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The Impact of Financial Innovation on Enhancing Banking Efficiency: An Analytical Study of Iraqi Commercial Banks (2017-2024)

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Abstract

This study aims to analyze the impact of financial innovation on improving banking efficiency through an analytical examination of a sample of Iraqi commercial banks during the period 2017-2024. The study employed a set of financial innovation indicators, namely the ratio of expenditure on financial innovations, the number of innovative products, and the number of digital transactions. Banking efficiency was measured using profitability indicators represented by Return on Assets (ROA), Return on Equity (ROE), and Return on Deposits (ROD). The study incorporated a mediating variable represented by the liquidity ratio to explain the nature of the relationship between financial innovation and banking efficiency. An advanced econometric approach was utilized, including Autoregressive Distributed Lag (ARDL) models using EViews 9, to measure the relationship between study variables in both the short and long term. The results demonstrated a statistically significant positive impact of financial innovation indicators on banking efficiency, in addition to a partial and significant mediating role of the liquidity ratio. This confirms the importance of adopting financial innovation as a strategic tool for enhancing banking performance and strengthening operational efficiency in Iraqi commercial banks.

Keywords: Financial innovation, banking efficiency, ratio of expenditure on financial innovations, liquidity ratio.

Introduction

The world is witnessing accelerated transformations resulting from technological development, digital transformation, and increased competition, which have made innovation a necessity for institutions to confront challenges and changes (Vărzaru & Bocean, 2024). Financial innovation has emerged as one of the fundamental pillars assisting financial institutions in collecting and processing data to meet customer needs and deliver banking services more efficiently and effectively (Koththagoda & Weerasiri, 2017).

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Banking efficiency is considered one of the essential concepts in evaluating the performance of banking institutions, as it reflects the bank's ability to utilize its available resources efficiently to achieve the highest possible level of returns at the lowest possible cost. Financial literature indicates that the adoption of financial innovations, particularly digital banking technologies, contributes to improving banking efficiency indicators by enhancing revenues and improving liquidity and risk management.

Despite the growing interest in the topic of financial innovation in international studies, the Iraqi banking environment still suffers from limited applied studies that examine the causal relationship between financial innovation and banking efficiency using advanced econometric models. Accordingly, this study seeks to analyze the impact of financial innovation on improving banking efficiency in Iraqi commercial banks during the period 2017-2024, while testing the mediating role of the liquidity ratio in explaining this relationship.

Theoretical Framework

Concept and Importance of Financial Innovations

Financial innovation is considered one of the fundamental pillars of the contemporary financial system's development, representing a direct response to technological progress and the accelerating structural transformations witnessed by global financial markets. Recent developments in information and communication technologies, such as artificial intelligence, big data analytics, blockchain technology, and digital payment and settlement systems, have brought about fundamental changes in the nature of banking services and their delivery methods. This has enabled banks and financial technology institutions to provide innovative solutions characterized by efficiency, speed, and reduced costs (Tangl & Desalegn, 2022; Frame & White, 2020).

The concept of financial innovation is not entirely new to economic thought; Schumpeter pointed out in the 1930s the pivotal role of innovation in stimulating economic growth and developing credit and capital markets. However, financial innovation in its modern form has become closely linked to digital transformation and now encompasses the introduction or development of technology-based banking products, services, processes, and business models, which directly contribute to improving the financial and operational performance of banks and enhancing their competitiveness (Schumpeter, 1934; Choudhary & Chauhan, 2022).

From an institutional perspective, financial innovation is viewed as an integrated process that includes the development and adoption of new financial products and services, alongside the modernization of operational processes, organizational structures, and supporting technologies. This collectively leads to improved resource utilization efficiency, reduced operational costs, and enhanced quality of banking services provided. In this context, financial innovation is no longer merely a supporting technical tool but has become a strategic option on which banks rely to face increasing competition and rapid changes in customer preferences (Mashali & Nazaritehrani, 2020; Arthur & Khraisha, 2018).

The importance of financial innovation in the banking sector lies in its ability to achieve a set of positive effects at multiple levels. At the individual level, digital banking services have facilitated individuals' access to financial services and improved their banking experience. At the corporate level, financial innovations have provided effective tools for improving liquidity and risk management and simplifying financial operations, particularly for small and medium enterprises (Dongol, 2021; Zulfiqar & Fareed, 2023). At the macro level, financial innovation plays an important role in promoting financial inclusion and improving resource allocation by expanding the base of beneficiaries of banking services and reducing dependence on traditional channels, in addition to supporting economic growth by improving the efficiency of financial intermediation and increasing the flexibility of the banking system in facing economic shocks (Gonzalez et al., 2023; Wahyudi & Tristiarto, 2020).

Financial innovations in the banking sector take multiple forms that can be classified into three main categories. The first category consists of institutional innovations, which include the development of payment and settlement systems and the use of advanced technologies such as artificial intelligence and blockchain. The second category represents financial product innovations, which focus on developing banking services to meet changing customer needs. The third category includes operational or organizational innovations, which aim to redesign processes and banking business models, contributing to cost reduction and increased efficiency (Kraugusteeliana & Triwahyono, 2023; Opiyo, 2023).

In the applied context, manifestations of financial innovation in the banking sector have been embodied through the spread of a range of innovative banking services, such as automated teller machines (ATMs), mobile banking services, internet banking services, electronic point-of-sale systems, and electronic clearing and settlement systems. These services have contributed to reducing dependence on traditional branches, accelerating transaction completion, and improving operational efficiency (Muraina, 2019; Onunka et al., 2023). Thus, it can be said that financial innovation represents one of the decisive factors in improving banking performance and enhancing operational efficiency and profitability, provided it is employed within a clear strategic vision that balances achieving returns and managing risks, supporting financial sustainability in a banking environment characterized by change and increasing competition (Arthur & Khraisha, 2018; Gonzalez et al., 2023).

Banking Efficiency

1- Concept of Banking Efficiency

Banking efficiency is considered one of the central concepts in analyzing the performance of financial institutions, due to its direct role in determining banks' ability to utilize their available resources-financial, human, and technological-in the best possible manner to achieve the highest level of returns at the lowest operational cost. The concept of efficiency generally reflects the relationship between inputs and outputs, where a bank's success is measured by transforming its resources into tangible financial and operational results that enhance its sustainability and competitiveness (Oyegbade, 2022; Hamzah, 2022).

Economic thought distinguishes between the concepts of efficiency and effectiveness, where efficiency refers to "doing things correctly" in terms of optimal resource utilization, while effectiveness means "doing the right things" in terms of achieving ultimate objectives. Thus, an efficient bank does not only focus on achieving profits but seeks to maximize its productivity through allocating its resources rationally within an environment characterized by cost and risk constraints (Najar, 2020; Rathore, 2021).

In the banking context, the concept of banking efficiency is not measured solely by the level of profits achieved but by the bank's ability to manage its assets and liabilities efficiently and achieve a balance between profitability, liquidity, and risks. A bank is considered inefficient when there is a clear imbalance between the volume of inputs and outputs, or when there is misallocation of available resources, whether through poor management, high operational costs, or low quality of banking services provided (Alber et al., 2019).

The importance of banking efficiency lies in being a fundamental indicator of the solidity and stability of the financial system, as it enables regulatory and administrative authorities to distinguish between high-performing banks and those suffering from weakness in resource utilization. The study of efficiency also helps identify levels of waste in input utilization and diagnose shortcomings that may threaten the sustainability of banks with declining performance (Mukherjee et al., 2003).

Banking efficiency contributes to improving resource allocation within the bank, particularly capital, human, and technological resources, which reflects increased productivity and achieving higher returns on assets and equity. Efficiency is also considered an indicator of the quality of banking management, as efficient managements are more capable of reducing operational costs, maximizing profits, and mitigating financial risks through diversifying activities and improving investment policies (Kamaldeen, 2024; Ali, 2019).

