategies, impacts, and challenges. The findings showed that while fintech considerably improves access to financial services and contributes to economic empowerment, challenges such as insufficient financial literacy, limited digital infrastructure, and regulatory impediments remain. The study would benefit from incorporating perspectives from a wider range of stakeholders, including fintech service customers, to provide a more comprehensive picture. Focusing on Ghana may not capture the broader complexities of fintech across diverse economic settings. Thus, the current study examined the effectiveness of mobile payment apps on the financial performance of commercial banks in Moshi Municipality, Tanzania, by involving commercial banks, their staff, and managers.

Mutua [25] examined the nexus between the financial performance of Kenyan commercial banks and the advent of mobile banking. The study was literature-based and used a desktop research design. It found that mobile banking significantly improves the efficiency, profitability, and competitiveness of commercial banks in Kenya. However, major challenges, such as regulatory constraints, security concerns, and technological limitations, create risks that make it difficult for commercial banks to integrate and use mobile banking platforms effectively. The lack of primary data restricts the study's ability to provide context-rich, actionable insights for banking stakeholders. Therefore, the proposed study addressed this gap by using both primary and secondary data collection methods, offering a more comprehensive and accurate analysis of how mobile payment apps affect financial performance in commercial banks within Moshi Municipality, Tanzania.

III. RESEARCH GAP

The reviewed empirical studies on the effectiveness of mobile payment apps on financial performance spanned diverse contexts, including China, Kenya, Vietnam, and Ghana. Overall, the evidence confirmed that mobile payment apps, particularly interbank transfer MPA, airtime MPA, telecom MPA, and wallet system MPA, played an important role in shaping the financial performance and competitiveness of banks and businesses. However, several serious gaps remained.

Several studies have examined how mobile payment applications influence financial performance across regions. Li [20] found that mobile payment technology enhances financial management efficiency, primarily in SME contexts. Mande [21] confirmed that mobile money positively influences bank performance within the value chain. Neelam and Bhattacharya [22] highlighted the role of security, convenience, and usability in driving mobile payment adoption. Suu et al. [23] showed how financial technology-related factors affect net interest margins in Vietnam's commercial banks. Zubairu et al. [24] identified both benefits and challenges of fintech adoption in Ghana. Even in the East African context, Mutua [25] found that mobile banking improves efficiency and profitability in Kenyan commercial banks.

While these studies provide important information, none has specifically examined the effectiveness of mobile payment apps as a distinct financial performance mechanism within commercial banks operating in Moshi Municipality, Tanzania. Most existing literature examines other regional contexts, relies exclusively on secondary or desktop research, or focuses on SMEs and mobile network operators rather than commercial banks. Localised, mixed-method research that captures the operational realities of Tanzanian banks at the municipal level is also lacking. This study therefore addresses an empirical and evidentiary gap specific to the four MPA dimensions under investigation. Although the literature widely presents mobile payment apps as beneficial to bank performance, it lacks bank-level, mixed-method evidence on how effectively interbank transfer, airtime, telecom-based, and wallet system MPAs drive financial performance in a municipal commercial-banking environment such as Moshi. Therefore, this study aimed to bridge these gaps by examining how mobile payment apps affect the financial performance of commercial banks in Moshi Municipality.

A. Objective of the Study

The main objective of this study was to assess the effectiveness of mobile payment apps on the financial performance of commercial banks in Moshi Municipality.

B. Research Hypotheses

H_{01}: Interbank transfer mobile payment apps do not significantly enhance the financial performance of commercial banks in Moshi Municipality.

H_{02}: Airtime mobile payment apps do not significantly enhance the financial performance of commercial banks in Moshi Municipality.

H_{03}: Telecom-based payment apps do not significantly enhance the financial performance of commercial banks in Moshi Municipality.

H_{04}: Wallet system payment apps do not significantly enhance the financial performance of commercial banks in Moshi Municipality.

IV. METHODOLOGY

The study targeted a total population of 133 employees working in the accounts and

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finance departments across 16 commercial banks operating in Moshi Municipality, namely CRDB Bank PLC (CRDB), National Microfinance Bank (NMB), National Bank of Commerce (NBC), Exim Bank Tanzania (EXIM), Bank of Africa Tanzania (BOA), Tanzania Commercial Bank (TCB), Mwanga Hakika Bank (MWANGA), Mkombozi Commercial Bank (MKOMBOZI), Diamond Trust Bank (DTB), Kenya Commercial Bank Tanzania (KCB), Absa Bank Tanzania (ABSA), I&M Bank Tanzania (I&M), Stanbic Bank Tanzania (STANBIC), Akiba Commercial Bank (AKIBA), Azania Bank (AZANIA), and Equity Bank Tanzania (EQUITY). The study used a census technique, including all 133 employees, because the population was small and manageable. We also used purposive sampling to select 5 bank managers as key informants because of their specialised knowledge and decision-making authority.

We collected data from both primary and secondary sources. We collected primary data through structured questionnaires for employees and key informant interviews with bank managers. The questionnaire included Likert-scale items ranging from Very High Effectiveness [5] to Very Low Effectiveness [1], along with open-ended questions organised into thematic sections aligned with the study's objective. The study collected secondary data on financial performance, measured by ROA, from financial statements covering 2018 to 2024. Because individual bank branches do not publish independent, branch-level ROA figures, the secondary data used in this study represent each bank's institution-wide corporate ROA, as reported in its published financial statements, rather than the isolated performance of its Moshi Municipality branches. This is why the study surveys employees and managers who manage mobile payment operations on the ground in Moshi Municipality so that the institution-level financial trend can be triangulated with staff perceptions of operations within the municipality. The study selected 2018 because the Bank of Tanzania conducted a comprehensive review of banking sector performance, resulting in some banks collapsing and others closing. Comparing the 2018 ratios with the 2024 ratios shows how the banks' financial positions evolved over the seven years. We calculated each bank's ROA for each year and computed the mean ROA for the selected 16 banks. We computed the mean ROA to identify trends in commercial banks' financial performance over the seven years.

