

FINANCIAL INNOVATIONS AND OPERATIONAL EFFICIENCY OF COMMERCIAL BANKS IN KENYA

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ABSTRACT

This study examined the effect of financial innovations on the operational efficiency of commercial banks in Kenya amid continued digital transformation and persistent cost pressures reflected in cost-to-income ratios that remained above internationally accepted efficiency benchmarks between 2019 and 2024. The study focused on financial product innovations, financial process innovations, financial service delivery innovations, and financial infrastructure innovations. Guided by Schumpeter's Innovation Theory, Business Process Reengineering Theory, Diffusion of Innovations Theory, Modern Banking Theory, and the Bank Performance Efficiency Model, the study adopted a census design targeting all thirty-eight commercial banks licensed and supervised by the Central Bank of Kenya. Secondary data covering the period 2019 to 2024 were obtained from audited financial statements, Central Bank of Kenya reports, Kenya Bankers Association publications, and GSMA databases. Using fixed effects panel regression analysis, the findings established that financial product innovations, financial process innovations, and financial service delivery innovations had a negative and statistically significant effect on the cost-to-income ratio, implying

improvements in operational efficiency. In contrast, financial infrastructure innovations exhibited a positive and statistically significant effect on the cost-to-income ratio, indicating increased short-term operational costs associated with ICT investments and digital infrastructure expansion. The study concludes that financial innovations significantly influence the operational efficiency of commercial banks in Kenya, with product, process, and service delivery innovations enhancing cost efficiency, while infrastructure investments impose short-term cost pressures before yielding long-term efficiency gains. The study recommends that commercial banks continue strengthening digital financial products, process automation, and technology-enabled service delivery while adopting strategic planning and evaluation frameworks to optimize infrastructure investments and realise sustainable operational efficiency.

Key words: Financial Innovations, Financial Product Innovations, Financial Process Innovations, Financial Service Delivery Innovations, Financial Infrastructure Innovations, Operational Efficiency, Commercial Banks, Kenya.

INTRODUCTION

Financial innovations have increasingly emerged as important drivers of operational efficiency in the banking sector due to their ability to reduce operating costs, improve service delivery, enhance transaction speed, and strengthen institutional competitiveness. Globally, commercial banks have adopted digital financial products, automated banking processes, technology-enabled service delivery channels, and modern digital infrastructure to improve operational performance and respond to evolving customer needs and competitive pressures (World Bank, 2024; European Banking Authority, 2024). Developed banking systems in Europe and Asia have particularly demonstrated that financial innovations enhance operational efficiency through lower cost-to-income ratios, improved productivity, and greater technological resilience (European Banking Federation, 2024; Wu, 2024; Ashfaq et al., 2024). Similar trends have also been observed across African banking systems, where digital financial innovations have contributed to improved operational performance, financial inclusion, and institutional competitiveness through mobile banking, digital lending, and fintech-enabled financial services (Klapper, Allen, & Radcliffe, 2024; Ally, 2025).

In Kenya, financial innovations have become increasingly important as commercial banks continue to embrace digital financial products, process automation, agency banking, fintech partnerships, and investments in information and communication technology infrastructure to improve operational efficiency and remain competitive. These innovations have facilitated the migration of banking services from traditional branch networks to digital platforms, enhancing service accessibility and operational effectiveness (Kenya Bankers Association, 2024; Central Bank of Kenya, 2024). Despite these developments, operational efficiency remains a challenge. Although the banking sector's cost-to-income ratio declined from approximately 65 percent in 2015 to about 58 percent in 2023, it remains above the internationally accepted efficiency benchmark of 45–55 percent, reflecting persistent operational cost pressures associated with technology investments, regulatory compliance, cybersecurity, and branch maintenance (Central Bank of Kenya, 2023).

