



Assessing The Effects of Digital Financial Services on Financial Performance of Commercial Banks in Rwanda (2019-2025)

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Abstract: *This study assessed the effects of Digital Financial Services (DFS) on the financial performance of commercial banks in Rwanda.. The purpose was to examine how DFS channels; mobile banking, internet banking, and ATM/card services impact key financial performance indicators, namely Return on Assets (ROA) and Return on Equity (ROE). The research adopted a descriptive and explanatory design, using secondary data from nine commercial banks over six years, yielding 54 firm-year observations. Data was analyzed using descriptive statistics and multiple linear regression to test hypotheses. Findings revealed that DFS adoption positively influenced ROA and ROE, with internet banking and mobile banking contributing most significantly to profitability and efficiency. However, high investment costs, cybersecurity risks, and regulatory compliance requirements were noted as challenges that can offset short-term gains. The study concludes that DFS enhances operational efficiency, diversifies revenue streams, and strengthens risk management, but requires careful cost control and innovation strategies. It is recommended that Rwandan commercial banks continue investing in secure digital infrastructure, expand customer-centric DFS products, and strengthen regulatory compliance to maximize long-term financial performance.*

Keywords: *Financial Performance; Digital Financial Services; Automated Teller Machines (ATMs) Mobile Banking ; and Internet banking*

How to cite this work (APA):

Manishimwe, E. & Tarus, T. (2026). Assessing The Effects of Digital Financial Services on Financial Performance of Commercial Banks in Rwanda. (2019-2025). *Journal of Research Innovation and Implications in Education*, 10(3), 13 – 22.
<https://doi.org/10.59765/nvd29f>

1. Introduction

The global financial industry has undergone profound transformation driven by the adoption of Digital Financial Services (DFS). These services—comprising mobile banking, internet banking, ATM/card services, and agency banking—have become central to enhancing profitability, reducing operational costs, and expanding financial inclusion. According to the World Bank (2021), global account ownership rose from 51% in 2011 to 76% in 2021, largely due to digital channels. Similarly, McKinsey & Company (2023) reported that more than 60% of client

interactions in advanced banking markets now occur online, significantly reducing branch traffic and operational expenses. At the global level, DFS has reshaped financial ecosystems by diversifying revenue streams, improving credit risk assessment, and strengthening customer retention.

Regionally, Africa has emerged as a leader in DFS adoption, accounting for nearly half of global mobile money accounts and 70% of transaction volumes (AfDB, 2025). Platforms such as M-Pesa, MoKash, and K-Advance have expanded access to payments, savings, credit, and insurance. Empirical studies confirm these impacts: Necib (2024) found that online banking significantly improved ROA and ROE among French

banks, while Mugisha (2024) reported that e-banking positively influenced profitability in Kenyan commercial banks. In East Africa, DFS has also contributed to capital market development, exemplified by Kenya's mobile-only government bond, M-Akiba, which broadened investment opportunities among the general population (EADB, 2025).

Locally, Rwanda has embraced DFS through national digital strategies and regulatory oversight by the National Bank of Rwanda (BNR). Between 2019 and 2025, DFS income grew from 18% to 35% of total banking revenues (BNR, 2025). Mobile network operators such as MTN Rwanda and Airtel, alongside commercial banks, have expanded mobile wallets, agency banking, and internet banking services. These innovations have reduced transaction costs, increased non-interest income, and improved credit risk assessment for SMEs (Lynca, 2024). However, challenges remain, including high investment costs, cybersecurity risks, and intensified competition from fintech firms, which may offset short-term profitability.

While global and regional studies have demonstrated the positive impact of DFS on financial performance, most existing research in Rwanda has focused on **financial inclusion** and SME growth rather than institutional performance. Scholars such as Uwababyeyi & Rulinda (2024) highlighted correlations between financial innovations and bank performance, but comprehensive evidence on how DFS adoption affects **ROA, ROE, and overall profitability of commercial banks** remains limited. This creates a critical research gap: the lack of empirical analysis on whether DFS adoption translates into measurable improvements in the financial performance of Rwandan commercial banks. This study therefore seeks to fill that gap by systematically assessing the effects of DFS on ROA, ROE, and overall profitability of commercial banks in Rwanda between 2019 and 2025.