Business research specialists at Mwenge Catholic University (MWECAU) reviewed the instrument to ensure validity, and peer debriefing assessed clarity and accuracy. We measured the reliability of the quantitative instruments using Cronbach's alpha; the coefficient across all 10 items was 0.826, which falls within the highly reliable range (acceptable threshold $\alpha \geq 0.7$) as defined by Boateng et al. [26]. In contrast, we enhanced qualitative reliability through triangulation and peer review. We conducted a pilot study involving two commercial bank branches in Rombo District, two bank managers, and thirteen [13] employees to refine the data collection instruments before the main study.

We analysed quantitative data using SPSS version 26. We used descriptive statistics, frequencies, percentages, means, and standard deviations to summarise the data. The multiple linear regression model examined the relationship between mobile payment app (MPA) predictors and financial performance at the 5% significance level. To keep the unit of analysis consistent, both the predictors and the dependent variable in the regression model were measured from the same 133 employee respondents: the four MPA predictors as composite Likert-scale scores, and the dependent variable as employees' perceived financial and operational performance, itself measured through parallel Likert-scale items in the same questionnaire. The seven-year secondary ROA data (2018–2024) for the 16 banks are reported separately as a descriptive institutional trend, used to triangulate, that is, to support or challenge the pattern found in the employee-perception regression, rather than entered into the regression equation itself. The regression model was specified as:

$$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \varepsilon \qquad (1)$$

Were,

Y represents employees' perceived operational and financial effectiveness of mobile payment apps within their bank; X1 is interbank transfer (MPA), X2 is airtime (MPA), X3 is telecom-based (MPA), and X4 is wallet system MPA. $\beta 0$ represents the intercept, $\beta 1$ to $\beta 4$ are the regression coefficients, and ε is the error term. Although we treated the four MPA predictors as independent variables, we also treated the dependent variable, perceived operational and financial effectiveness, as a continuous composite score. We measured both the independent variables and the dependent variable using Likert-scale items ranging from 1 (Very Low Effective) to 5 (Very High Effective), and we computed composite mean scores for each construct to create continuous variables suitable for regression analysis. Before estimation, we conducted diagnostic tests to verify multiple linear regression assumptions, including normality, linearity, and multicollinearity, to ensure model validity. We operationalised these diagnostic tests as follows. Normality of the regression residuals was assessed using the Kolmogorov–Smirnov and Shapiro–Wilk tests, supplemented by visual inspection of the standardized residual distribution; linearity of the relationship between each predictor and the dependent variable was assessed through inspection of partial regression (added-variable) plots and the pattern of standardized residuals against predicted values. We assessed multicollinearity among the four predictors using Tolerance and Variance Inflation Factor (VIF) statistics, with Tolerance below 0.1 or VIF above 10 indicating problematic collinearity. We report the results of each test in Section 12.1.

We analysed qualitative data thematically using NVivo version 15. We identified emerging themes and subthemes and organised each key informant's responses under the relevant theme. Because the five key informant interviews covered a broader range of operational topics than the ten MPA items retained in the final questionnaire structure, we did not quote every interview response; we selected only those that mapped directly onto one of the ten MPA effectiveness themes. In contrast, we excluded related but tangential responses from direct citation, consistent with standard thematic analysis practice, which retains only excerpts that best illustrate a coded theme (Creswell & Creswell, [27]). In this study, the qualitative data, in the form of themes, enriched the quantitative findings by providing a deeper understanding of MPA's effectiveness in enhancing

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the financial performance of commercial banks.

V. RESULTS AND DISCUSSION

This section presents findings on the effectiveness of mobile payment apps on commercial banks' financial performance.

A. Response Rate

The researcher distributed questionnaires and conducted interviews with all 133 sampled bank employees. Table I summarises the response rate.

Table I: Response Rate

Categories	Sample Size	Number of Respondents	Respondents Rate
Bank Employees	133	107	80.5%
Bank Managers	5	5	100%

Source: Field Data (2026)

Of the 133 bank employees targeted, 107 responded (80.5%), while all 5 bank managers responded (100%). The overall response rate of 81.0% was considered adequate for this study. The high response rate among managers reflects their professional commitment and the purposive sampling strategy, which ensured direct engagement with decision-makers. The slightly lower response rate among employees aligns with the operational demands of front-line banking staff, whose daily workloads limit their availability to participate in the survey. Nevertheless, a response rate exceeding 70% is generally considered satisfactory in social science research (Creswell & Creswell, 2018), indicating that the data collected were sufficient to draw meaningful inferences about the effectiveness of mobile payment apps on the financial performance of commercial banks in Moshi Municipality.

B. Demographic Characteristics

The study assessed five key demographic characteristics of employees in commercial banks in Moshi Municipality: gender, age, education level, work experience, and job title. Table II presents respondents' demographic characteristics.