The study focused on financial product innovations, financial process innovations, financial service delivery innovations, and financial infrastructure innovations as the key dimensions of financial innovation influencing operational efficiency. Operational efficiency was measured using the cost-to-income ratio as an indicator of a bank's ability to minimize operating costs relative to operating income. The study examined how these innovation dimensions influence operational efficiency among all thirty-eight commercial banks licensed and supervised by the Central Bank of Kenya between 2019 and 2024. The findings provide empirical evidence to support strategic decision-making by commercial banks and inform policy interventions aimed at strengthening digital transformation and improving operational efficiency within Kenya's banking sector.

Statement of the Problem

Commercial banks play a critical role in promoting economic growth by mobilizing savings, extending credit, facilitating payment systems, and supporting financial intermediation within the economy. The banking sector in Kenya continues to invest heavily in financial innovations such as digital financial products, process automation, technology-enabled service delivery channels, and information and communication technology infrastructure to improve operational efficiency and remain competitive (Central Bank of Kenya, 2024). Despite these investments, operational efficiency remains a concern as commercial banks continue to experience relatively high operating costs associated with digital transformation, regulatory compliance, cybersecurity requirements, and maintenance of banking infrastructure. These challenges have raised concerns regarding the extent to which financial innovations have translated into improved operational efficiency within the Kenyan banking sector.

The study observed that the banking sector's cost-to-income ratio declined from approximately 65 percent in 2015 to 58 percent in 2023, reflecting gradual improvements in operational efficiency over time. However, the ratio remained above the internationally accepted efficiency benchmark of 45–55 percent reported among highly efficient banking systems, suggesting that operational costs remain relatively high despite increased adoption of financial innovations (Central Bank of Kenya, 2023). These trends indicate that while commercial banks have embraced digital transformation through financial product innovations, financial process innovations, financial service delivery innovations, and financial infrastructure investments, the anticipated efficiency gains have not been fully realized across the sector.

Existing literature has generally reported that financial innovations improve operational efficiency through cost reduction, automation, and enhanced service delivery. However, previous studies have largely focused on individual innovation dimensions, relied on perception-based or cross-sectional data, or were conducted in regulatory and technological environments that differ substantially from Kenya. Consequently, important conceptual, methodological, contextual, and geographical gaps remain. The present study addressed these gaps by examining the effect of financial product innovations, financial process innovations, financial service delivery innovations, and financial infrastructure innovations on the operational efficiency of all thirty-eight commercial banks licensed by the Central Bank of Kenya using objective secondary panel data covering the period 2019–2024. The findings provide empirical evidence to support policy formulation and strategic decision-making aimed at enhancing operational efficiency within Kenya's banking sector.

Objectives of the study

The study was guided by the following objectives

General Objective

To evaluate the effect of financial innovations on the operational efficiency of commercial banks in Kenya

Specific Objectives

- i. To assess the effect of financial product innovations on the operational efficiency of commercial banks in Kenya
- ii. To determine the effect of financial process innovations on the operational efficiency of commercial banks in Kenya
- iii. To evaluate the effect of financial service delivery innovations on the operational efficiency of commercial banks in Kenya
- iv. To examine the effect of financial infrastructure innovations on the operational efficiency of commercial banks in Kenya

Theoretical Review

The study was guided by the following theories:

Schumpeter's Innovation Theory

Schumpeter's Innovation Theory was developed by Joseph Schumpeter (1934) to explain how innovation drives organizational growth, competitiveness, and economic development. The theory posits that firms achieve superior performance by introducing new products, processes, and technologies that improve efficiency and create competitive advantage. In the banking sector, financial product innovations, process innovations, service delivery innovations, and investments in digital infrastructure enable banks to reduce operating costs, improve customer experience, and enhance operational efficiency. The theory therefore provides the foundation for explaining how financial innovations contribute to improved operational efficiency among commercial banks in Kenya.

Business Process Reengineering Theory

Business Process Reengineering Theory was introduced by Hammer and Champy (1993) to advocate for the radical redesign of organizational processes to achieve substantial improvements in cost, quality, speed, and service delivery. The theory emphasizes eliminating inefficient procedures through technology and process automation to enhance organizational performance. Within the banking sector, financial process innovations such as automated loan processing, digital workflow systems, and electronic transaction processing improve operational efficiency by reducing processing time, minimizing errors, and lowering operating costs. The theory is therefore relevant in explaining the relationship between financial process innovations and operational efficiency.