1.2 Statement of Problem

Digital Financial Services (DFS) is a fast-growing market across the globe and commercial banks continue to make substantial investments in digital technologies, anticipating improved financial outcomes. In Rwanda, Digital Financial Services has grown significantly, and all is due to help from National Bank of Rwanda (BNR) and other key players like Rwanda Stock Exchange (RSE), and Rwanda Bankers Association (RBA). From 2019 to 2025 income from Digital Financial Services grew from 18% to 35% these changes point to a significant opportunity for enhanced commercial bank performance. Increased digital transactions can save operating costs for branches and cash handling, increase non-interest revenue through

transaction fees, and improve liquidity management through real-time settlements.

Despite this rapid growth of DFS in Rwanda which improved financial inclusion rose from 65% in 2018 to 77% in 2025, e-payment usage rose at 54% in 2025, and adult owning phone at 87% which increased at 38% from 2019 to 2025 their actual effects of on financial performance of banks is still ambiguous (Sossouvi, 2021). Although DFS are thought to reduce operating costs, enhance service delivery, and broaden customer experience, it requires substantial upfront investment in ICT infrastructure, cybersecurity systems, staff training, and regulatory compliance. These costs may offset short-term profitability and increased competition from fintech firms and mobile money operators may pressure traditional banks' margins. (AccessToFinanceRwanda, 2020). According to Abenaa Addai (2020), different organizations see enhanced profitability, customer obsession; whereas others encounter difficulties linked to system downtime, cybersecurity risk, elevated implementation costs, and low customer adoption (RUGIRANGOGA, 2024).

Existing scholars have primarily emphasized the contribution of DFS to elevating financial inclusion and fostering the growth of SMEs. Yet relatively little attention has been directed toward understanding how the usage of DFS affects fundamental performance indicators of commercial banks in Rwanda—namely profitability, operational efficiency, asset quality, and revenue diversification. While earlier studies underscore the social and developmental advantages of digital finance, they often overlook its direct institutional and financial consequences. This disparity emphasizes the necessity to investigate whether DFS growth results in quantifiable gains in Rwandan commercial banks' financial performance.

1.3 Objectives of the Study.

1.3.1 General Objectives

The general objective of the study was to assess effects of Digital Financial services on the financial performance of commercial bank in Rwanda.

1.3.2 Specific Objectives.

1. To investigate the impact of Digital Financial Services on ROA of banks in Rwanda.
2. To assess how DFS influence the Return on Equity (ROE) of commercial banks in Rwanda.
3. To analyze the overall effect of Digital Financial Services on commercial banks' performance.

Hypothesis of the Study

Ho1: DFS have no effect on ROA of Rwandan commercial banks.

Ho2: DFS have no influence on Return on Equity of commercial banks in Rwanda.

Ho3: “Digital Financial Services has no effects on overall Financial Performance of commercial banks in Rwanda.

2. Literature Review

This section covers conceptual review, theoretical frameworks and empirical studies in relation to the research variables. It also presents the conceptual framework and emphasizes the research gap that the study addresses.

2.1 Conceptual Review

Financial performance refers to the extent to which a financial institution generates returns from the resources under its control. In this study, financial performance is operationalized using ROA and ROE. ROA is calculated as net income divided by total assets and indicates the return generated from the asset base. ROE is calculated as net income divided by shareholders' equity and indicates the return generated on owners' capital.

Digital Financial Services refer to financial products and transactions delivered through digital technologies and channels. The study focuses on three observable channels contained in the supplied dataset: mobile banking, internet banking, and ATM/card services. Agency banking was discussed in the dissertation, but it was not included in the supplied regression dataset; it is therefore not treated as an explanatory variable in the revised empirical analysis

2.1.1 Financial Performance

It reflects certain degree at which a institution/firm generates profits and effectively manages its resources. Strong performance signals stability, sustainable growth, and enhanced investor confidence (Kenton, 2025). Various metrics are employed to evaluate financial performance; however, Return on Assets (ROA) is widely regarded as a key indicator of profitability and efficiency. ROA measures how effectively a firm utilizes its assets to produce earnings, expressed as a percentage (Maja, 2024). A higher ROA percentage indicates better resource utilization and stronger managerial efficiency (Maja, 2024).