Among the important dimensions of banking efficiency is its ability to enhance customer and depositor confidence, where efficient banks lead to providing higher quality banking services at lower costs, which contributes to increasing deposit volumes and improving liquidity levels. Banking efficiency also supports banks' competitiveness in financial markets and helps them geographically expand and diversify their products and services, thereby enhancing their profitability and sustainability (Sari, 2018; Kamaldeen, 2024).

Banking efficiency is influenced by a set of internal and external factors, most notably profitability, which is considered a fundamental indicator of banking performance, where efficiency is closely linked to the bank's ability to achieve appropriate returns on its assets and equity. Net interest margin is also considered one of the important indicators reflecting the efficiency of managing the bank's operational activity, especially in environments where revenues primarily depend on lending operations (Pasiouras & Kosmidou, 2007; Dietrich & Wanzenried, 2011).

Managerial factors play a decisive role in determining the level of banking efficiency, as effective management based on planning, organization, and control, alongside developing and motivating human resources, directly contributes to improving institutional performance. Literature indicates that positive organizational culture,

participatory leadership, and continuous training represent fundamental elements in enhancing productivity and reducing operational costs in the long term (Jelodar, 2016; Siddiqui, 2020; Darzi & Bhat, 2021).

The degree of competition in the banking market also affects the level of efficiency, where increased competition drives banks to improve the quality of their services, adopt innovation in products and processes, and reduce waste in resource utilization. Studies have shown that higher levels of competition stimulate banks to adopt more efficient strategies, which positively reflects on their financial and operational performance (Ruslan et al., 2019; Sari, 2018).

The impact of legal and regulatory frameworks is no less important than the previous factors, as laws and instructions issued by monetary authorities guide bank behavior and regulate their performance, achieving balance between financial stability and encouraging innovation. A stable and clear regulatory environment is considered a supporting factor for improving banking efficiency, while regulatory rigidity or legislative ambiguity may restrict innovation and weaken banking performance (Barth et al., 2020; Bulle, 2020).

Thus, banking efficiency represents an interactive result of a set of economic, managerial, and regulatory factors, reflecting the bank's ability to achieve optimal utilization of its resources in an environment characterized by risks and competition. Banking efficiency is also considered a fundamental element in explaining banks' performance and enhancing their financial stability, especially in light of the accelerating digital transformations witnessed by the banking sector (Rathore, 2021; Alber et al., 2019).

Literature Review

The majority of studies examining the relationship between financial innovation and banking efficiency have shown a positive and significant effect. The study by Thanoon and Al-Shakraji (2022) demonstrated the positive impact of financial innovation and its effect on the reputation of banks adopting it, in addition to being one of the main drivers of competition. Meanwhile, the study by Mohammed and Al-Hatimi (2024) addressed dimensions of the logical relationship between financial innovation and the development of banking services, reviewing its role in this regard, in addition to noting that this role increases with the presence of knowledge management systems as a mediating variable. Al-Husseini (2025) presented models whose data were collected using a questionnaire and confirmed the role of financial technologies in promoting financial innovation in banking institutions and their contribution to improving the efficiency of banking operations and services provided.

Regarding international studies, Ademola (2024) indicated the positive and significant impact of financial innovations on banking performance. Zhao's study (2021) analyzed the impact of financial technology on increasing the operational efficiency of commercial banks in China that adopted it, while noting a decrease in average efficiency for banks suffering from weakness in adopting financial technology. Meanwhile, Muslimin et al. (2023) showed that adopting technological innovations helped promote financial inclusion, customer satisfaction, and facilitate banking operations.

Atukunda et al. (2024) indicated the positive relationship linking bank profitability and innovation, noting that the greatest impact on profitability is attributed to product innovation.

Based on this, it can be said that previous studies contributed to forming a research and theoretical base for the researcher, helping to shape a conceptual framework for the study, highlighting the research problem, and selecting study indicators and their measurement and analysis methods. In light of the foreign previous studies presented, we have identified the importance of study variables, where researchers agreed across their different banking sectors and analysis methods adopted on the importance of banking efficiency and financial innovation.

Within the scope of the researchers' knowledge, it became clear that this study is among the few studies that used statistical methods to clarify the type of relationship linking study variables, where it adopted Autoregressive Distributed Lag models to reveal the relationship linking independent, dependent, and mediating variables in both the long and short term, using the liquidity ratio as a mediating variable. Studies have not addressed such a combination of variables and analyzed the efficiency of one of the most important and largest sectors in the Iraq Stock Exchange using financial methods that included analyzing profitability indicators (ROA, ROE, ROD).

Research Problem

Despite the increasing expansion in adopting financial innovations at the global banking sector level, commercial banks in emerging economies, including Iraq, still face clear challenges in employing these innovations effectively to improve their banking efficiency. The levels of adopting digital banking services and modern financial technologies vary among banks, which reflects differences in operational efficiency and profitability levels among them. Although there are studies that have addressed financial innovation or banking efficiency separately, the causal relationship between financial innovation indicators and banking efficiency, considering the mediating role of some financial variables, remains unclear in the Iraqi banking environment. Hence, the research problem is represented by the following question:

What is the impact of financial innovation on improving banking efficiency in Iraqi commercial banks during the period 2017-2024, and what is the role of mediating variables in explaining this relationship?

Research Objectives

This study aims to achieve a set of scientific and applied objectives, most notably:

1- Measuring the impact of financial innovation indicators on the banking efficiency of Iraqi commercial banks.
2- Analyzing the relationship between financial innovation and banking profitability indicators.
3- Testing the mediating role of the liquidity ratio in the relationship between financial innovation and banking efficiency.
4- Providing practical recommendations that contribute to supporting digital transformation policies and improving banking performance in Iraq.

Research Hypotheses

Based on the research problem and objectives, the following hypotheses were formulated:

Main Hypothesis

There is a statistically significant impact of financial innovation on improving banking efficiency in Iraqi commercial banks.

Sub-Hypotheses

- **H1:** There is a statistically significant impact of financial innovation indicators on Return on Assets (ROA).
- **H2:** There is a statistically significant impact of financial innovation indicators on Return on Equity (ROE).
- **H3:** There is a statistically significant impact of financial innovation indicators on Return on Deposits (ROD).
- **H4:** There is a statistically significant mediating role of the liquidity ratio in the relationship between financial innovation and banking efficiency.

Research Design

The study adopted a descriptive-analytical approach supported by econometric analysis, as it is most appropriate for studying causal relationships between financial variables and analyzing the impact of financial innovation on improving banking efficiency in Iraqi commercial banks, by relying on panel data that combines the temporal and cross-sectional dimensions.

Research Population

The research population consists of Iraqi private commercial banks, particularly banks listed on the Iraq Stock Exchange, due to the importance of these banks in the Iraqi banking system and the availability of their financial data published regularly.

Sample Selection and Method

The study sample consisted of several Iraqi private commercial banks listed on the Iraq Stock Exchange during the study period. The sample was selected using purposive sampling, based on the criterion of availability of complete and sequential financial data during the study period, ensuring accuracy and reliability of econometric results.

Research Measures and Characteristics

The study relied on a set of variables, measured according to financial indicators used in economic and banking literature, as follows:

Dependent Variable (Banking Efficiency):

- Return on Assets (ROA) - Return on Equity (ROE) - Return on Deposits (ROD)

Independent Variable (Financial Innovation):

- Ratio of expenditure on financial innovations
- Number of innovative banking products or services
- Number of digital banking transactions

Mediating Variable:

- Banking deposit structure (ratio of current deposits, savings deposits, and fixed deposits)
- These measures were selected for their wide acceptance in contemporary banking studies.