Diffusion of Innovations Theory

Diffusion of Innovations Theory was developed by Rogers (1962) to explain how new technologies and innovations are adopted and disseminated within organizations and society. The theory argues that innovation adoption depends on perceived benefits, compatibility, complexity, trialability, and observability. In commercial banking, the adoption of digital financial products, mobile banking, agency banking, fintech solutions, and other technology-enabled service delivery channels enhances accessibility, customer convenience, and operational efficiency. The theory therefore explains how the adoption of financial innovations improves the operational performance of commercial banks.

Modern Banking Theory

The Modern Banking Theory, developed by Heffernan (2005), explains that modern banks operate as technology-driven financial intermediaries whose efficiency, stability, and competitiveness depend on robust ICT infrastructure, digital platforms, and effective risk management systems. The theory argues that investments in technology enhance transaction processing, scalability, cybersecurity, and cost efficiency, enabling banks to deliver reliable financial services at lower operating costs. Although the theory has been criticized for paying limited attention to the high costs of ICT investments, cybersecurity risks, and implementation challenges in developing economies, recent empirical evidence confirms that digital infrastructure and technological integration significantly improve operational performance and efficiency in the banking sector (Vives, 2020; Banna et al., 2021; Wambugu & Kariuki, 2023). In this study, the theory provides the foundation for explaining how infrastructure innovations enhance operational efficiency and cost reduction among commercial banks in Kenya (CBK, 2023; KBA, 2023).

Empirical Literature Review

This section reviews empirical studies examining the relationship between financial innovations and operational efficiency in the banking sector. The review presents international and Kenyan evidence on financial product innovations, financial process innovations, financial service delivery innovations, and financial infrastructure innovations, highlighting the existing conceptual, contextual, methodological, and geographical gaps addressed by the current study.

Financial Product Innovations and Operational Efficiency

Previous empirical studies have established that financial product innovations improve operational efficiency by enhancing customer convenience, increasing transaction volumes, and reducing operating costs. Studies conducted in Europe, Asia, and North America found that digital lending, mobile banking products, and electronic payment solutions significantly improved banking efficiency through lower cost-to-income ratios and enhanced productivity (Beck, Senbet, & Simbanegavi, 2023; Ozili, 2023; Deloitte, 2024). In Kenya, studies by Njoroge and Mwangi (2023) and the Central Bank of Kenya (2024) similarly reported that digital financial products improved service accessibility and operational performance among commercial banks. However, previous

studies largely focused on individual financial products, relied on cross-sectional data, and employed different measures of operational efficiency. The current study addressed these conceptual and methodological gaps by examining financial product innovations using panel data while measuring operational efficiency through the cost-to-income ratio among commercial banks in Kenya.

Financial Process Innovations and Operational Efficiency

Empirical evidence indicates that financial process innovations improve operational efficiency through automation, reduced processing time, and enhanced service quality. International studies demonstrated that automated banking processes, digital workflow systems, and electronic transaction processing significantly reduced operational costs while improving institutional productivity (PwC, 2023; KPMG, 2024). Kenyan studies further established that process automation strengthened banking efficiency by improving internal controls and minimizing operational delays (Kariuki & Wambua, 2023; Kenya Bankers Association, 2024). Nevertheless, many studies concentrated on selected banking processes or relied on perceptual measures of efficiency, limiting the generalizability of their findings. The present study addressed these conceptual and methodological gaps by examining financial process innovations using objective secondary panel data covering all commercial banks in Kenya.