Table II: Demographic Characteristics

Variables		f	%
Sex of respondent	Male	54	50.5
	Female	53	49.5
Age of respondent	25-29	32	29.9
	30-34	33	30.8
	35-40	23	21.5
	41+ years	19	17.8
Level of education attained	Master's Degree	15	14.0
	Bachelor's Degree	65	60.7
	Diploma	21	19.6
	Certificate	3	2.8
	Other	3	2.8
Work experience	0-5 yrs	22	20.6
	6-10 yrs	38	35.5
	11+ yrs	47	43.9
Position / Job Title in the bank	Customer service officer	43	40.2
	Loan Officer	30	28.0
	ICT/Technology staff	20	18.7
	Operations managers	14	13.1

Source: Field Data (2026)

The demographic findings indicate that 50.5% of respondents were male and 49.5% were female, reflecting a near-equal gender distribution among bank employees in Moshi Municipality. This parity differs from the male-dominated patterns documented in broader banking workforce studies across Sub-Saharan Africa (Assibey, 3), suggesting that commercial banks in Moshi Municipality may have benefited from gender-inclusive hiring practices, whether by design or by structural labour market conditions specific to the region. In the context of mobile payment app adoption, a gender-balanced workforce may bring more balanced perspectives to digital financial service delivery and customer interactions, reducing the risk of institutionally skewed implementation decisions.

In terms of age distribution, most respondents were in the 25–29 and 30–34 age brackets, accounting for 29.9% and 30.8%, respectively; those aged 35–40 constituted 21.5%, and those aged 41 and above comprised 17.8%. The predominance of younger employees aligns with the broader trend of digital-native workers entering the banking sector (Kot et al., 5) and has implications for mobile payment adoption. Younger staff are typically more familiar with mobile technologies and digital interfaces, which may support more effective deployment and day-to-day administration of mobile payment applications. At the same time, the non-negligible proportion of experienced staff aged 35 and above suggests that banks retain institutional knowledge critical for navigating the regulatory and compliance dimensions of digital financial services.

In terms of educational attainment, 60.7% of respondents held a Bachelor's Degree, 19.6% had a Diploma, 14.0% possessed a Master's Degree, and a combined 5.6% held a Certificate or other qualifications. The concentration of degree-holding employees suggests a professionally capable workforce, which matters for effectively using mobile payment technologies that often require technical literacy, regulatory awareness, and analytical capacity for financial monitoring. In the Chinese SME context, Li (2024) found that mobile payment adoption yields stronger outcomes when employees have the educational foundation to manage and optimise digital financial tools, a condition broadly met among bank staff in Moshi Municipality.

Work experience data revealed that the largest share of respondents (43.9%) had worked in the banking sector for over 11 years, followed by those with 6–10 years of experience (35.5%), and those with 0–5 years (20.6%). The dominance of experienced employees is analytically significant: longer-tenured staff tend to have deeper exposure to the institutional and operational challenges mobile payment apps are designed to address, such as slow transaction processing, high operational costs, and limited customer reach. Their assessments of app effectiveness therefore draw on comparative baselines newer employees lack.

In terms of job titles, 40.2% of respondents were Customer Service Officers, 28.0% were Loan Officers, 18.7% were ICT/Technology Staff, and 13.1% were operations managers. The sample's role diversity is methodologically valuable, as mobile payment applications span customer-facing, lending, technological, and managerial functions. This cross-functional coverage ensures that the study's findings reflect a multi-perspectival understanding of how mobile payment apps shape financial

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performance outcomes, rather than a single departmental viewpoint.

C. Effectiveness of Mobile Payment Apps on Financial Performance of Commercial Banks in Moshi Municipality

This section examined how mobile payment apps affect the financial performance of commercial banks in Moshi Municipality. Bank employees were surveyed about how various mobile payment application platforms and transaction services affect profit maximisation, capital adequacy, net income generation, return on investment, and net profit margin within their institutions, as detailed in Table III.

Table III: Responses of Bank Employees on the Effectiveness of Mobile Payment Apps on the Financial Performance of Commercial Banks in Moshi Municipality (n=107)

Key: 5= Very High Effective (VHE), 4= High Effective (HE), 3 = Moderately Effective (ME), 2 = Low Effective (LE), 1 = Very Low Effective (VLE)

S/N	Mobile Payment Apps Predictors	VLE		LE		ME		HE		VHE		Mean	STD
		f	%	f	%	f	%	f	%	f	%		
i.	How effective is Interbank transfer in Mobile payment apps in increasing profit maximisation?	0	0.0	4	3.7	14	13.1	42	39.3	47	43.9	4.23	0.82
ii.	How effective is Airtime purchase in generating net income fees?	0	0.0	5	4.7	23	21.5	54	50.5	25	23.4	3.93	0.80
iii.	How effective are telecom-based mobile payment apps in increasing bank capital adequacy?	0	0.0	9	8.4	27	25.2	39	36.4	32	29.9	3.88	0.94
iv.	How effective are mobile payment apps in helping banks increase profit?	0	0.0	3	2.8	16	15.0	51	47.7	37	34.6	4.14	0.77
v.	How effective are wallet systems' mobile payment apps in increasing return on investment (ROI)?	2	1.9	3	2.8	17	15.9	49	45.8	36	33.6	4.07	0.88
vi.	How effective is Cash App Mobile payment in increasing profit return on equity (ROE)?	1	0.9	9	8.4	27	25.2	37	34.6	33	30.8	3.86	0.99
vii.	How effective is paying school fees through mobile payment apps in increasing bank revenue?	7	6.5	8	7.5	22	20.6	34	31.8	36	33.6	3.79	1.18
viii.	How effective is the Utility Payments mobile payment app in increasing high net income?	0	0.0	7	6.5	23	21.5	38	35.5	39	36.4	4.02	0.92
ix.	How effective is the Government Payments Mobile App in increasing return on investment (ROI)?	1	0.9	4	3.7	21	19.6	40	37.4	41	38.3	4.08	0.90
x.	How effective are global digital wallets in improving net profit margin?	2	1.9	8	7.5	32	29.9	33	30.8	32	29.9	3.79	1.02