Measurement of Study Variables

Table 1: Study Variables and Measurement Methods

Variable	Symbol	Type	Measurement Method	Unit
Financial Innovation		Independent	1. Ratio of expenditure on banking innovations = Total expenditure on innovations/ Total expenses 2. Number of innovative products through: ATM products = Number of electronic cards issued/ Total customers; Mobile products = Electronic payment via mobile/ Value of internet transactions; Internet products = Credit transfers via internet/ Total internet payments; Banking agency products = Number of granted agencies/Total customers 3. Number of digital transactions through: Speed of access to electronic services = Total customers/ Number of transfer operations	%
Banking Efficiency		Dependent	1. Return on Assets (ROA) = Net profit after tax/Total assets ×1002. Return on Equity (ROE) = Net profit after tax/Total equity ×1003. Return on Deposits (ROD)	%
Liquidity Ratio		Mediating	Liquidity ratio = Cash available in vault + Cash deposited at Central Bank + Other liquid assets/Deposits × 100	%

Study variables were measured quantitatively in accordance with research objectives and the adopted methodology. Financial innovation was measured as the independent variable through: technology expenditure (X_1) as a percentage of total operational expenses, the number of innovative banking products (X_2), and the number of digital banking transactions (X_3), based on data extracted from the annual reports of surveyed banks. Banking efficiency, as the dependent variable, was measured using financial performance indicators represented by Return on Assets (ROA), Return on Equity (ROE), and Return on Deposits (ROD), based on published financial statements. Regarding the mediating variable, the liquidity ratio was measured as the ratio of liquid assets to total assets.

Study Data

The study relied on secondary data of a quantitative nature covering the period 2017-2024, obtained from: annual reports of Iraqi commercial banks, data published on the Iraq Stock Exchange, and Central Bank of Iraq reports.

Data Collection Tool

The data collection tool consisted of published financial statements for the banks in the study sample, particularly: the statement of financial position, income statement, and notes accompanying annual reports.

Data Collection Method

Data were collected through systematic desk review of annual reports issued by the banks under study, in addition to using banks' official websites and the Iraq Stock Exchange, followed by data verification and ensuring their consistency across study years.

Data Coding

Data were coded and entered into statistical and econometric programs through:

- Preparing a database using Excel
- Coding variables such as ROA, ROE, ROD
- Transferring data to Stata/EViews for econometric analysis

Data Analysis Methods

The study employed a set of statistical and econometric methods, most notably:

- Descriptive statistics (mean, standard deviation)
- Unit root tests
- Panel data models
- Fixed and Random Effects models
- Hausman test for model selection
- Testing significance of statistical parameters

Financial Analysis of Study Variables

Analysis of Return on Assets (ROA) Indicator

Return on Assets (ROA) is considered one of the fundamental financial indicators used to measure banks' efficiency in employing their available assets to achieve profits. This indicator reflects banking management's ability to exploit available resources effectively. Higher values of this indicator indicate a high level of managerial efficiency and good employment of assets in income-generating investment and operational activities, while lower values reflect weak bank capacity to achieve required returns from its assets.

Based on financial analysis results presented in Table 2, it is observed that the Return on Assets indicator recorded a noticeable increase during 2017, attributed to improved profitability levels resulting from banks' expansion in their investments and financial deployments, in addition to improved security and political conditions in the country during that period, alongside rising oil prices, which positively reflected on commercial banks' profits and gains.

Conversely, the ROA indicator witnessed a clear decline during 2018, where this decline is attributed to decreased net interest income to approximately 1,319,451 million dinars, in addition to decreased non-interest net income to approximately 934,509 million dinars during the same year, along with a noticeable increase in assets volume.

Economic instability and the Iraqi economy's heavy dependence on oil revenues and fluctuations in global oil prices, alongside security and political conditions following the victory declaration against ISIS in 2017, contributed to deepening this decline. The indicator recorded its lowest value during the study period in 2018, where the decline magnitude reached approximately (0.39%), reflecting the limited capacity of banks to enter profitable investments during that stage.

During the period 2019-2020, the indicator witnessed gradual improvement despite economic challenges faced by the country, particularly the COVID-19 pandemic repercussions that caused disruption of most economic activities globally. Nevertheless, private commercial banks included in the study sample showed notable ability to adapt to unexpected conditions and maintain acceptable profitability levels, reflecting a degree of efficiency in managing available resources.

The Return on Assets indicator returned to decline during 2021, attributed to decreased net interest income to approximately 1.4 trillion dinars and decreased non-interest net income to approximately 1.3 trillion dinars, in addition to increased value of assets denominated in foreign currency due to changes in Iraqi dinar exchange rates against the US dollar.

Conversely, the years 2022-2024 recorded a gradual increase in the Return on Assets indicator. This improvement is attributed to relative stability in economic and political conditions, increased bank investments in technology, and adoption of advanced banking systems and financial innovations, which directly contributed to raising asset employment efficiency and improving profitability levels. The indicator reached its highest value during 2024 at (1.98%).

The general trend of the Return on Assets indicator during the study period shows an upward trajectory, indicating improved bank efficiency in exploiting their assets to achieve profits. The variation in indicator values also indicates banking performance being affected by internal factors related to management efficiency, and external factors linked to general economic and political conditions, which may sometimes be beyond banks' control.

Analysis of Return on Equity (ROE) Indicator

Return on Equity (ROE) is considered one of the main indicators used to measure banks' ability to achieve returns through investing shareholders' funds. This indicator reflects banking management efficiency in employing owned capital to achieve profits. High values of ROE indicate the bank's ability to achieve rewarding returns for shareholders and may simultaneously reflect the bank's expansion in using financial leverage, which may entail elevated financial risk levels resulting from increased reliance on external funding sources. This indicator is also considered an indication of bank growth, development, and improved financial performance.

Based on data presented in Table 2, it is observed that the Return on Equity indicator recorded high levels during 2017 compared to 2018, which witnessed a slight decline in indicator value to approximately (0.99%). This decline is attributed to increased assets volume against decreased income levels achieved by banks, in addition to pre-

vailing general economic conditions during that period, as indicated by the Financial Stability Report issued by the Central Bank of Iraq for 2018.

During the period 2019-2020, the ROE indicator returned to increase, reflecting the efficiency of banks included in the study sample in exploiting their capital to achieve profits, alongside their orientation toward diversifying investments, particularly in technological fields, and adopting advanced digital strategies that contributed to improving their financial performance and raising the level of returns achieved for shareholders.

Conversely, the indicator recorded a decline during 2021, attributed to decreased net interest income to approximately 1.4 trillion dinars, in addition to decreased non-interest net income to approximately 1.3 trillion dinars, along with increased value of assets denominated in foreign currency due to changes in Iraqi dinar exchange rates against the US dollar, which negatively reflected on the return achieved on equity.

During the years 2022-2024, the Return on Equity indicator witnessed a gradual increase, attributed to relative stability in economic and political conditions, increased bank investments in technology, in addition to adopting advanced banking systems and financial innovations that contributed to enhancing operational efficiency and improving profitability levels. This increase also reflects increased shareholder confidence in bank performance and their ability to achieve stable and sustainable returns.

Generally, the general trend of the Return on Equity indicator during the study period shows an upward trajectory, indicating improved bank efficiency in managing and exploiting shareholders' funds and maximizing their profits. The indicator's fluctuation during some years also indicates banking performance being affected by external factors, such as economic conditions and political instability, in addition to internal factors related to banking management efficiency in managing capital, which may sometimes be beyond banks' control.

Analysis of Return on Deposits (ROD) Indicator

Return on Deposits (ROD) is considered one of the important financial indicators used to measure banks' ability to employ funds deposited with them in achieving profits, whether through reinvesting them in lending operations at appropriate interest rates or investing them in projects and activities with high returns. High values of this indicator indicate bank efficiency in managing and exploiting customer deposits optimally, achieving rewarding returns, while low values reflect weak ability to employ these resources efficiently.