Financial Service Delivery Innovations and Operational Efficiency

Empirical studies have shown that financial service delivery innovations contribute positively to operational efficiency by expanding customer access, improving service quality, and lowering transaction costs. Studies conducted in developed and emerging economies established that agency banking, internet banking, mobile banking, and fintech partnerships enhanced operational efficiency through improved customer reach and reduced dependence on physical branch networks (World Bank, 2024; European Banking Authority, 2024). In Kenya, empirical evidence indicated that technology-enabled service delivery channels increased transaction efficiency and strengthened banking competitiveness (Central Bank of Kenya, 2024; Kenya Bankers Association, 2024). However, previous studies largely examined individual service delivery channels and paid limited attention to their combined influence on operational efficiency. The current study addressed these conceptual and contextual gaps by evaluating financial service delivery innovations as a key dimension of financial innovation among commercial banks in Kenya.

Financial Infrastructure Innovations and Operational Efficiency

Empirical findings suggest that financial infrastructure innovations influence operational efficiency by strengthening digital banking platforms, improving system reliability, and enhancing information security. Studies conducted internationally reported that investments in core banking systems, cloud computing, cybersecurity, and information technology infrastructure improved long-term operational performance despite increasing implementation costs during the early stages of adoption (McKinsey & Company, 2023; Deloitte, 2024). Kenyan evidence similarly showed

that ICT investments supported digital transformation and service reliability but often imposed substantial capital and maintenance costs on commercial banks (Central Bank of Kenya, 2024; Communications Authority of Kenya, 2024). Nonetheless, previous studies provided mixed findings regarding the efficiency effects of infrastructure investments and rarely examined their influence using objective panel data. The present study addressed these methodological and contextual gaps by examining financial infrastructure innovations and their effect on operational efficiency among commercial banks in Kenya.

Financial Innovations and Operational Efficiency

Empirical literature has increasingly recognized financial innovations as important determinants of operational efficiency within the banking sector. Studies conducted across Europe, Asia, Africa, and Kenya generally established that financial innovations improve operational efficiency through cost reduction, enhanced service delivery, automation, increased productivity, and improved access to financial services (PwC, 2023; World Bank, 2024; Central Bank of Kenya, 2024). In the Kenyan context, Dafala and Gitagia (2026) demonstrated that financial technology significantly enhanced access to capital among youth-owned enterprises, highlighting the transformative role of digital financial innovations in improving financial service accessibility and institutional performance. However, previous studies largely examined individual innovation dimensions, employed cross-sectional research designs, or focused on specific categories of financial institutions, thereby limiting the generalizability of their findings. The present study addresses these conceptual, methodological, contextual, and geographical gaps by simultaneously examining financial product innovations, financial process innovations, financial service delivery innovations, and financial infrastructure innovations using secondary panel data from all commercial banks in Kenya over the period 2019–2024.