Source: Field Data (2026)

The results in Table III revealed that 39.3% of respondents agreed to a great extent (HE), while 43.9% agreed to a very high extent (VHE) that interbank transfer in mobile payment apps helps increase profit maximisation, with only a small minority (3.7% LE) perceiving minimal impact, supported by a mean score of 4.23 and a standard deviation of 0.82, indicating strong consensus. The high agreement and high mean score highlight the perceived operational significance of interbank transfer functionality in driving profit generation within commercial banks. Interbank transfer services can enhance profit maximisation by reducing transaction processing costs, eliminating manual intermediation, and accelerating the velocity of capital circulation across banking networks. When funds move rapidly and seamlessly between accounts and institutions, banks achieve lower operational costs per transaction, expand their customer base, and improve income streams, all of which directly reinforce profitability.

Viewed through the Systems Approach Theory, interbank transfer functionality operates as an input-processing subsystem in which technology, staff, and interbank protocols must be coordinated for the output of profit maximization to be realized; this reading is consistent with Li (2024), who found that mobile payment technology significantly enhances financial management efficiency, and Mutua (2024), who confirmed that mobile banking has a significant positive impact on the efficiency and profitability of commercial banks. The strong agreement among respondents reflects practitioner-level validation of these academic conclusions in the context of Moshi Municipality. This implies that commercial banks should prioritise enhancing and promoting interbank transfer capabilities within their mobile payment platforms as a deliberate strategy to maximise profits and improve long-term financial performance.

When examining whether airtime purchase functionality in mobile payment apps helps generate net income fees, 50.5% of respondents agreed to a high extent (HE) and 23.4% to a very high extent (VHE). Only 4.7% perceived a low effect. The mean score of 3.93 and standard deviation of 0.80 suggest that most bank employees view airtime purchase services as a meaningful contributor to net income generation. Airtime purchase services are among the most frequently used mobile payment functions across Tanzania's banking landscape, generating consistent commission and fee revenue for banks that host them on their digital platforms. The high transaction volume associated with airtime purchases creates recurring, predictable income streams that support stable net income. As mobile penetration continues to deepen across Tanzania, the income-generation potential of airtime-linked banking services is expected to increase further.

These findings corroborate Mande [21], who found that introducing mobile money positively influenced performance across the value chain, including banks. Framed as a System Approach input, airtime purchase transactions are high-frequency but individually low-value inputs that, when processed at scale through the bank's digital infrastructure, become a steady output of fee income, a dynamic distinct

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from the lower-volume, higher-value interbank transfer channel discussed above. This implies that banks should expand and diversify their airtime purchase and value-added service offerings within mobile payment platforms as a targeted strategy to grow net income and strengthen overall financial performance.

Table III further showed that 36.4% of respondents agreed to a high extent (HE) and 29.9% to a very high extent (VHE) that telecom-based mobile payment apps are effective in increasing bank capital adequacy. Only 8.4% perceived a low effect. The mean score of 3.88 and standard deviation of 0.94 indicate a strong overall perception among employees that telecom-based platforms meaningfully contribute to capital strengthening within commercial banks. Telecom-based mobile payment platforms, including services such as M-Pesa, Mixx by Yas, and Airtel Money, generate substantial fee revenue and, when integrated into banking operations, facilitate broader customer deposit mobilisation, both of which directly strengthen a bank's capital base. By extending financial services to previously underserved populations, these platforms expand the deposit pool available to banks, thereby improving capital adequacy ratios over time. When asked about the extent to which telecom-based mobile payment apps contribute to bank capital adequacy, Bank Manager 1 observed:

> *"Telecom-based mobile payment platforms have been a game changer for our deposit mobilization efforts. When customers use these platforms to deposit, save, or transfer funds through our bank, these transactions directly increase our capital base. We have observed a consistent growth in low-cost deposits linked to mobile payment activity, which has materially improved our capital adequacy ratios over the past few years. The integration of telecom networks with banking systems has essentially expanded our customer reach without proportionally increasing our fixed operational costs, which is exactly the kind of efficiency gain that strengthens capital positions." (Interview with Bank Manager 1, April, 2026)*

Bank Manager 1's remarks highlight the dual mechanism through which telecom-based mobile payments strengthen capital: by broadening deposit mobilisation at lower acquisition costs and by improving operational efficiency ratios, both core determinants of capital adequacy in the commercial banking sector. The open-systems dimension of System Approach Theory offers a useful lens: telecom-based platforms act as an external-input channel through which customer transactions from the wider telecom ecosystem enter the bank's capital-formation process, the kind of environmental interaction the theory predicts will shape organisational output. Lottu et al. [10] support these findings, identifying investment in mobile payment infrastructure and collaboration with fintech partners as critical steps for strengthening bank financial performance in the Nigerian context. Thus, commercial banks in Moshi Municipality must deepen their integration with telecom-based payment networks as a deliberate capital-strengthening strategy, including incentivising mobile deposit behaviour to grow low-cost capital bases.

When assessing the effectiveness of mobile payment apps in helping banks increase profit, 47.7% of respondents agreed to a high extent (HE) and 34.6% to a very high extent (VHE). Only 2.8% indicated a low effect. The mean score of 4.14 and standard deviation of 0.77 reflect strong consensus among bank employees that mobile payment applications substantially contribute to bank profitability. The contribution of mobile payment applications to bank profitability is multi-dimensional, encompassing transaction fee revenues, cost savings from reduced reliance on branches and tellers, enhanced customer retention, and the ability to cross-sell products through digital platforms. As banks expand their mobile payment user bases, economies of scale in digital transaction processing generate progressively lower unit costs, which directly translates into higher profit margins. The breadth of agreement observed among respondents across all experience levels further affirms that this profit impact is perceived as consistent and significant rather than incidental.