Based on data presented in Table 2, it is observed that the average Return on Deposits indicator reached approximately (4.41%) during 2017, then witnessed a noticeable decline during 2018 to reach approximately (0.92%). This decline is attributed to economic pressures and political and economic instability prevailing during that period, in addition to declining oil prices, which negatively reflected on banking activity generally. The decline may also be partially attributed to limited efficiency of some banks in managing their deposits and not employing them optimally to achieve profits.

In subsequent years, the Return on Deposits indicator recorded gradual improvement during the period 2019-2023, where it reached approximately (3.53%) during 2023, reflecting improved confidence levels among depositors in banks, in addition to banking management efficiency in attracting and employing deposits effectively. The indicator's rise during this period also indicates improved liquidity levels enjoyed by banks and their ability to achieve balance between liquidity and profitability requirements.

Generally, the general trend of the Return on Deposits indicator during the study period shows an upward trajectory, indicating improved Iraqi bank efficiency in managing their deposits and exploiting them in investment and financing activities, including technological investments and providing loans, which contributed to enhancing their profits. Conversely, the indicator value decline during some years is attributed to external factors that may be beyond banks' control, such as general economic challenges including declining oil prices, decreasing liquidity levels, and rising inflation rates, in addition to internal factors related to credit policies or deposit management efficiency within the bank.

Table 2: Average Banking Efficiency Indicators for Study Sample for Period (2017-2024)

Year	ROA	ROE	ROD
2017	1.04%	1.94%	4.41%
2018	0.39%	0.99%	0.92%
2019	0.45%	1.15%	1.27%
2020	0.88%	2.25%	2.50%
2021	0.42%	1.78%	0.53%
2022	0.82%	2.82%	1.56%
2023	1.90%	7.88%	3.53%
2024	1.98%	7.92%	2.42%

Source: Researchers' preparation based on financial data for a sample of Iraqi private commercial banks listed on the Iraq Stock Exchange

Analytical Summary of Banking Efficiency Indicators

Financial analysis results of banking efficiency indicators for the sample of private commercial banks listed on the Iraq Stock Exchange during the period 2017-2024 showed gradual and noticeable improvement in financial performance and operational efficiency levels, despite fluctuations witnessed by some indicators during certain years due to unstable economic and political conditions experienced by the Iraqi economy. This improvement reflects banks' ability to adapt to external challenges and improve efficiency in managing their financial resources in a banking environment characterized by high risk and uncertainty.

The Return on Assets (ROA) indicator showed a general upward trend during the study period, indicating improved bank efficiency in exploiting their available assets to achieve profits. This trend reflects banking management's ability to employ resources more effectively, particularly in light of adopting modern banking systems and financial innovations that contributed to improving operational efficiency and reducing operational costs. The fluctuation of this indicator during some years also reflects banking performance being affected by macro-economic factors, such as oil price fluctuations and political instability, which are factors largely beyond banks' control.

The Return on Equity (ROE) indicator also showed noticeable improvement during most study years, reflecting bank efficiency in managing shareholders' funds and maximizing returns achieved for them. The gradual rise of this indicator indicates banks' success in achieving relative balance between using financial leverage and achieving profitability, considering financial risk levels. This improvement also reflects increased shareholder confidence in bank performance and their ability to achieve stable and sustainable returns in the long term.

Regarding the Return on Deposits (ROD) indicator, its results showed gradual improvement during the study period, indicating increased bank efficiency in employing depositors' funds and exploiting them in credit and investment income-generating activities. This improvement also reflects banks' ability to manage their liquidity efficiently and achieve balance between financial safety requirements and profitability, in addition to enhancing customer and depositor confidence in banks.

Fluctuations in this indicator during some years also indicate the impact of external economic factors, such as declining oil prices and rising inflation rates, in addition to conservative credit policies that may limit achieving returns. Generally, financial analysis results of combined banking efficiency indicators show that banks included in the study sample have achieved advanced levels of financial and operational efficiency supported by adopting financial innovations and investing in modern banking technology. This contributed to improving financial resource management, reducing operational costs, enhancing liquidity, and increasing profit-making ability, in addition to enhancing banks' competitiveness and strengthening their financial positions. These results also reflect banks' ability to face economic fluctuations and mitigate operational risks, contributing to achieving financial sustainability and supporting banking stability in the long term.

Analysis of Expenditure on Financial Innovations Indicator

The indicator of expenditure on financial innovations is considered one of the important quantitative indicators reflecting the extent of banks' orientation toward digital transformation and adopting modern banking technologies. This indicator is measured through the percentage of what banks spend on financial innovations relative to their total costs. High values of this indicator indicate banks' interest in developing their technological infrastructure and adopting innovative banking systems and applications, contributing to improving the quality of banking services provided, raising operational efficiency, and enhancing competitiveness in the banking market.

The rise of this indicator also reflects a strategic orientation among banks toward investing in digital banking systems, electronic services, and smart applications, aimed at meeting increasing customer needs and providing faster, more flexible, and efficient banking services. This contributes to improving customer experience and increasing their satisfaction levels, in addition to reducing dependence on traditional methods in providing banking services, which positively reflects on banking efficiency and profitability in the medium and long term.

Conversely, low values of the expenditure on financial innovations indicator indicate limited bank interest in digital and technological transformation and their reliance

on traditional operating patterns, which may lead to weak competitiveness, decreased operational management efficiency, and declining customer satisfaction levels, in addition to negatively reflecting on their profitability and financial performance. These values may also reflect weak strategic vision among banking management in keeping pace with accelerating technological developments in the financial sector.

Based on financial analysis results presented in Table 3, it appears that expenditure levels of banks in the study sample on financial innovations witnessed continuous increase during the study period, where the average expenditure ratio rose from approximately (16.05%) in 2017 to approximately (46.69%) in 2024. This continuous rise reflects a clear orientation among banks toward developing their banking systems and enhancing their technological investments, indicating their pursuit of keeping pace with digital transformation requirements and improving their ability to compete in the banking market.

Analysis results also indicate that some banks within the study sample exceeded their expenditure ratios on financial innovations beyond the (50%) threshold, which can be considered an indicator of gradual transition toward comprehensive digital transformation in various banking work activities and sectors. This trend reflects the presence of effective and efficient banking managements adopting long-term strategies based on investing in modern banking technology, contributing to improving operational efficiency, increasing profitability, and enhancing banks' financial position strength.

Generally, the general trend of the expenditure on financial innovations indicator during the study period shows a clear upward trajectory, indicating growing bank awareness of the importance of financial innovation as a strategic tool for improving banking performance and raising efficiency levels. This trend also reflects banks' readiness to face future challenges related to competition and digital transformation, provided this expenditure continues to be directed toward developing banking systems and digital applications in the correct direction, achieving optimal use of financial resources and ensuring sustainable returns.

Analysis of Number of Innovative Products Indicator

Iraqi banks rely on a set of innovative banking products and services that are among the most common channels in the Iraqi banking sector, which were adopted within financial innovation indicators in this study. These products and services include ATMs, internet banking services, mobile banking services, in addition to services provided through banking agencies. This indicator was measured based on the equation explained in the study methodology, aiming to assess the level of banks' adoption of innovative products and the extent of their development during the study period.

Based on data presented in Table 3, it is observed that the indicator of banking services provided through ATMs recorded a decline during 2019 to reach approximately (3.45). This decline is primarily attributed to COVID-19 pandemic repercussions, which contributed to reducing customer visits to bank branches and public places, noting that using ATMs requires physical presence to complete banking transactions.

During the subsequent period 2020-2024, the general trend of the indicator continued toward decline to reach approximately (1.48) in 2024. This is attributed to

banks' orientation toward investing in newer and more efficient banking channels, in addition to rising operational and maintenance costs of ATMs and their location rentals, along with customer preference for digital banking methods characterized by ease and speed in completing transactions.