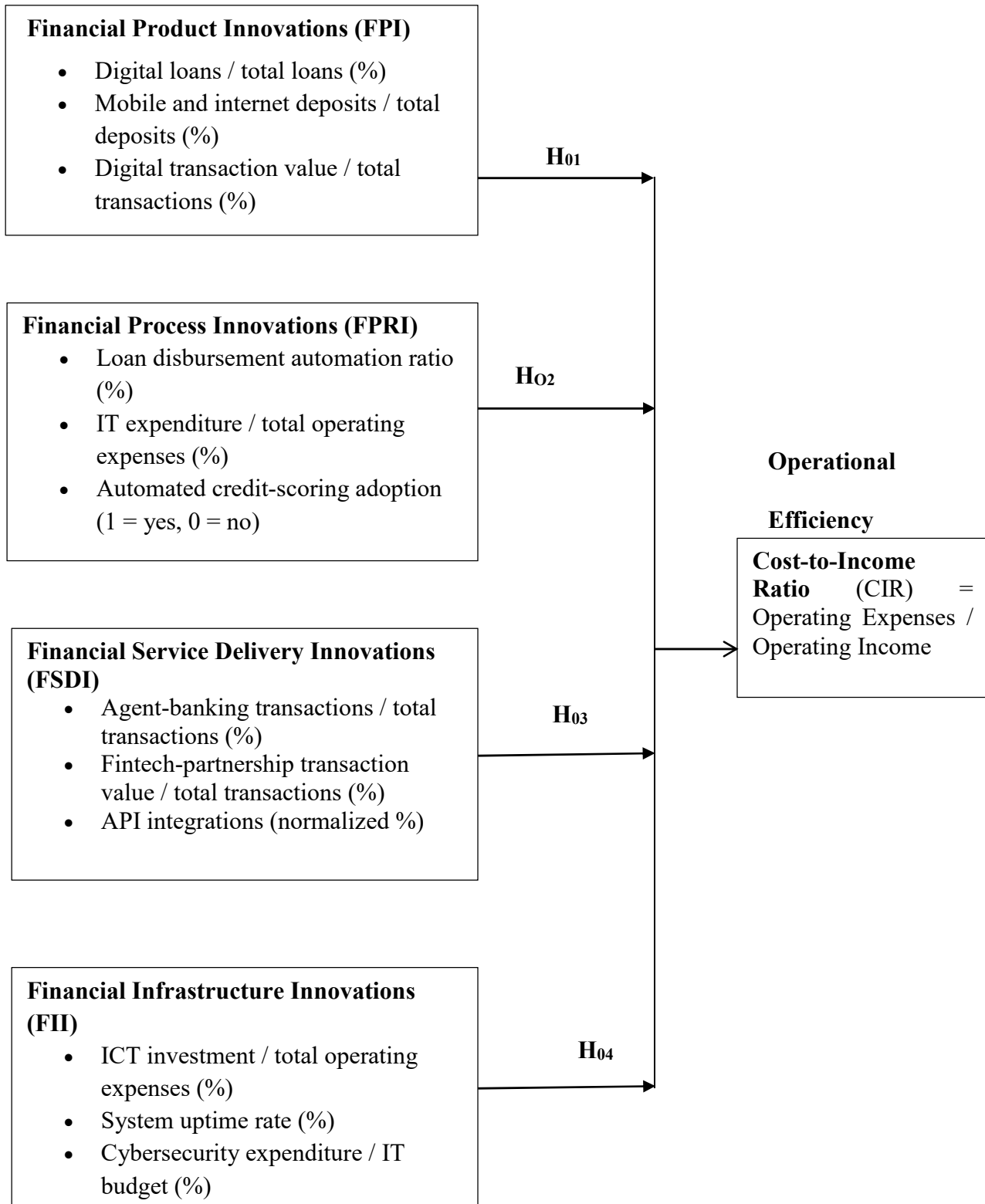
Conceptual framework

The conceptual framework illustrates the hypothesized relationship between financial innovations and operational efficiency among commercial banks in Kenya. The study conceptualizes financial innovations as the independent variable comprising financial product innovations, financial process innovations, financial service delivery innovations, and financial infrastructure innovations. Operational efficiency, measured using the cost-to-income ratio, constitutes the dependent variable. The conceptual framework is as below:

Independent variable

Financial innovations

Dependent variable



RESEARCH METHODOLOGY

The study adopted a longitudinal research design guided by the positivist research philosophy, which emphasizes objective measurement, empirical observation, and statistical analysis in examining relationships among variables (Creswell & Creswell, 2020; Saunders, Lewis, & Thornhill, 2019). The design was considered appropriate for investigating the effect of financial innovations on the operational efficiency of commercial banks in Kenya over the period 2019–2024. The study operationalized financial innovations using financial product innovations, financial process innovations, financial service delivery innovations, and financial infrastructure innovations, while operational efficiency was measured using the cost-to-income ratio. Panel regression analysis was employed to examine the effect of financial innovations on operational efficiency.

The target population comprised all the thirty-eight commercial banks licensed and supervised by the Central Bank of Kenya because of their significant role in Kenya's financial system and the availability of reliable financial information. The study adopted a census approach to include the entire population of commercial banks, thereby eliminating sampling bias and enhancing the generalizability of the findings. The unit of analysis was the individual commercial bank, with annual observations obtained from audited financial statements, Central Bank of Kenya supervisory reports, Kenya Bankers Association publications, and other publicly available industry reports covering the period 2019–2024.