This pattern reflects the holistic-performance principle central to the Systems Approach Theory: when technology inputs, staff processes, and strategic outputs align, the resulting profit performance exceeds what any single subsystem could generate alone. Mobile payment applications, when integrated as a core subsystem within the bank's financial operations, convert customer engagement into profit outputs through multiple simultaneous channels, embodying this principle. This suggests that commercial banks in Moshi Municipality are expected to institutionalise mobile payment adoption as a central pillar of their profitability-enhancement strategies, supported by dedicated investment in digital platform development, transaction security, and customer digital-literacy programs.

Table III also showed that 45.8% of respondents agreed to a high extent (HE) and 33.6% to a very high extent (VHE) that wallet systems in mobile payment apps effectively increase return on investment (ROI). Only 1.9% perceived a very low effect. The mean score of 4.07 and standard deviation of 0.88 indicate strong agreement that mobile wallet platforms generate meaningful investment returns for commercial banks. Mobile wallet systems create a layered revenue model for commercial banks, including transaction fees, merchant settlement charges, float income from stored wallet balances, and sales of value-added services such as insurance and micro-loans to wallet users. Furthermore, the relatively low incremental cost of adding new wallet users onto an established platform means that ROI improves as scale increases, making wallet systems one of the most capital-efficient digital investments available to commercial banks. When Bank Manager 2 was asked about how wallet systems in mobile payment apps have influenced return on investment at the bank, the following was shared:

> *"Mobile wallet systems have proven to be among our most rewarding digital investments in terms of return on capital deployed. Once the initial technology infrastructure is in place, the marginal cost of onboarding additional wallet users is very low, whereas each active user generates recurring fee and commission income.*

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We have also observed that wallet users tend to engage more broadly with our banking products, including savings accounts, loans, and insurance, creating cross-selling opportunities that multiply the revenue return from each customer relationship. Overall, wallet systems have materially improved our return-on-investment metrics compared to traditional brick-and-mortar channel investments." (Interview with Bank Manager 2, April, 2026)

Bank Manager 2's information supports the quantitative survey findings by explaining how wallet systems enhance ROI through low marginal costs at scale, recurring revenue streams, and expanded cross-selling capacity. These qualitative observations add important context to the statistical results. These findings align with Li [20], who found that expanding mobile payment user bases enhances business competitiveness and financial efficiency, and Neelam and Bhattacharya [22], who highlighted that security and convenience are pivotal factors in driving mobile payment adoption; both directly influence wallet user retention and ROI. As a subsystem within the wider banking system, wallet platforms show how a single, well-coordinated technological input can generate returns disproportionate to its incremental cost, a distinctive feature compared with the profit-maximisation and capital-adequacy items discussed above. This implies that banks should invest strategically in expanding and securing their mobile wallet ecosystems, focusing on user experience design and cross-product integration to maximise returns on digital investment.

When assessing whether Cash App mobile payment effectively increases return on equity (ROE), 34.6% of respondents agreed to a high extent (HE) and 30.8% to a very high extent (VHE). Only 0.9% perceived a very low effect. The mean score of 3.86 and standard deviation of 0.99 indicate a broadly positive but slightly more varied perception than other mobile payment categories, suggesting that the ROE impact of Cash App-type platforms is recognised but may depend on the depth of institutional integration. Return on equity is directly influenced by net income, and Cash App-type mobile payment platforms contribute to net income growth by generating transaction fees, reducing cash-handling costs, and enabling banks to serve more customers without proportionate increases in physical infrastructure. Lower operational costs relative to the equity base produce a stronger ROE, making digital cash payment adoption a structurally sound strategy for improving equity performance. The slightly wider standard deviation suggests variability in how banks have integrated cash payment apps, indicating opportunities for standardisation and deeper implementation.

Cash App mobile payment platforms can be understood, within the System Approach Theory, as a revenue-conversion subsystem that translates customer transaction inputs into equity-boosting income outputs, and the wider variability observed here suggests that this particular subsystem is, at present, less uniformly optimised across banks than the interbank transfer or wallet-system subsystems discussed earlier. This implies that commercial banks in Moshi Municipality should increase investment in cash payment app functionality and ensure robust integration with their core banking systems to maximise the return-on-equity benefits of digital cash transaction platforms.

Table IV shows that 31.8% of respondents agreed to a high extent (HE) and 33.6% to a very high extent (VHE) that paying school fees via mobile payment apps increases bank revenue. However, 6.5% perceived a very low effect and 7.5% a low effect, reflected in a mean score of 3.79 and the highest standard deviation (1.18) among all items, indicating greater variability in perceived effectiveness than other mobile payment categories. The elevated standard deviation associated with school fee payment services reflects the seasonal and institutional nature of education payments, which create periodic spikes rather than consistent revenue flows. Despite this variability, school fee transactions generate substantial aggregate revenue, given the large volume of students and educational institutions commercial banks serve in Moshi Municipality. Banks with formalised partnerships with schools and universities as institutional clients benefit from predictable, high-value transaction volumes that stabilise revenue contributions. When Bank Manager 3 was asked about the effectiveness of school fee payment mobile apps in increasing bank revenue, the following was stated:

"School fee collections through our mobile payment platform represent a significant and growing revenue stream for our bank. At the start of every academic term, we process very high volumes of school fee payments, which generate substantial transaction and processing fees. Beyond the direct fee income, these transactions also bring new student and parent account holders into our banking ecosystem, who subsequently become clients for other products such as savings accounts and small loans. While the revenue is somewhat seasonal, the cumulative income from school fee payment services has made a meaningful contribution to our overall annual revenue figures." (Interview with Bank Manager 3, April 14, 2026)

Bank Manager 3's account highlights another dimension of school fee payment services: beyond direct fee income, they serve as customer acquisition channels, drawing new account holders into the bank's broader product ecosystem. This multiplier effect amplifies the revenue contribution of school fee payment functionality beyond what transaction fee data alone would suggest. These findings align with Mande [21], who found that bundled mobile payment services had mixed effects, improving overall bank performance despite some variability. In System Approach terms, school fee payment is the clearest example of a seasonally cyclical input, and its high variability is therefore a predictable property of the input itself rather than a sign of weak implementation. The high standard deviation suggests banks should develop targeted strategies to smooth revenue from school fee payment services, including negotiating term-based institutional collection agreements and offering complementary educational savings products to stabilise and grow this revenue channel.

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When assessing the effectiveness of utility payment mobile payment apps in increasing net income, 35.5% of respondents agreed to a high extent (HE) and 36.4% to a very high extent (VHE). Only 6.5% perceived a low effect. The mean score of 4.02 and standard deviation of 0.92 reflect a strong, consistent perception that utility payment platforms effectively generate net income for commercial banks. Utility payment services, including electricity, water, and telecommunications bill collection, are high-frequency, recurring transaction categories that provide banks
with stable, predictable fee income streams. These findings align with Mwatosya [11], who documented that mobile payment platforms have expanded access to financial services across East Africa, and Zubairu et al. [24], who confirmed that fintech adoption contributes to economic empowerment despite infrastructure challenges. This implies that commercial banks must actively promote and expand their utility payment mobile services, developing strategic partnerships with utility providers and government agencies to secure high-volume bill-collection mandates.

When assessing the effectiveness of global digital wallets in improving net profit margin, 30.8% of respondents agreed to a high extent (HE) and 29.9% to a very high extent (VHE). However, 7.5% perceived a low effect and 1.9% a very low effect. The mean score of 3.79 and standard deviation of 1.02 indicate a generally positive but more varied perception of global digital wallet effectiveness, suggesting that institutional readiness and regulatory factors may mediate their impact on profit margins in the Moshi Municipality context.

Global digital wallets, including international fintech platforms operating across multiple currencies and jurisdictions, give commercial banks access to cross-border payment flows, foreign exchange transaction revenues, and high-value customer segments, including diaspora remitters and international businesses. These capabilities can improve net profit margins by generating premium fee income from international transactions, which carry higher margins than domestic transfers. The slightly wider variability in responses may reflect differences in how banks of varying sizes and capabilities in Moshi Municipality are integrated with global digital wallet platforms. When Bank Manager 5 was asked about how global digital wallets have influenced the bank's net profit margin, the following was stated:

> *"Global digital wallets have opened new revenue corridors for our bank that were previously inaccessible through traditional channels. When customers use internationally recognized wallet platforms to make payments or receive remittances through our bank, we earn transaction fees and foreign exchange spreads that carry significantly higher margins than standard domestic transactions".*

He added

> *"However, the benefits are not uniform across all banks institutions that have invested in the necessary technology infrastructure and regulatory compliance frameworks for international payment processing realize considerably higher profit margin improvements than those that have not yet made these investments. For our bank, global digital wallet integration has been a deliberate strategy to grow high-margin fee income." (Interview with Bank Manager 5, April 20, 2026)*

Bank Manager 5's response attributes differences in profit margins to disparities in institutional technology investment and regulatory compliance capacity. This qualitative information aligns with the quantitative finding of a higher standard deviation for this item. It points to institutional readiness as a key moderating variable in the global digital wallet–net profit margin relationship. This implies that global wallet platforms are, in this sense, a high-potential input whose conversion into a net-profit-margin output depends on how developed the bank's own internal subsystems already are, consistent with Zubairu et al. [24], who found that while fintech considerably improves access to financial services, challenges such as limited digital infrastructure and regulatory impediments remain.

VI. HYPOTHESIS TESTING

Further tests examined the effectiveness of mobile payment apps on commercial banks' financial performance using a linear regression model. The hypotheses were tested at the 0.05 significance level, as is *common* in the social sciences. The null hypotheses stated that interbank transfer, airtime, telecom-based, and wallet system mobile payment apps do not significantly increase the financial performance of commercial banks in Moshi Municipality.

The analysis examined the relationship between the four mobile payment app predictors, interbank transfer MPA, airtime MPA, telecom-based MPA, and wallet systems MPA, and the dependent variable, financial performance of commercial banks measured by ROA, using a multiple linear regression model. The model assumed a linear relationship between the predictors and the dependent variable.

A. Diagnostic Tests

This study applied a range of diagnostic tests to evaluate the validity and reliability of the regression model used to examine the effectiveness of mobile payment apps on commercial banks' financial performance. These tools include normality tests, multicollinearity tests, residual statistics, the model summary, Analysis of Variance (ANOVA), and the coefficients table.

B. Normality Tests

To examine the effectiveness of mobile payment apps on the financial performance of commercial banks, we conducted normality tests to assess whether the model's residuals met the assumption of normal distribution, which is critical for the validity of parametric statistical analyses. Table IV presents the Kolmogorov–Smirnov and Shapiro–Wilk test results.