2.1.2 Digital Financial Services (DFS)

According to World Bank (2025), these financial services and products are issued using online tools and technology, including smartphones, ATMs/cards, and other electronic

channels. According to financeec (2025), Mobile money, online banking, agency banking, and mobile banking are some of these services that are worldly consumed. DFS makes it possible for people and companies to easily virtually transact. Customers gain from easily available, effective, and user-friendly financial services, while financial institutions profit from transaction fees and higher transaction volumes. (finance.ec, 2025).

2.1.3 Mobile Banking

This is usage of mobile phones to transact through USSD code and banking apps on the mobile. Mobile banking has easy the way customers receive services from banks such as purchase of airtime, deposit, paying bills, money transfer, loan request, and withdrawals (Innocente, 2024). Mobile banking facilitates emergency response and disaster recovery as it acts as a digital lifeline when physical infrastructure is inaccessible for example during Covid-19 customers were still able to transact using mobile banking. Mobile banking enables operational continuity as banks use mobile banking to notify customers of the trends and how they can access the services. Besides, mobile banking transparency and accountability to both customers and commercial banks can track transactions, bank statements and all historical records on the phone; thus, providing customer satisfaction. In addition, mobile banking has enabled commercial banks to obtain affordable transaction fees from their clients and to tap in the unusual markets that would be impossible for commercial banks to access; for example, rural and diaspora population (Nyataya & Ukwimanishaka , 2022).

2.1.4 Internet banking.

This is a platform that allows customers to carry out financial transactions through a bank's website or mobile application (Lundin, 2024). Banks use core banking systems like swift payment, RTGS, EFTs, among others to enable customers to make secured payments both local and international. More than 11,000 institutions use swift payments which enable institutions to stay connected and make more than 5% of the revenues for financial institutions and in 2025 the global digital banking sector generated \$1.61 trillion and since 2018 1,646 physical branches have closed in the U.S which highlight move to digital banking (Malyshev, 2025). Bank of Kigali's 2023 financials highlighted that internet banking and other digital banking contributed to 34.8% of non-interest income year to year and their operating income increased by 23.6% which highlights highest contribution of bank financial performance (Marguerite, 2024).

2.1.5 ATM/Card Services

According to Amanda (2025), an Automated Teller Machine (ATM) is a self-service banking device that uses a card and a personal identification number (PIN) to allow

users to check account balances, make deposits, and withdraw cash. ATMs have evolved as before, they are only used for withdrawals, but currently as technology has evolved now, they are used to deposit cash, make transfers, check balance and change PIN, which has eased the way customers interact with banks. (Kagan, 2025). In 2022 Bank of Kigali had over 100 ATMs across the country which improved financial performance through transactional fees for both internal and external clients and not it boosted their financial performance, but also it has improved operational efficiency through reduction of operation costs for instance Bank of Kigali have employed 70 offsite branches which minimized the need to recruit employees that increases costs to bank (UMUTONI, 2023).

2.2. Theoretical Review

2.2.1 Everett Rogers' Diffusion of Innovation Theory (1962):

According to Halton (2026), It illustrates how new concepts, products, and technology proliferate from inventors to the public over time. This is most important when analyzing the adoption of different Digital Financial Services (DFS). This theory shows that there are different categories of people which include innovators which are open to risk which make them first to try new ideas, and, in this context, we analyze to see how the innovators in DFS are affected especially on Rwanda's context (Halton, 2026) t. For example, Bank of Kigali is identified as leading institution to adopt DFS in Rwanda and they have managed to be the largest institution to have extensive ATM networks across the country and they pioneered in digital payment solutions among others; thus, being awarded the best bank in Rwanda for the fifth time by Global Finance Magazine; besides, it has helped to serve more than one million clients (BK, 2025).