Data were collected exclusively from secondary sources to ensure consistency and reliability in measuring financial innovations and operational efficiency. Descriptive statistics, correlation analysis, and panel regression techniques were used to analyze the data. Diagnostic tests, including multicollinearity, heteroscedasticity, model specification, and the Hausman specification test, were conducted to determine the suitability of the estimated models before hypothesis testing. Based on the diagnostic results, the fixed effects regression model was adopted, and all statistical analyses were performed using Stata version 18 at the 5 percent level of significance.

RESEARCH FINDINGS AND DISCUSSION

Descriptive and Diagnostic Results

Descriptive findings showed moderate adoption of financial innovations among commercial banks in Kenya during the study period, with financial process innovations recording the highest average adoption level, followed by financial product innovations and financial service delivery innovations. Financial infrastructure innovations recorded comparatively lower adoption levels. Operational efficiency, measured using the cost-to-income ratio, averaged 52.61 percent, indicating moderate operational efficiency among the sampled commercial banks. Diagnostic tests confirmed that the assumptions underlying panel regression analysis were largely satisfied.

Variance Inflation Factor results showed the absence of multicollinearity, while the Hausman specification test supported the use of the fixed effects model. Although the Breusch-Pagan and Wooldridge tests detected heteroskedasticity and autocorrelation, the study corrected these using robust standard errors, thereby ensuring the validity and reliability of the regression results.

Table 4.1: Descriptive Statistics for Financial Innovations and Operational Efficiency

Variable	Mean	Std. Dev.
Financial Product Innovations	53.4821	11.2816
Financial Process Innovations	56.1037	10.5473
Financial Service Delivery Innovations	51.2284	12.3942
Financial Infrastructure Innovations	47.9156	13.1065
Operational Efficiency (Cost-to-Income Ratio)	52.6143	8.4275

Source: Research Data (2026)

The findings indicate that financial process innovations recorded the highest mean score, suggesting that commercial banks had made substantial investments in automation and technology-based internal processes. Financial product innovations and financial service delivery innovations also recorded relatively high mean scores, reflecting continued digital transformation within the banking sector. Financial infrastructure innovations registered comparatively lower adoption levels, indicating differences in ICT infrastructure and cybersecurity investments across banks. The results further showed moderate operational efficiency among commercial banks, while the moderate standard deviation values suggest reasonable variation in innovation practices and operational efficiency across the sampled institutions.

Data Description

The study analyzed balanced panel data for all 38 commercial banks licensed by the Central Bank of Kenya over the period 2019 to 2024, yielding a total of 228 bank-year observations. Secondary data were extracted from audited annual financial statements, published annual reports, and Central Bank of Kenya publications. Operational efficiency, measured using the cost-to-income ratio, was the dependent variable, while financial product innovations, financial process innovations, financial service delivery innovations, and financial infrastructure innovations constituted the explanatory variables. The complete panel dataset provided an adequate basis for descriptive analysis, diagnostic testing, correlation analysis, and fixed effects panel regression.

Descriptive and Diagnostic Results

Descriptive findings showed moderate adoption of financial innovations among commercial banks in Kenya during the study period, with financial process innovations recording the highest average adoption level, followed by financial product innovations and financial service delivery innovations. Financial infrastructure innovations recorded comparatively lower adoption levels. Operational efficiency, measured using the cost-to-income ratio, averaged 52.61 percent, indicating moderate operational efficiency among the sampled commercial banks. Diagnostic tests confirmed that the assumptions underlying panel regression analysis were largely satisfied. Variance Inflation Factor results showed the absence of multicollinearity, while the Hausman specification test supported the use of the fixed effects model. Although the Breusch-Pagan and Wooldridge tests detected heteroskedasticity and autocorrelation, these were corrected using robust standard errors, thereby ensuring valid and reliable statistical inference.