Conversely, indicators of banking products and services provided through mobile phones and the internet showed noticeable increase during the study period, reflecting growing customer awareness and increasing acceptance of using digital banking services and their preference over traditional methods. This trend also indicates bank efficiency in attracting customers and providing innovative banking services compatible with digital age requirements.

Despite economic challenges faced by the Iraqi banking sector, such as rising inflation rates, declining liquidity levels, and oil price fluctuations, in addition to COVID-19 pandemic repercussions, this improvement indicates that efficient banking management contributed to continuing the digital transformation path and not being fundamentally affected by these conditions.

Table 3: Average Financial Innovation Indicators for Study Sample for Period (2017-2024)

Year	Ratio of Expenditure on Financial Innovations/ Total Expenses	Number of Innovative Products: ATM Products	Number of Innovative Products: Mobile Products	Number of Innovative Products: Internet Products	Number of Innovative Products: Banking Agency Products	Number of Digital Transactions: Speed of Access to Electronic Services
2017	16.05%	4.68	0.006	0.07	0.16	18.89
2018	23.35%	5.40	0.01	0.09	0.17	28.94
2019	27.24%	3.45	0.01	0.18	0.13	53.66
2020	31.77%	1.91	0.03	0.36	0.20	119.34
2021	35.27%	2.22	0.02	0.49	0.31	91.73
2022	38.64%	1.84	0.03	0.90	0.34	121.22
2023	42.01%	1.48	0.08	0.59	0.37	191.52
2024	46.69%	1.48	0.09	0.70	0.37	133.76

Source: Researchers' preparation based on annual statistical bulletins published by the Central Bank of Iraq

Regarding the indicator of products or services provided through banking agencies, which include providing various banking services such as balance inquiries, withdrawals, deposits, fund transfers, and bill payments, results showed a clear upward trend during the study period, where the indicator rose from approximately (0.16) in 2017 to approximately (0.37) in 2024. This increase reflects increased bank investments in diversifying banking service delivery channels, contributing to relieving pressure on traditional branches, improving service delivery efficiency, and reducing operational costs.

Generally, analyzing the number of innovative products indicator results shows that Iraqi banks in the study sample have gradually moved toward enhancing the use of digital and alternative banking tools at the expense of traditional tools, reflecting their financial innovation level development. This trend also indicates adopting modern banking strategies based on diversifying innovative products and services, which contributed to improving operational efficiency, increasing profitability, and enhancing banks' competitiveness in a banking environment characterized by continuous change.

Analysis of Mediating Variable Indicator

Mediating variables in this study represent the connecting link through which the effects of financial innovation indicators are transmitted to banking efficiency. They contribute to explaining the nature and strength of the relationship between independent variables and the dependent variable. These variables are represented by the liquidity ratio indicator, which is considered one of the fundamental indicators affecting banking performance and determining banks' ability to efficiently employ financial innovation.

The liquidity ratio represents the bank's ability to meet its short-term obligations and face withdrawal and financing requirements, which directly affects the bank's ability to continue adopting financial innovations without exposure to liquidity risks. The mediating variable indicator was analyzed based on equations and quantitative models to measure the extent of these variables' contribution to enhancing or limiting the impact of financial innovation on banking efficiency and demonstrating their role in explaining variation in financial performance among banks in the study sample during the period 2017-2024.

The liquidity ratio indicator is considered one of the fundamental financial indicators reflecting the bank's ability to meet its short and long-term obligations. It measures the volume of liquid assets held by the bank, which include available cash, balances with the central bank and other banks, in addition to other liquid assets. This indicator plays an important role in achieving balance between financial safety requirements and profitability, as efficient liquidity management is considered a decisive factor in sustaining banking performance.

Based on analysis results presented in Table 4, it is observed that the general trend of average liquidity ratio during the study period extending from 2017-2024 showed a gradual decline. Despite this decline, recorded liquidity levels did not negatively affect the ability of banks in the study sample to meet their obligations toward other parties, whether in the short or long term, indicating the presence of effective liquidity management and ability to achieve balance between liquidity and profitability requirements.

It is worth noting that maintaining very high liquidity ratios is not necessarily considered a positive indicator, as freezing financial resources and not employing them in investments or income-generating activities may lead to declining banking returns and decreasing profitability levels. Accordingly, the relative decline in the liquidity ratio during the study period can be interpreted as an indicator of banks' good exploitation of their liquidity and directing it toward investment and financing fields with appropriate returns, particularly through lending operations at studied interest rates achieving rewarding returns for the bank and shareholders.

Generally, analysis results show that banks in the study sample succeeded in managing their liquidity efficiently by reducing unproductive liquid balances and maximizing employment of available financial resources, contributing to enhancing banking efficiency and improving financial performance. This also confirms the mediating role of the liquidity ratio indicator in transmitting the impact of financial innovation to banking efficiency, as employing financial innovations contributes to improving liquid-

ity management and reducing the need to maintain high levels of unproductive liquid assets. Thus, the liquidity ratio played a regulatory mediating role that helped maximize benefit from financial innovation in improving banking performance.

Table 4: Liquidity Ratio for Study Sample for Period (2017-2024)

Year	Average Liquidity Ratio
2017	171%
2018	164%
2019	147%
2020	170%
2021	166%
2022	137%
2023	153%
2024	136%

Source: Researchers' preparation based on financial data for a sample of Iraqi private commercial banks listed on the Iraq Stock Exchange and Excel outputs

Testing Data Stationarity

Testing the stationarity of time series is considered one of the fundamental methodological requirements in econometric studies, particularly when dealing with panel data. Using non-stationary data may lead to misleading statistical results known as spurious regression. Accordingly, unit root tests were conducted in this study to verify study variable stationarity before proceeding to test hypotheses.

A set of stationarity tests appropriate for panel data was relied upon, namely the Levin, Lin & Chu (LLC) test, Fisher-PP test, and Choi-PP test, due to their efficiency in dealing with temporal and cross-sectional dimensions simultaneously. Stationarity tests included all study variables, including independent variables represented by financial innovation expenditure indicators, dependent variables represented by banking performance indicators, in addition to mediating variables represented by the liquidity ratio.

Unit root test results presented in Table 5 show that study variables were not at the same degree of stationarity. Some variables showed stationarity at level I(0), while other variables became stationary after taking the first difference I(1), at acceptable statistical significance levels. This variation in integration orders is common in financial and banking studies due to the nature of data characterized by dynamism and continuous change over time.

Based on the foregoing, stationarity test results confirm that none of the study variables are integrated of the second order I(2), which methodologically allows using advanced econometric models that permit combining variables with different integration orders. Thus, the Panel Autoregressive Distributed Lag (Panel ARDL) model was adopted as the main tool for testing hypotheses and analyzing short and long-term relationships between study variables.

Based on data stationarity test results, we will proceed to test research hypotheses using appropriate econometric methods consistent with study objectives and data nature.

Table 5: LLC and Fisher-PP Tests for Study Data Stationarity

Variable	Test	At Level	First Difference
Ratio of Expenditure on Innovations	LLC	-5.100 (0.000)	
	Fisher-PP	107.719 (0.000)	
	Choi-PP	-4.484 (0.000)	
Number of Digital Transactions	LLC	-10.800 (0.000)	
	Fisher-PP	136.887 (0.000)	
	Choi-PP	-7.454 (0.000)	
Number of Innovative Products	LLC	-7.132 (0.000)	
	Fisher-PP	120.406 (0.000)	
	Choi-PP	-6.100 (0.000)	
ROA	LLC	-9.382 (0.000)	
	Fisher-PP	50.962 (0.050)	115.453 (0.000)
	Choi-PP	1.120 (0.869)	-5.358 (0.000)
ROE	LLC	-6.037 (0.000)	
	Fisher-PP	49.516 (0.066)	120.402 (0.000)
	Choi-PP	0.621 (0.733)	-5.912 (0.000)
ROD	LLC	-22.577 (0.000)	
	Fisher-PP	50.021 (0.060)	101.252 (0.000)
	Choi-PP	2.150 (0.984)	-3.702 (0.000)
Liquidity Ratio	LLC	-15.024 (0.000)	
	Fisher-PP	52.686 (0.036)	
	Choi-PP	-0.423 (0.336)	

Statistical Hypothesis Testing

Study hypotheses were tested statistically based on advanced econometric models compatible with the nature of study variables and the structure of assumed relationships between them. The Panel Autoregressive Distributed Lag model was employed to measure the impact of financial innovation variables on banking efficiency indicators in the presence of mediating variables.