2.2.2 Technology Acceptance Model (TAM)

It was invented by Davis Fred in 1989 and serves as the cornerstone of information technology since it illustrates how consumers embrace and modify new technologies (Dziak, 20202). According to Schorr (2023), people adopt technology based on perceived usefulness (PU), which means it enhances performance, and perceived ease of use (PEOU), which shows how much people trust the system is easy to use. As a result, it affects behavior, attitude toward the use, and system use.

2.2.3 Financial intermediation theory

States that by connecting the need between surplus and deficit units, institutions like banks work as middlemen to lower transaction costs and lessen information asymmetries (Boot, Mr. Lev , Mr. Luc, & Peter, 2020). According to Wilson (2025), digital channels play a big role in enhancing and accelerating modernization core intermediation functions by the usage of technology to

lower costs, improve accessibility, and monitoring. Financial Intermediation theory was started in 1960s by Gurley and showed, it was modernized in early 20th century, and it was due to information asymmetry occurs when one party in the economy possesses greater knowledge than the other in the economy (Wilson, 2025). Since all players have access to the information, there are no transactional costs associated with accessing it in the neoclassical model of a perfect financial market (Boot, Mr. Lev , Mr. Luc, & Peter, 2020).

2.2.4 Dynamic Capabilities Theory by David Teece and Gary (1994)

This theory highlights how companies achieve sustainable competitive advantage in the rapidly changing ecosystem. "This theory highlights that a company should react swiftly to opportunities and challenges, new strategic assets, and modify current assets to satisfy shifting market demands (Jocelyn, 2024)." Therefore, this theory is applicable to the study as firms leverage the usage of new technologies to create new business models as commercial banks adopt usage of digital financial services to create new business models, strategic alliances where commercial banks patternner with Mastercard, Visa card among other stakeholders to keep up with the market trends and meet customer needs.

2.3. Empirical Review

2.3.1 Internet banking and financial performance.

According to Opuni-Frimpong, Modupe , & Justice (2025), Internet banking has been widely adopted by commercial banks to elevate efficiency and financial results. Theoretically it reduces transaction costs, improves asset utilization and expands non-interest income for commercial banks; thus, strengthens financial performance indicators such as ROA. According to Sarah &Rulinda (2024), in Rwanda introduction of internet banking has enabled sector an increase on ROA of 0.94% in 2020 and 2.98% in 2022; which reflects efficiency assets utilization. Not only in Rwanda internet banking has improved financial performance, also in Kenya has accounted for increase of 64.3% in 2022 which highlights its contribution to profitability of commercial banks in east Africa (Abebe Tilahun Kassaye* & Anteneh , 2025). According to Opuni-Frimpong, Modupe , & Justice (2025), "the study carried out in Ghana from 20 universal banks between 2017 and 2022 show that there is positive correlation of Digital Financial Services on financial performance as it shows positive impact on return on assets and return on equity as key metrics for financial performance of financial institutions." This has improved bank efficiency, operational capacity, and profitability for all financial sector either small, big and micro financial institutions.

2.3.2 Mobile banking and financial performance.

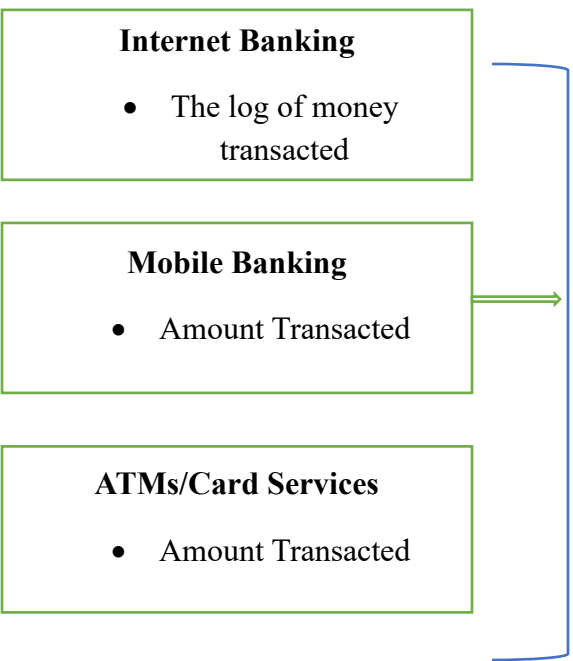
According to (Shyaka 2021), Numerous research conducted in Rwanda have shown that mobile banking and banking financial success are positively correlated. For instance, according to Lynca (2024), “reported a strong positive correlation between mobile banking and financial performance at Bank of Kigali ($r = 0.798, p < 0.05$).” This finding indicates that electronic banking significantly enhances institutional performance, suggesting that digital financial services contribute to improved profitability and efficiency (Shyaka, 2021).