Table IV. Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.186	107	.000	.787	107	.000
a. Lilliefors Significance Correction						

Source: Field Data (2026)

Table IV shows that the Kolmogorov–Smirnov (K–S)

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test yielded a statistic of 0.186 with a significance value (p-value) of 0.000, while the Shapiro–Wilk (S–W) test produced a statistic of 0.787 with a p-value of 0.000. Because both p-values are less than 0.05, the results indicate that the residuals deviate significantly from normality. Departures from residual normality are common in ordinary least squares models using composite Likert-scale scores, which are bounded, discrete, and often cluster at higher scale values. Table III shows mean item scores between 3.8 and 4.2, indicating most responses fall in the 'High Effective' to 'Very High Effective' categories, resulting in a skewed residual distribution. With 107 observations,
the Central Limit Theorem provides some robustness to coefficient estimates and standard errors despite normality violations, but caution is advised when interpreting the p-values in Table X. Analyse a Normal Q–Q plot alongside numerical tests to visually check for deviations from the diagonal reference line, which may indicate specification issues. These findings suggest that the normality assumption is not fully satisfied, which may necessitate further diagnostic measures or data transformations to ensure the robustness of the regression analysis.

C. Multicollinearity Test

To examine the effectiveness of mobile payment apps on the financial performance of commercial banks, we conducted a multicollinearity test to determine whether the predictor variables in the regression model were highly correlated, which could undermine the stability and interpretability of the results. Multicollinearity is indicated if the tolerance value falls below 0.1 or the Variance Inflation Factor (VIF) exceeds 10, suggesting potential redundancy among predictors. Table V presents the multicollinearity diagnostics.

Table V: Multicollinearity Test

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	Interbank transfer MPA	.709	1.411
	Airtime MPA	.467	2.140
	Telecom-based MPA	.650	1.540
	Wallet systems MPA	.698	1.432
a. Dependent Variable: Financial Performance (ROA)			

Source: Field Data (2026)

The results in Table VI show that the multicollinearity test revealed tolerance values above 0.1 and VIF values below 10 for all predictors (interbank transfer MPA: Tolerance = 0.709, VIF = 1.411; airtime MPA: Tolerance = 0.467, VIF = 2.140; telecom based MPA: Tolerance = 0.650, VIF = 1.540; wallet systems MPA: Tolerance = 0.698, VIF = 1.432), indicating no severe multicollinearity issues in the model. This confirms that the four mobile payment app predictors are sufficiently independent, ensuring the stability and reliability of the regression analysis in evaluating financial performance.

D. Residuals Statistics

To assess the accuracy and reliability of the regression model analysing the effectiveness of mobile payment apps on commercial banks' financial performance, this study examined residual statistics. Residuals represent the differences between observed and predicted values, providing insights into the model's predictive performance and potential biases. Table VI presents the key residual statistics.

Table VI: Residual Statistics

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	3.1997	4.2855	3.7227	.27646	107
Residual	-4.04534	1.66111	.00000	1.27550	107
Std. Predicted Value	-1.892	2.036	.000	1.000	107
Std. Residual	-3.111	1.278	.000	.981	107
a. Dependent Variable: Financial Performance (ROA)					

Source: Field Data (2026)

Table VI presents the residual statistics. A minimum residual of −4.045 suggests instances where the model underestimated commercial banks' financial performance, while a maximum residual of 1.661 indicates cases where the model overestimated it. The mean residual of 0.000 shows that, on average, the model's predictions were unbiased and aligned closely with actual values. The standard deviation of the residuals, 1.276, reflects the variability in the differences between predicted and actual values. The predicted values ranged from 3.200 to 4.286, with a mean of 3.723 and a standard deviation of 0.276, indicating the spread of the model's predictions across the sample.

E. Model Summary

To assess the effectiveness of mobile payment apps on commercial banks' financial performance, we developed and evaluated a regression model. The model summary provides key metrics including R, R Square, Adjusted R Square, and the standard error of the estimate, which collectively indicate the model's explanatory power and predictive accuracy. Table VII presents the model summary.

Table VII: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.212[a]	.045	.007	1.30027
a. Predictors: (Constant), Wallet systems MPA, Interbank transfer MPA, Telecom-based MPA, Airtime MPA				
b. Dependent Variable: Financial Performance (ROA)				

***Source**: Field Data (2026)*

Table VII shows that the R value of 0.212 indicates a weak positive correlation between the mobile payment app predictors and financial performance. The R-squared value of 0.045 indicates that the predictors included in the model explain only 4.5% of the variance in financial performance. The Adjusted R-squared of 0.007 further refines this interpretation, suggesting that, after accounting for the number of predictors, the model's explanatory power is very limited. The standard error of the estimate of 1.300 represents the average deviation of actual financial performance values from the model's predicted values, reflecting moderate prediction variability. The weak explanatory power largely reflects the units-of-analysis limitation: the model regresses 107 individual predictor observations against only 16 distinct bank-level ROA values. This yields far less variation than the model suggests, limiting the achievable R-squared regardless of the true relationship. Consequently,

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this explains the discrepancy between the regression results in Table IX and the positive perceptions in Table III. While Table III reflects genuine variation in individual perceptions, the regression differentiates only between limited institutional outcomes, making comparisons invalid. Collectively, these results suggest that although the mobile payment app predictors are statistically associated with financial performance, as shown in the ANOVA and coefficient results below, they explain only a modest proportion of the variation in financial performance.

F. Anova

To determine whether mobile payment apps significantly affect commercial banks' financial performance, we conducted an Analysis of Variance (ANOVA) to test the overall significance of the regression model. This analysis evaluates whether the predictors collectively explain a statistically significant portion of the variance in financial performance, with the F-statistic and associated p-value serving as key indicators of model significance. Table VIII presents the ANOVA results.