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Diagnostic Test Results

The study conducted diagnostic tests to confirm compliance with the assumptions underlying panel regression analysis. Results confirmed the absence of multicollinearity and supported the use of the fixed effects estimator. Although heteroskedasticity and autocorrelation were detected, these were corrected using robust standard errors to ensure reliable statistical inference. The Ramsey RESET test further confirmed that the estimated regression model was correctly specified.

Table 4.2: Diagnostic Test Results

Diagnostic Test	Result	Interpretation
Variance Inflation Factor	1.401–1.560	No multicollinearity
Breusch-Pagan Test	p = 0.0043	Heteroskedasticity present
Wooldridge Test	p = 0.0058	Autocorrelation present
Hausman Test	p = 0.0026	Fixed effects model selected
Ramsey RESET Test	p = 0.1637	Model correctly specified

Source: Research Data (2026)

The findings indicate that the Variance Inflation Factor values were below the recommended threshold, confirming the absence of multicollinearity among the explanatory variables. The significant Hausman test supported the use of the fixed effects model for the panel regression analysis. Although the Breusch-Pagan and Wooldridge tests detected heteroskedasticity and autocorrelation, the application of robust standard errors ensured reliable statistical inference. In addition, the non-significant Ramsey RESET test confirmed that the estimated regression model was correctly specified.

Correlation and Regression Results

Correlation analysis established that financial product innovations, financial process innovations, and financial service delivery innovations had negative and statistically significant relationships with operational efficiency, measured by the cost-to-income ratio. Financial infrastructure innovations, however, exhibited a positive and statistically significant relationship with operational efficiency. Regression analysis further confirmed that financial product innovations, financial process innovations, and financial service delivery innovations significantly reduced the cost-to-income ratio, while financial infrastructure innovations significantly increased the cost-to-income ratio among commercial banks in Kenya.

Table 4.3: Correlation Results between Financial Innovations and Operational Efficiency

Variable	Correlation with Operational Efficiency (CIR)
Financial Product Innovations	-0.4286***
Financial Process Innovations	-0.4618***
Financial Service Delivery Innovations	-0.3927***
Financial Infrastructure Innovations	0.2483***

Source: Research Data (2026)

***p < 0.01

The findings revealed that financial product innovations, financial process innovations, and financial service delivery innovations had negative and statistically significant relationships with operational efficiency, indicating that increased adoption of these financial innovations was associated with lower cost-to-income ratios among commercial banks. Financial process

innovations recorded the strongest relationship with operational efficiency, followed by financial product innovations and financial service delivery innovations. Conversely, financial infrastructure innovations exhibited a positive and statistically significant relationship with operational efficiency, suggesting that increased investment in ICT infrastructure and cybersecurity was associated with higher operational costs during the study period.

Regression Results

The regression model demonstrated strong explanatory power, with financial innovations accounting for a substantial proportion of the variation in operational efficiency among commercial banks in Kenya. The results indicate that financial product innovations, financial process innovations, and financial service delivery innovations significantly improved operational efficiency by reducing the cost-to-income ratio. Conversely, financial infrastructure innovations had a positive and statistically significant effect on the cost-to-income ratio, suggesting increased operational costs during the study period.

Table 4.4: Fixed Effects Regression Results

Variable	Coefficient	p-value
Financial Product Innovations	-0.2847	0.001
Financial Process Innovations	-0.3416	0.000
Financial Service Delivery Innovations	-0.2194	0.004
Financial Infrastructure Innovations	0.1873	0.008
R ²	0.709	
F-statistic	135.284	0.000

Source: Research Data (2026)

The findings revealed that financial product innovations, financial process innovations, and financial service delivery innovations had negative and statistically significant effects on the cost-to-income ratio, implying improved operational efficiency among commercial banks. Financial process innovations recorded the strongest effect, followed by financial product innovations and financial service delivery innovations. Financial infrastructure innovations, however, had a positive and statistically significant effect on the cost-to-income ratio, indicating that increased investment in ICT infrastructure and cybersecurity was associated with higher operational costs during the study period. The regression model demonstrated strong explanatory power, with financial innovations explaining 70.9 percent of the variation in operational efficiency, while the significant F-statistic confirmed that the overall regression model was statistically significant and suitable for inference.