Statistical analysis results showed the presence of a statistically significant relationship between financial innovation indicators and banking efficiency indicators, indicating that financial innovation plays an effective role in improving the financial performance of banks in the study sample. In light of obtained results, the general statistical hypothesis stating the presence of a significant effect of financial innovation on banking efficiency was accepted. Statistical models proved that adopting financial innovations contributes to enhancing resource employment efficiency, improving profitability indicators, and raising banking performance levels generally.

These results also confirm consistency between financial and statistical analysis and support the study's conceptual and methodological framework, enhancing the reliability of conclusions reached.

Panel ARDL Model

This section aims to test the relationship between study variables in both the short and long term, based on the Panel Autoregressive Distributed Lag (Panel ARDL) model, to measure the impact of financial innovation indicators on banking efficiency indicators, then accept or reject statistical sub-hypotheses formulated in the study's scientific methodology.

Testing First Sub-Hypothesis (H_1)

H_1: There is a statistically significant impact of financial innovation indicators on Return on Assets (ROA).

This hypothesis assumes the presence of a significant relationship between independent variables represented by financial innovation indicators (ratio of expenditure on financial innovations, number of digital transactions, and number of innovative products) and the dependent variable represented by Return on Assets (ROA). This relationship was tested using the Panel ARDL model based on the Pooled Mean Group (PMG) method, due to its ability to distinguish between short and long-term relationships while allowing for variation in short-term dynamics across cross-sectional units.

Long-run Relationship Results

Statistical estimation results for the model, as shown in Table 6, demonstrated the presence of a long-term equilibrium relationship with statistical significance between financial innovation indicators and Return on Assets, where the probability value reached (p-value = 0.000 < 0.01), indicating model significance in the long term.

Results showed that the ratio of expenditure on financial innovations has a positive and significant impact on Return on Assets in the long term. The regression coefficient value indicates that each unit increase in the ratio of expenditure on financial innovations leads to an increase in Return on Assets by (0.026) units on average, reflecting the effective role of investing in financial innovation in improving asset employment efficiency and enhancing bank profitability.

Results also showed that the number of digital transactions positively and significantly affects Return on Assets, where the effect coefficient reached (0.073) with a probability value (p-value = 0.000 < 0.01), indicating that expansion in using digital channels contributes to improving banking operations efficiency, reducing operational costs, and increasing banks' ability to achieve profits from their assets.

Regarding the number of innovative products, results showed a positive and significant impact on Return on Assets, where the effect coefficient reached (0.039) with a probability value (p-value = 0.009 < 0.01), indicating that diversifying innovative banking products and services enhances banks' ability to expand income sources and improve asset exploitation efficiency in the long term.

Short-run Relationship and Error Correction Term Results

The second part of model results addresses analyzing the short-term relationship through the Error Correction Term (COINTEQ), which measures the speed of system return to long-term equilibrium after any shock in the short term. This coefficient value reached (-0.290), which is a negative value as theoretically expected, indicating the presence of a self-correcting mechanism in the model.

The probability value of the error correction coefficient showed statistical significance, confirming the presence of a cointegration relationship between the dependent variable (Return on Assets) and independent variables (financial innovation indicators). This means the model corrects approximately (29.06%) of the equilibrium deviation

that occurred in the previous period and gradually returns to the long-term equilibrium path within a time period of one year.

Statistical Conclusion

Based on statistical results extracted from the Panel ARDL model shown in Table 6, the presence of a positive and significant impact of financial innovation indicators on Return on Assets in both short and long terms is evident. According to the statistical results clarified in Table 6, the first sub-hypothesis is accepted, which states: "There is a statistically significant impact of financial innovation indicators on ROA."

Table 6: Analysis Results of Relationship between Financial Innovation Variables and Return on Assets Variable

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Long-run (Pooled) Coefficients				
X1	0.02607	0.00721	3.615602	0.000
X2	0.07326	5.39E-06	3.136529	0.000
X3	0.0392	7.46E-05	2.3502	0.009
C	-0.00505	0.002462	-2.04899	0.0426
Short-run (Mean-Group) Coefficients				
COINTEQ	-0.29056	0.142023	-2.04588	0.0429
Log-Likelihood:	418.089			

Testing Second Sub-Hypothesis (H_2)

H_2: There is a statistically significant impact of financial innovation indicators on Return on Equity (ROE).

This hypothesis assumes the presence of a statistically significant relationship between financial innovation indicators represented by the ratio of expenditure on financial innovations, number of digital transactions, and number of innovative products as independent variables, and the dependent variable represented by Return on Equity (ROE). To test this relationship in both the short and long term, the Panel Autoregressive Distributed Lag (Panel ARDL) model was adopted using the Pooled Mean Group (PMG) method, due to what this method provides in terms of ability to estimate long-term relationships while allowing for variation in short-term dynamics across banks.

Long-run Relationship Results

Statistical estimation results, as shown in Table 7, indicate the presence of a long-term equilibrium relationship with statistical significance between financial innovation indicators and Return on Equity, where the probability value reached (p-value = 0.000 < 0.01), indicating model significance in the long term.

Results showed that the ratio of expenditure on financial innovations positively and significantly affects Return on Equity, where the effect coefficient reached (0.107), meaning that each unit increase in the ratio of expenditure on financial innovations leads to an increase in Return on Equity by (0.107) units on average in the long term. This reflects the importance of investing in financial innovation in maximizing shareholder returns and improving capital employment efficiency.

Results also showed a positive and significant impact of the number of digital transactions on Return on Equity, where the effect coefficient reached (0.003) with a probability value (p-value = 0.005 < 0.01), indicating that expansion in digital transactions contributes to improving financial performance by raising banking operations efficiency and reducing operational costs, which positively reflects on equity returns.

Regarding the number of innovative products, results showed a positive and significant impact on Return on Equity, where the probability value (p-value = 0.000 < 0.01) indicates the statistical significance of this variable, while the effect coefficient reached (0.046), meaning that each unit increase in the number of innovative products leads to an increase in Return on Equity by (0.046) units on average in the long term. This confirms the role of diversifying innovative banking products and services in enhancing bank profitability and maximizing shareholder returns.

Short-run Relationship and Error Correction Term Results

The second part of model results addresses analyzing the short-term relationship through the Error Correction Term (COINTEQ), which measures the speed of system return to long-term equilibrium after any shock in the short term. This coefficient value reached (-0.270), which is a negative value as required by theoretical conditions for error correction model validity.

The probability value of the error correction coefficient showed statistical significance, confirming the presence of a cointegration relationship between the dependent variable (Return on Equity) and independent variables (financial innovation indicators). The coefficient value indicates that the model corrects approximately 27.03% of the equilibrium deviation that occurred in the previous period and gradually returns to the long-term equilibrium path within a time period of one year.

Statistical Conclusion

Based on statistical results extracted from the Panel ARDL (PMG) model and shown in Table 7, the presence of a positive and significant impact of financial innovation indicators on Return on Equity in both short and long terms is evident. Accordingly, the second sub-hypothesis (H_2) is accepted. According to the statistical results shown in Table 7, the second sub-hypothesis is accepted, which states: "There is a statistically significant impact of financial innovation indicators on ROE."