2.3.3 ATMs/Card services and financial performance.

Globally, the use of ATMs and card services has remained relatively stable despite increasing competition from other digital payment channels. Their continued relevance reflects both sustainability and cost-effectiveness, as they provide customers with 24/7 access to funds at lower costs compared to traditional teller services.

Independent Variable

Digital Financial Services



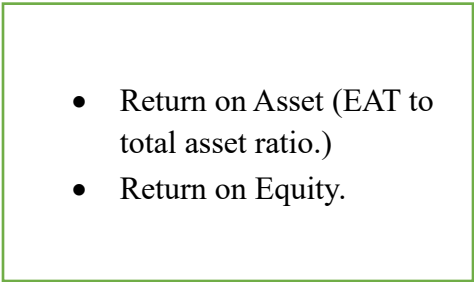
A study by Uwababyeyi and Ephrard (2024), conducted at BPR between 2020 and 2022, “examined the relationship between financial innovation and bank performance using questionnaires, interviews, and document reviews.” According to Izabayo & Rulinda (2024), “innovations such as mobile banking, internet banking, the BPR App, and ATMs contributed positively to key performance indicators including Return on Assets (ROA), Return on Equity (ROE), and Net Interest Margin (NIM) and study recommended that BPR continue investing in digital financial services to further enhance its financial performance.”

2.4 Conceptual Framework

Conceptual framework refers to visual or written research agenda that shows key variables of research and their connection. According to Kothari (2004), shows how independent and dependent variables in research have a cause-and-effect relationship. Independent Variable in this research is Digital financial services and dependent variables is financial performance.

Dependent Variable.

Financial Performance



2.5. Research Gap

Most of the earlier research emphasizes how technology-driven banking solutions support financial inclusion and enhance consumer satisfaction. However, there hasn't been much focus on how these advances affect banks' overall financial results using objective metrics like ROA profitability ratios. Ogotu and Fatoki (2019), for example, studied the usage of electronic channels in Kenya, but their research was limited to that nation and did not investigate the operational trade-offs that come with the expansion of such services. To close this gap, the current study examines how Rwandan commercial banks' profitability and sustainability are impacted by technology-enabled banking platforms, considering both immediate and long-term consequences (Saunders et al., 2019; Kothari, 2004).

3. Methodology

3.1 Research Design

The study uses a quantitative, explanatory design supported by descriptive and time-series analysis. The descriptive component summarizes changes in digital transaction activity and bank profitability over time, while

2.5 Measurement of Variables

the explanatory component uses OLS regression to examine the statistical association between digital-service indicators and financial-performance measures.

3.2 Study Population and Unit of Analysis

The study population comprised nine commercial banks identified in the supplied dissertation. The empirical dataset, however, is reported in annual sector-level aggregates rather than bank-by-bank observations. The available observations cover six years, 2019–2024. Accordingly, the unit of analysis for the regression models is the annual aggregate observation ($n = 6$).

3.3 Data Sources and Collection Instrument

The study relies exclusively on secondary data contained in published financial statements, banking-sector reports, and digital-finance statistics identified in the supplied research materials. A document-analysis guide was used to extract annual figures for mobile banking, internet banking, ATM/card transactions, net profit, total assets, and total equity. The extracted data were checked for consistency across years and transformed into ratios for ROA and ROE.

Table 1. Operationalization of study variables.