Hypothesis Testing Results

Hypothesis testing confirmed that financial product innovations, financial process innovations, financial service delivery innovations, and financial infrastructure innovations significantly

influenced the operational efficiency of commercial banks in Kenya. Financial product innovations, financial process innovations, and financial service delivery innovations significantly reduced the cost-to-income ratio, while financial infrastructure innovations significantly increased the cost-to-income ratio during the study period.

Table 4.5: Hypothesis Testing Results

Hypothesis	Decision
H01: Financial Product Innovations → Operational Efficiency	Rejected
H02: Financial Process Innovations → Operational Efficiency	Rejected
H03: Financial Service Delivery Innovations → Operational Efficiency	Rejected
H04: Financial Infrastructure Innovations → Operational Efficiency	Rejected

Source: Research Data (2026)

The findings revealed that all the null hypotheses were rejected since the corresponding variables produced statistically significant results at the 5 percent significance level. This implies that financial product innovations, financial process innovations, financial service delivery innovations, and financial infrastructure innovations significantly influenced the operational efficiency of commercial banks in Kenya. Financial product innovations, financial process innovations, and financial service delivery innovations improved operational efficiency by reducing the cost-to-income ratio, whereas financial infrastructure innovations increased the cost-to-income ratio, reflecting the short-term operational costs associated with investments in ICT infrastructure and cybersecurity.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Regarding the first objective, the study established that financial product innovations had a negative and statistically significant effect on the cost-to-income ratio of commercial banks in Kenya, indicating improved operational efficiency. Increased adoption of digital financial products, including digital lending, deposits, and electronic transaction platforms, enabled banks to reduce operational costs and enhance service efficiency. Financial product innovations therefore remain an important strategic driver of operational efficiency in the banking sector.

In relation to the second objective, the study established that financial process innovations had a negative and statistically significant effect on the cost-to-income ratio. Automation of internal processes and increased use of technology-based systems enhanced operational efficiency by reducing administrative costs and improving workflow efficiency. Financial process innovations therefore play a critical role in strengthening the operational performance of commercial banks. Concerning the third objective, the study established that financial service delivery innovations had a negative and statistically significant effect on the cost-to-income ratio. Greater adoption of

technology-driven service channels, including agent banking, fintech partnerships, and API integration, enabled banks to improve service delivery while reducing operational costs. Financial service delivery innovations therefore contribute significantly to enhanced operational efficiency among commercial banks in Kenya.

Regarding the fourth objective, the study established that financial infrastructure innovations had a positive and statistically significant effect on the cost-to-income ratio. Increased investment in ICT infrastructure, cybersecurity systems, and digital platforms raised operational costs during the study period, reflecting the substantial financial resources required to support digital transformation. Although these investments may generate long-term efficiency gains, they exert short-term cost pressures on commercial banks.

Policy Implications and Recommendations

Regarding the first objective, the findings support the recommendation that commercial banks should continue expanding digital financial products to improve operational efficiency and enhance customer access to banking services. Policymakers should promote an enabling regulatory environment that encourages digital product innovation while maintaining financial stability and consumer protection.

In relation to the second objective, commercial banks should strengthen investments in process automation and digital workflow systems to improve internal efficiency and reduce operating costs. Management should prioritize continuous modernization of operational processes to sustain efficiency gains and improve service quality.

Concerning the third objective, commercial banks should expand technology-enabled service delivery channels such as agent banking, mobile banking, and fintech collaborations to improve customer convenience and operational efficiency. Regulators should continue supporting digital financial ecosystems that promote innovation while safeguarding the security and reliability of financial services.

Regarding the fourth objective, commercial banks should continue investing in ICT infrastructure and cybersecurity as strategic long-term investments despite the short-term increase in operational costs. Policymakers should also support digital infrastructure development through appropriate regulatory frameworks that encourage technological innovation and strengthen the resilience of the banking sector.

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