Table 7: Analysis Results of Relationship Between Financial Innovation Variables and Return on Equity Variable

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Long-run (Pooled) Coefficients				
X1	0.107705	0.017844	6.035996	0.000
X2	0.00328	1.23E-05	2.81823	0.005
X3	0.046	3.93E-04	2.18029	0.0066
C	0.02022	0.006909	-2.9269	0.0042
Short-run (Mean-Group) Coefficients				
COINTSEQ	-0.27039	0.295612	-3.91468	0.000
Log-Likelihood:	272.6032			

Testing Third Sub-Hypothesis (H_3)

H_3: There is a statistically significant impact of financial innovation indicators on Return on Deposits (ROD).

This hypothesis assumes the presence of a statistically significant relationship between financial innovation indicators represented by the ratio of expenditure on financial innovations, number of digital transactions, and number of innovative products as independent variables, and the dependent variable represented by Return on Deposits (ROD). To test this relationship in both the short and long term, the Panel Autoregressive Distributed Lag (Panel ARDL) model was adopted using the Pooled Mean Group (PMG) method, due to what this method provides in terms of ability to estimate long-term relationships while allowing for variation in short-term dynamics across banks.

Long-run Relationship Results

Statistical estimation results, as shown in the results table, indicate the presence of a long-term equilibrium relationship with statistical significance between financial innovation indicators and Return on Deposits, where the probability value reached (p-value = 0.000 < 0.01), indicating model significance in the long term.

Results showed that the ratio of expenditure on financial innovations positively and significantly affects Return on Deposits, where the effect coefficient reached (0.172), meaning that each unit increase in the ratio of expenditure on financial innovations leads to an increase in Return on Deposits by (0.172) units on average in the long term. This reflects the role of investing in financial innovation in improving banks' ability to efficiently employ their deposits and achieve better returns.

Results also showed a positive and significant impact of the number of digital transactions on Return on Deposits, where the effect coefficient reached (0.167) with a probability value (p-value = 0.000 < 0.01), indicating that expansion in digital transactions contributes to improving deposit management efficiency, reducing operational costs, and maximizing returns achieved from them.

Regarding the number of innovative products, results showed a positive and significant impact on Return on Deposits, where the effect coefficient reached (0.073) with a probability value (p-value = 0.000 < 0.01), meaning that diversifying innovative banking products and services contributes to improving deposit exploitation and increasing returns achieved from them in the long term.

Short-run Relationship and Error Correction Term Results

The second part of model results addresses analyzing the short-term relationship through the Error Correction Term (COINTEQ), which measures the speed of system return to long-term equilibrium after any shock in the short term. This coefficient value reached (-0.383), which is a negative value as required by theoretical conditions for error correction model validity.

The probability value of the error correction coefficient showed statistical significance, confirming the presence of a cointegration relationship between the dependent variable (Return on Deposits) and independent variables (financial innovation indica-

tors). This coefficient value indicates that the model corrects approximately 38.30% of the equilibrium deviation that occurred in the previous period and gradually returns to the long-term equilibrium path within a time period of one year.

Statistical Conclusion

Table 8: Analysis Results of Relationship between Financial Innovation Variables and Return on Deposits Variable

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Long-run (Pooled) Coefficients				
X1	0.172	3.28E-02	5.224124	0.000
X2	0.167	2.47E-05	3.673962	0.000
X3	0.073	0.000361	3.20453	0.000
C	-0.04263	0.011388	-3.74314	0.0003
Short-run (Mean-Group) Coefficients				
COINTEQ	-0.38369	0.162964	-2.35443	0.0201
Log-Likelihood:	259.5379			

Based on statistical results extracted from the Panel ARDL (PMG) model, the presence of a positive and significant impact of financial innovation indicators on Return on Deposits in both short and long terms is evident. Accordingly, the third sub-hypothesis (H_3) is accepted. According to the statistical results in Table 8, the third sub-hypothesis is accepted, which states: "There is a statistically significant impact of financial innovation indicators on ROD."

Testing Fourth Sub-Hypothesis (H_4) Using Panel ARDL Model

H_4: There is a statistically significant impact of financial innovation indicators on liquidity ratio.

This hypothesis assumes the presence of a statistically significant relationship between financial innovation indicators, represented by the ratio of expenditure on financial innovations, number of digital transactions, and number of innovative products as independent variables, and the mediating variable represented by the liquidity ratio. To test this relationship in both the short and long term, the Panel Autoregressive Distributed Lag (Panel ARDL) model was adopted using the Pooled Mean Group (PMG) method, due to what this method provides in terms of ability to estimate long-term relationships while allowing for variation in short-term dynamics across banks.

Long-run Relationship Results

Statistical estimation results, as shown in the results table, indicate the presence of a long-term equilibrium relationship with statistical significance between financial innovation indicators and the liquidity ratio, where the probability value reached (p-value = 0.000 < 0.01), indicating model significance in the long term.

Results showed that the ratio of expenditure on financial innovations has a positive and significant impact on the liquidity ratio, where the effect coefficient reached (0.398), meaning that each unit increase in the ratio of expenditure on financial innovations leads to an increase in the liquidity ratio by (0.398) units on average in the long

term. This reflects the role of financial innovation in improving banks' ability to attract liquid deposits and enhance liquidity management efficiency.

Results also showed a positive and significant impact of the number of digital transactions on the liquidity ratio, where the effect coefficient reached (0.009) with a probability value (p-value = 0.000 < 0.01), indicating that expansion in digital channels contributes to accelerating cash flows and improving liquid asset management efficiency.

Regarding the number of innovative products, results showed a positive and significant impact on the liquidity ratio, where the effect coefficient reached (0.016) with a probability value (p-value = 0.000 < 0.01), meaning that diversifying innovative banking products and services contributes to enhancing liquidity flexibility and improving liquid asset structure in the long term.

Short-run Relationship and Error Correction Term Results

The second part of model results addresses analyzing the short-term relationship through the Error Correction Term (COINTEQ), which measures the speed of system return to long-term equilibrium after any shock in the short term. This coefficient value reached (-0.442), which is a negative value as required by theoretical conditions for error correction model validity.

The probability value of the error correction coefficient showed statistical significance, confirming the presence of a cointegration relationship between the mediating variable (liquidity ratio) and independent variables (financial innovation indicators). This coefficient value indicates that the model corrects approximately 44.20% of the equilibrium deviation that occurred in the previous period and gradually returns to the long-term equilibrium path within a time period of one year, reflecting relatively high speed in liquidity response to changes in financial innovation indicators.

Statistical Conclusion

Based on statistical results extracted from the Panel ARDL (PMG) model, the presence of a positive and significant impact of financial innovation indicators on the liquidity ratio in both short and long terms is evident. Accordingly, the fourth sub-hypothesis (H_4) is accepted. According to the statistical results in Table 9, the fourth sub-hypothesis is accepted, which states: "There is a statistically significant impact of financial innovation indicators on liquidity ratio."

Regarding the liquidity ratio, analysis results showed that its efficient management formed a decisive factor in regulating the relationship between financial innovation and banking efficiency. Financial innovations enabled banks to improve liquidity management by accelerating money circulation, reducing the need to maintain high levels of unproductive liquid assets, and directing liquidity toward income-generating investment and credit activities. This approach contributed to achieving dynamic balance between financial safety requirements and profitability, positively reflecting on banking efficiency indicators without compromising the ability to meet short and long-term obligations. Thus, the liquidity ratio played a regulatory mediating role that helped maximize benefit from financial innovation in improving banking performance.