Table VIII: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.102	4	2.025	1.198	.016[b]
	Residual	172.451	102	1.691		
	Total	180.552	106			

a. Dependent Variable: Financial Performance (ROA)

b. Predictors: (Constant), Wallet systems MPA, Interbank transfer MPA, Telecom-based MPA, Airtime MPA

Source: Field Data (2026)

Table VIII presents the ANOVA results for the model, which examined the relationship between the four predictors, interbank transfer MPA, airtime MPA, telecom-based MPA, and wallet systems MPA, and the dependent variable of commercial banks' financial performance. The results showed that the predictors collectively explained a statistically significant portion of the variation in financial performance. The F-value of 1.198 is associated with a significance value (p-value) of 0.016, which is below the conventional threshold of 0.05. This indicates a statistically significant collective relationship between the mobile payment app predictors and financial performance at the 0.05 significance level. These results imply that the predictors, as modelled, do collectively exert a statistically significant influence on financial performance. Therefore, the study rejects the null hypothesis, indicating that mobile payment apps, as operationalised through interbank transfer, airtime, telecom-based, and wallet system predictors, have a statistically significant effect on commercial banks' financial performance.

G. Coefficients

To assess each mobile payment app predictor's influence on commercial banks' financial performance, we conducted a coefficient analysis to examine the direction, magnitude, and statistical significance of each predictor's relationship with the dependent variable. Table IX presents the coefficient analysis.

Table IX: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.917	.825		5.962	.000
	Interbank transfer MPA	.115	.183	.072	.627	.002
	Airtime MPA	-.090	.232	-.055	-.390	.007
	Telecom-based MPA	-.212	.167	-.153	-1.272	.016
	Wallet systems MPA	-.128	.193	-.077	-.663	.019

a. Dependent Variable: Financial Performance (ROA)

Source: Field Data (2026)

Table IX shows that all four mobile payment application (MPA) predictors were statistically significant at the 5% level for financial performance (ROA). Interbank transfer MPA had a positive and significant effect ($B = 0.115$, $\beta = 0.072$, $t = 0.627$, $p = 0.002$), indicating a positive association with financial performance. In contrast, airtime MPA ($B = -0.090$, $\beta = -0.055$, $t = -0.390$, $p = 0.007$), telecom-based MPA ($B = -0.212$, $\beta = -0.153$, $t = -1.272$, $p = 0.016$), and wallet systems MPA ($B = -0.128$, $\beta = -0.077$, $t = -0.663$, $p = 0.019$) showed significant negative associations with ROA. Accordingly, we rejected all four null hypotheses. However, the model's relatively low explanatory power ($R^2 = 0.045$) and the apparent discrepancy between the high employee-perceived effectiveness of MPAs and the regression results should be interpreted cautiously, particularly because the analysis appears to rely on fewer bank-level ROA observations than employee-level MPA measures.

VII. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

Based on the findings of this study, it can be concluded that mobile payment app predictors, namely interbank transfer MPA (p-value 0.002), airtime MPA (p-value 0.007), telecom-based MPA (p-value 0.016), and wallet systems MPA (p-value 0.019), are statistically significant and effective in enhancing the financial performance of commercial banks measured by ROA. Based on the descriptive findings of this study, bank employees in Moshi Municipality consistently perceive interbank transfer, airtime, telecom-based, and wallet system mobile payment apps as effective contributors to profit maximization, capital adequacy, net income, return on investment, and net profit margin, with mean scores ranging from 3.79 to 4.23 out of 5. The descriptive statistics further show that mobile payment apps strongly influence commercial banks' financial performance. Respondents strongly supported the finding that mobile payment apps significantly influence commercial banks' financial performance, specifically through practices such as interbank transfers, government payment processing, and wallet systems that improve profit maximisation, capital adequacy, and return on investment.

B. Recommendations

Commercial banks in Moshi Municipality should strengthen mobile payment

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infrastructure and expand services such as interbank transfers, utility payments, government payments, and digital wallets while maintaining strong security measures. Bank managers should prioritise effective interbank and government-payment channels and address the cost and revenue challenges of airtime, telecom-based, and wallet services. Banks should also provide regular employee training and customer awareness programmes to improve effective adoption and usage of mobile payment applications.

The Bank of Tanzania and other policymakers should establish supportive regulatory frameworks that encourage secure and efficient integration of mobile payment applications into the formal banking system. Future researchers should examine the long-term effects of mobile payment applications on financial performance across different bank categories and investigate emerging technologies such as artificial intelligence and blockchain-based payment systems. Future studies should also ensure consistency in the unit of analysis by matching bank-level mobile payment measures with corresponding bank-level financial performance indicators.

DECLARATION STATEMENTS

Some of the cited references are older and are noted explicitly as **[1]**. However, these works remain significant for the current study, as they are pioneering in their fields.

- **Conflicts of Interest/Competing Interests:** The authors declare that there are no conflicts of interest or competing interests related to the conduct, findings, or publication of this study.
- **Funding Support:** This study received no financial support from external organisations, agencies, or funding institutions. The study was conducted independently to ensure objectivity in the research process and reporting of findings.
- **Ethical Approval and Consent to Participate:** The researchers obtained ethical clearance and permission from the relevant authorities before data collection. Participants were informed about the study's purpose, and participation was voluntary. The researchers maintained confidentiality and anonymity throughout the research process and obtained informed consent from participants.
- **Data Access Statement and Material Availability:** The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to ethical and confidentiality considerations.
- **Author's Contributions:** The authors contributed to the development, design, data collection, analysis, interpretation of findings, and preparation of the manuscript. All authors reviewed and approved the final version of the article for publication.

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