Variable	Operational measure	Role
Mobile banking	Annual mobile-banking transaction volume	Independent
Internet banking	Annual internet-banking transaction volume	Independent
ATM/card services	Annual ATM/card transaction volume	Independent
ROA	Net profit ÷ total assets × 100	Dependent
ROE	Net profit ÷ total equity × 100	Dependent

3.5 Data Processing and Analysis

Data were coded, edited, checked, and transformed into a consistent annual format. Descriptive statistics included means, standard deviations, ranges, skewness, and kurtosis. Pearson correlation coefficients were used to examine pairwise associations. OLS regression was then used separately for ROA and ROE. The general model was specified as:

$$Y_t = \beta_0 + \beta_1 MB_t + \beta_2 ATM_t + \beta_3 IB_t + \varepsilon_t$$

where Y is either ROA or ROE, MB is mobile-banking transactions, ATM is ATM/card transactions, IB is

internet-banking transactions, β_0 is the intercept, β_1 – β_3 are coefficients, and ε is the error term.

The supplied EViews output was also examined for normality, serial correlation, heteroskedasticity, and multicollinearity. The revised interpretation places particular emphasis on sample size and the very high correlation between mobile and internet banking, because these conditions materially limit the strength of coefficient-level inference.

3.6 Validity, Reliability and Ethical Considerations

Validity was supported through the use of clearly defined financial ratios and transaction measures and by tracing the extracted figures to published institutional sources identified in the research materials. Reliability was addressed through consistent extraction and checking procedures across years. Because the study uses publicly available secondary data, no personal participant information was collected. Academic integrity was maintained by acknowledging the sources of published information and avoiding alteration of reported figures.

3.7 Limitations

The principal limitation is the small number of annual observations available for the regression analysis. Six observations and three explanatory variables leave very limited degrees of freedom and make coefficient

estimates sensitive to individual years. A second limitation is the very high correlation between mobile and internet banking, which creates multicollinearity and makes it difficult to isolate the independent contribution of each channel. Third, the analysis uses annual aggregate data, so it cannot establish bank-specific effects or fully control for differences in bank size, capitalization, macroeconomic conditions, or management. These limitations mean that the regression findings should be treated as exploratory evidence rather than definitive causal estimates.

4. Results and Discussion

4.1 Digital Financial Services Transaction Trends

Table 2. Digital financial services transactions, 2019–2024.

Year	Mobile banking	Internet banking	ATM/card
2019	1,808,944	2,276,446	578,060
2020	2,349,788	2,362,415	678,911
2021	7,176,221	3,446,124	1,079,762
2022	10,439,129	5,378,195	804,163
2023	20,776,838	10,697,166	98,774
2024	30,127,667	17,303,488	480,233

Mobile banking increased from 1,808,944 transactions in 2019 to 30,127,667 in 2024, while internet banking increased from 2,276,446 to 17,303,488. ATM/card transactions increased from 578,060 in 2019 to 1,079,762 in 2021, then fell sharply in 2023 before partially

recovering in 2024. The pattern indicates a substantial expansion of mobile and internet channels alongside greater volatility in ATM/card activity.

4.2 Financial Performance Trends

Table 3. Return on Assets, 2019–2024.

Year	Net profit (RWF bn)	Total assets (RWF bn)	ROA
2019	65.93	2,806.60	2.35%
2020	69.97	3,544.81	1.97%
2021	102.71	4,176.21	2.46%
2022	145.00	4,814.54	3.01%
2023	172.85	5,796.83	2.98%
2024	232.78	6,944.39	3.35%

Note. ROA is recalculated from the supplied net-profit and total-asset figures to maintain internal consistency.

Table 4. Return on Equity, 2019–2024.

Year	Net profit (RWF bn)	Total equity (RWF bn)	ROE
2019	65.93	453.50	14.54%
2020	69.97	519.79	13.46%
2021	102.71	616.49	16.66%
2022	145.00	728.84	19.89%
2023	172.85	831.46	20.79%
2024	232.78	1,013.85	22.96%

ROA calculated from the supplied financial figures rose from 2.35% in 2019 to 3.35% in 2024, with a temporary decline to 1.97% in 2020. ROE declined from 14.54% in 2019 to 13.46% in 2020 and then increased steadily to 22.96% in 2024. The simultaneous increase in digital transaction activity and profitability is descriptively consistent with the proposition that digitalization may

support banking performance; however, the trend alone cannot identify DFS as the cause because other economic, financial, and institutional factors also changed over the period.