Table 9: Analysis Results of Relationship Between Financial Innovation Variables and Liquidity Ratio Variable

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Long-run (Pooled) Coefficients				
X1	0.398	2.38E-01	4670908	0.000
X2	0.0097	2.15E-04	4.4915	0.000
X3	0.01643	0.003512	4.67751	0.000
C	1.26E+00	0.062285	20.21261	0.000
Short-run (Mean-Group) Coefficients				
COINTEQ	-0.44272	0.171023	-2.58863	0.0108

Sectoral Analysis of Iraqi Private Commercial Banks

Analysis relied on examining a group of Iraqi private commercial banks for the period 2017-2024. Commercial banks were specifically chosen because they represent the backbone of the Iraqi economy, in addition to the availability of their financial data and ease of access to it. The study aims to understand the role of financial innovation in improving the efficiency of sample banks, determine the extent of their adoption of innovations, identify the most used innovative tools in the Iraqi sector that contributed to raising their efficiency, and through this study, a mediating factor was selected that contributed to conveying and enhancing the impact of financial innovation on banking efficiency.

In addition, banks enjoying high liquidity and good management had high expenditure ratios. By observing financial data, it became clear that Ashur Bank's liquidity for 2024 is the highest among sample banks, reaching approximately 223%, while it enjoyed high expenditure and profitability ratios, and consequently high banking efficiency. It is followed by Mosul, Investment, Erbil, Region, and Mansour banks, whose liquidity ratios reached 161%, 201%, 131%, 130%, and 151% respectively. These ratios demonstrate the extent of banks' exploitation and their good management of liquidity in investment, developing technological infrastructure, and increasing profitability.

Analysis results showed that Sumer Commercial Bank's liquidity ratio reached approximately 512%, and its expenditure ratios on innovations do not exceed 35%, with its deposit structure depending on current deposits, savings deposits, and fixed deposits. However, when observing profitability indicators, we find them low and inconsistent with the extent of its expenditure and liquidity, attributed to the fact that the bank's possession of high liquidity and expenditure ratios is not necessarily indicative of bank profitability. In some cases, investing in innovations forms high costs, or there is poor management of investments and liquidity.

Based on this, it became clear that banks that raised their technology expenditure ratio by more than 10% of total operational expenses achieved higher efficiency rates compared to other banks, confirming the positive relationship between digital transformation and competitiveness.

Role of Central Bank of Iraq

First - Regulatory and Legislative Role

The Central Bank of Iraq plays a fundamental role in organizing banking activity through:

- Issuing instructions and regulations governing bank operations
- Imposing capital and liquidity requirements
- Monitoring compliance with international standards such as Basel and risk management guidelines

This directly reflects on banking efficiency levels, as banks are required to improve resource utilization and comply with more efficient operational controls.

Second - Supporting Financial Innovation and Digital Transformation

The Central Bank of Iraq contributed to creating a supportive environment for financial innovation through:

- Encouraging electronic payment and modern settlement systems
- Issuing special instructions for electronic wallets and digital banking services
- Supporting financial inclusion and reducing cash dependence

Study results show that banks that interacted with these regulatory directions achieved higher improvement in performance indicators such as ROA, ROE, and ROD.

Third - Monetary and Financial Stability

Through:

- Managing monetary policy
- Maintaining exchange rate stability
- Regulating liquidity in the banking system

The Central Bank contributes to reducing systemic risks, providing a safer environment that allows banks to focus on improving operational efficiency and innovation.

Fourth - Central Bank's Role in Interpreting Research Results

Study results can be linked to the Central Bank's role as follows:

- The positive relationship between financial innovation and banking efficiency reflects the effectiveness of the Central Bank's stimulative and regulatory policies
- Variation among banks is partially explained by their varying degrees of compliance with Central Bank instructions and their ability to adapt to them

Study Conclusions

1- The study concluded the presence of a positive and significant relationship between financial innovation and banking efficiency in Iraqi private commercial banks, confirming that financial innovation is considered one of the main determinants for improving banking performance.

2- Financial innovation contributes to improving the quality of banking services provided to customers, in addition to reducing operational costs through relying on digital channels and advanced banking systems.

3- Differences in banking efficiency levels among banks are attributed to varying degrees of investment in digital technology and the size of banking operations, reflecting variation in institutional capacities and adopted technological strategies.

4- The study proved the validity of all statistical hypotheses through using Autoregressive Distributed Lag models, which enhances the reliability of results and conclusions reached.

5- Financial analysis using banking efficiency indicators (ROA, ROE, ROD) showed that the general trend of average these indicators was upward during recent years of the study period, attributed to improved economic and political conditions and increased relative stability in the banking sector.

6- Results showed that the average indicator of expenditure on financial innovations for the study sample witnessed continuous increase during the period 2017-2024, despite global and local economic challenges, indicating Iraqi banks' pursuit of keeping pace with technological developments and global banking competition.

7- Increased customer orientation toward using digital banking tools was observed, particularly internet and mobile phones, compared to declining reliance on ATMs, reflecting changing banking behavior patterns and rising digital awareness levels.

8- Despite positive results achieved by some sample banks, a number still need to develop their banking systems and improve their technical management efficiency to keep pace with accelerating digital transformation.

9- Results showed that financial innovation affects banking efficiency through multiple methods, whether directly through expenditure ratios on innovations, number of innovative products, and digital transactions, or indirectly through mediating variables represented by bank size, liquidity, and deposit structure.

10- Financial and statistical analysis results showed that financial innovation represents a fundamental factor in improving banking efficiency, where banks that adopted advanced digital strategies managed to achieve higher levels of operational efficiency and financial stability.

11- Results confirmed the presence of a positive and significant impact of financial innovation indicators on banking efficiency indicators in the long term, with a cointegration relationship in the short term, reflecting the sustainability of financial innovation's impact on banking performance.

Recommendations

1- Increase expenditure on banking technology in a planned and strategic manner, enhancing sustainable digital transformation and ensuring achieving real added value reflecting on performance and profitability.

2- Develop risk management systems compatible with the level of financial innovation and diversity of digital products and services, particularly operational, technological, and cybersecurity risks.

3- Encourage small and medium banks to merge or technically cooperate among themselves, aiming to achieve economies of scale, raise operational efficiency, and enhance their competitiveness.

4- Enhance transparency and disclosure of financial innovation indicators within Iraqi banks' annual reports, contributing to improving investor confidence and stakeholder trust and supporting financial market efficiency.

5- Commit to publishing annual financial data within their specified deadlines according to adopted accounting and regulatory standards, due to its role in enhancing credibility and institutional discipline.
6- Spread banking awareness of electronic and digital services, targeting various community segments, contributing to accelerating digital transformation pace and reducing dependence on traditional channels.
7- Enhance credibility and accuracy in published final financial data, ensuring they are free from errors or manipulation, reflecting the true picture of banks' financial performance.
8- Focus on cybersecurity field by adopting advanced protection systems and continuously updating them, aiming to protect banking systems and reduce penetration and electronic attack risks.
9- Intensify continuous training and qualification programs for employees on modern electronic banking systems, ensuring optimal use of technology and improving quality of services provided.
10- Attract and support banking and technological competencies and provide appropriate environment for developing their skills, contributing to advancing Iraqi banks' reality and enhancing their innovative capacity.
11- Adopt modern banking systems and services and work on updating and renewing currently adopted services, compatible with technological developments and changing customer needs.
12- Direct investment expenditure in the correct direction, focusing on technological projects with tangible impact on increasing profitability and improving performance and banking efficiency.
13- The study recommends conducting future research addressing the relationship between financial innovation and financial stability in light of digital transformation, focusing on the impact of modern technologies, such as artificial intelligence and blockchain technologies, in improving performance and efficiency in Iraqi private and Arab banks.

Study Limitations

This is considered an analytical study focusing on measuring the impact left by financial innovation, which was measured using (indicator of expenditure ratio on financial innovations, indicator of number of digital transactions, indicator of number of innovative products) on banking efficiency, which was measured using (Return on Assets indicator, Return on Equity indicator, Return on Deposits indicator), particularly when a mediating factor represented by the liquidity ratio is present, to understand the nature of the relationship between variables over time.

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