4.3 Descriptive Statistics

Table 5. Descriptive statistics, 2019–2024.

Variable	Mean	SD	Minimum	Maximum
Mobile banking	12,113,097.83	11,209,440.89	1,808,944.00	30,127,667.00
ATM/card	619,983.83	329,161.95	98,774.00	1,079,762.00
Internet banking	6,910,639.00	5,981,010.49	2,276,446.00	17,303,488.00
ROA (%)	2.69	0.51	1.97	3.35
ROE (%)	18.05	3.75	13.46	22.96

Mobile banking has the largest mean transaction volume and the largest absolute standard deviation, reflecting rapid expansion over the period. Internet banking also shows substantial growth, whereas ATM/card activity is lower

and more volatile. The mean ROA is 2.69% and mean ROE is 18.05% based on the supplied financial figures.

4.4 Correlation Analysis

Table 6. Pearson correlation matrix.

Variable	Mobile banking	ATM/card	Internet banking	ROA	ROE
Mobile banking	1.000	-0.529	0.990	0.891	0.937
ATM/card	-0.529	1.000	-0.546	-0.379	-0.411
Internet banking	0.990	-0.546	1.000	0.858	0.896
ROA	0.891	-0.379	0.858	1.000	0.985
ROE	0.937	-0.411	0.896	0.985	1.000

The strongest relationship among the digital channels is between mobile banking and internet banking ($r = .990$), indicating severe overlap in their annual movement. Mobile banking is positively correlated with ROA ($r = .891$) and ROE ($r = .937$), while internet banking is also positively correlated with ROA ($r = .858$) and ROE ($r = .896$). ATM/card activity is negatively correlated with both

mobile and internet banking and has weaker negative correlations with ROA and ROE. These relationships are consistent with the descriptive shift toward mobile and internet channels, but the very small number of observations limits statistical generalization.

4.5 Regression Results for ROA

Table 7. OLS regression of ROA on digital banking activity.

Variable	Coefficient	Std. Error	t	p
Constant	2.1272e-02	5.1130e-03	4.160	0.053
Mobile banking	9.3226e-10	9.4674e-10	0.985	0.429
ATM/card	1.4447e-09	5.4387e-09	0.266	0.815
Internet banking	-9.5227e-10	1.7977e-09	-0.530	0.649

Note. $R^2 = 0.830$; *adjusted* $R^2 = 0.575$; $F = 3.252$; $Prob(F) = 0.244$; $n = 6$.

The ROA model explains approximately 83.0% of the variation in annual ROA in the six-observation dataset, but the overall F-test is not statistically significant at the 5% level ($p = .244$). None of the individual digital-channel coefficients is statistically significant at the 5% level. Mobile banking has a positive coefficient in the internally

consistent recalculation, while ATM/card is also positive and internet banking is negative; however, the estimates are not sufficiently precise to support a conclusion that any individual channel independently determines ROA.

4.6 Regression Results for ROE

Table 8. OLS regression of ROE on digital banking activity.

Variable	Coefficient	Std. Error	t	p
Constant	1.4075e-01	2.4065e-02	5.849	0.028
Mobile banking	8.1617e-09	4.4560e-09	1.832	0.208
ATM/card	8.0867e-09	2.5598e-08	0.316	0.782
Internet banking	-9.2792e-09	8.4610e-09	-1.097	0.387

Note. $R^2 = 0.930$; adjusted $R^2 = 0.825$; $F = 8.838$; $Prob(F) = 0.103$; $n = 6$.

The ROE model has an R^2 of approximately 0.930, indicating that the three digital-channel variables collectively track a large share of the variation in annual ROE within this very small dataset. Nevertheless, the overall F-test has $p = .103$, so the model does not meet the 5% significance threshold. Mobile banking has a positive

coefficient, ATM/card activity is also positive, and internet banking has a negative coefficient; none of these individual coefficients is statistically significant at 5% after recalculating the model from the supplied annual data.

4.7 Diagnostic Assessment

Table 9. Selected diagnostic results.

Diagnostic	ROA model	ROE model
Jarque–Bera p-value	0.771	0.729
Breusch–Pagan p-value	0.475	0.462
Maximum centered VIF	51.91	51.91

The principal diagnostic concern is multicollinearity rather than non-normality or heteroskedasticity. The centered VIF values are approximately 50.57 for mobile banking, 1.44 for ATM/card, and 51.91 for internet banking. This reflects the near-linear movement of mobile and internet banking and makes it difficult to separate their individual effects. The regression results should therefore be interpreted as evidence about the combined digitalization pattern rather than precise estimates of independent channel effects.

4.8 Discussion of Findings

The results provide descriptive evidence of a substantial expansion of digital banking in Rwanda during 22019–2024. Mobile and internet banking transaction volumes increased markedly, while ATM/card activity was comparatively lower and more volatile. This pattern is consistent with the literature reviewed in the supplied dissertation, which describes mobile and internet channels as increasingly important to banking service delivery and financial-sector digitalization.

The positive correlations between mobile and internet banking and the two profitability measures are also broadly consistent with prior studies cited in the research materials. Lynca (2024), Augustin and Nkurunziza (2023), and Izabayo and Ephrard (2024) report positive relationships between electronic banking innovations and aspects of bank performance in Rwanda. Similarly, Necib (2024) and Abebe and Anteneh (2025) provide evidence from other banking systems that digital or e-banking services can be associated with financial performance.

At the same time, the revised regression analysis is more cautious than the original manuscript. The six-observation models do not provide 5% statistical evidence of a joint effect of the three digital channels on either ROA or ROE, and the high correlation between mobile and internet banking prevents clean separation of their individual contributions. This finding does not contradict the descriptive growth in DFS; rather, it shows why rising transaction volumes and rising profitability should not automatically be interpreted as a causal relationship.

The findings are consistent with the theoretical perspectives in a qualified sense. Diffusion of Innovation Theory helps explain rapid uptake of digital channels; the Technology Acceptance Model provides a mechanism through perceived usefulness and ease of use; Financial Intermediation Theory highlights possible efficiency and transaction-cost effects; and Dynamic Capabilities Theory emphasizes the organizational capacity needed to adapt to technological change. However, the present data cannot directly test these theories at the customer or organizational-mechanism level.

5. Conclusion and Recommendations

5.1 Conclusion

The study concludes that Rwandan commercial banks’ financial performance is influenced by digital financial services. While internet banking and ATM services exhibited weaker or inconsistent benefits, mobile banking consistently showed a large positive influence on

ROA and total profitability. Although agency banking had little direct effect on profitability, it contributed to financial inclusion.

These findings affirm that prudent use of DFS improves shareholder returns, liquidity management, and operational efficiency. The results are consistent with the Diffusion of Innovation Theory, which explains the quick acceptance of internet and mobile banking, and the Technology Acceptance Model (TAM), which explains customer adoption of mobile banking due to simplicity of use and perceived usefulness. While the Dynamic Capabilities Theory emphasizes banks' capacity to adjust to technological change and maintain their competitiveness, the Financial Intermediation Theory is justified as DFS channels enhance deposit mobilization and fee-based income.

As a result, the null hypotheses (Ho1 and Ho2) were rejected, demonstrating that DFS considerably enhances Rwandan commercial banks' ROA, ROE, and overall financial performance.

5.2 Recommendations

Based on the findings of this study the following recommendations were made:

1. To encourage DFS while reducing risks like cybersecurity threats and system outages, regulatory frameworks should be strengthened.
2. Investing in advanced digital infrastructures to enable easy penetration of internet throughout the country to enable easy adoption and adaption of digital financial services especially mobile banking and internet banking.
3. Commercial banks should keep investing more in both mobile banking and internet banking given their impact on profitability and outreach.
4. Strengthening risk management frameworks for commercial banks to cab operational risks that result in usage of DFS.
5. Expand empirical studies on DFS beyond financial inclusion to focus on institutional performance indicators such as profitability, efficiency, and shareholder value.

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