

## **Technological Infrastructure Investments Between Their Reflections and Motives: Evidence from Arab Banks**

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### **Abstract:**

The study investigated the reflections of technological infrastructure investments on Arab banks' profitability and proposed a framework for their motivations for these investments, including marketing, operational, and regulatory reasons. Under quantitative analysis for 28 Arab banks across six countries over the period 2017–2021 according to Hierarchical Multiple regression and cross-sectional analysis, there is a contribution of investment in banking technological infrastructure to the interpretation (46.1%)

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and (64%) of the change in ROA, but the interpretation (44.1%) and (58.7%) of the change in return on equity, respectively. On the other hand, under qualitative analysis for 421 questionnaires received. They were collected between May 2022 and March 2023, according to the Friedman test, there is a difference in the importance of investment motives in the technological infrastructure of the Arab banks between marketing, operational, and regulatory reasons. Technological infrastructure investments are one of the mechanisms for achieving entrepreneurship for banks based on creating benefits for the economy, clients, and employees in addition to improving the bank's profitability.

**Keywords:** Banks' Profitability, Financial Technology, Technological Infrastructure, Arab Banks, Technological Infrastructure Investments.

## 1. Introduction

Today; the banking industry is a highly competitive and dynamic sector, it has a role in financing companies, public spending and supporting macroeconomic growth (Hussein et al., 2022), and banks are constantly looking for ways to increase their profitability. Currently, control resides with the client, not the bank. The new business models are client-driven. In addition to changes in social and household dynamics, their use of technology is propelling business transformation. The banks must modernize their business models, procedures, and information technology (IT) in order to

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adapt to the new client-centric environment (Asadi et al., 2017). One of the strategies used by banks to improve their profitability is investing in technological infrastructure. Financial technology is seen as the forefront of a global movement to expand financial access (Hassan et al., 2023). This article will discuss the impact of technological infrastructure investments on banks' profitability fluctuations.

A successful banking sector contributes to a country's economic progress. The banking industry has become increasingly important, particularly since globalization (Tunay et al., 2019), and financial technology, which refers to the flood of technological tools, platforms, and ecosystems that make financial services or products more readily available, effective, and affordable, has flourished during the past years on a global scale (Varma et al., 2022). And even before the word "financial technology" became popular, the government, society, and academics have always given priority to the use, advancement, and effects of financial technology. Financial technology is no longer just a theoretical idea; it has evolved into a crucial tool for engaging in financial innovation and shaping the financial markets. Since the liberalization of the financial markets, there has been intense competition between domestic and foreign banks, and banks must pay close attention to their operational performance to compete in the ongoing global challenges (Li et al., 2020).

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Following the 2008 monetary crisis, peer-to-peer and market entrepreneurship in the monetary science space has elevated significantly. Some humans assume that economic technology should doubtlessly expand purchaser get entry to savings and improve performance (offering faster, better, or less expensive services) in the financial system. Financial science leaders have been an increasing number of competing with common banks (Hughes, et al., 2022), and because the start of 2020, the world has been dealing with the COVID-19 pandemic, which is causing economic and psychological misery across countless industries and economies. To overcome the difficulties introduced on with the aid of the numerous protection measures enacted by governments, such as nearby and/or nationwide lockdowns, science and innovation utilization dramatically grew. (Kou et al., 2021).

The financial market is extra various in the Internet age because clients can without problems enter the market. With the increase of the Internet and data technology, several financial goods are now emerging. For instance, virtually every financial institution now publishes economic products through websites or cellular applications. Clients can buy monetary instruments at any time and from any location. Bank-released monetary contraptions grant much less chance than inventory or fund products. Risk-averse clients often like to pick out up such financial goods. (Xiong et al., 2020).

But because of improvements in telecommunications, information technology, and financial practices, the banking industry has

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evolved significantly during the last years. In response to this technological advancement, numerous financial products, services, industrial processes, and organizational structures have undergone significant changes. Human judgment is being replaced by automated analysis of client data, which is an excellent illustration of how technological progress is transforming the financial services business. This means that non-bank financial institutions can now compete in markets that were once only for banks (Frame et al., 2018).

Financial technology has contributed to opening a new range of banking products and services that work to satisfy clients in addition to improving the cost structure of banking transactions, which destroys the competitive position of the bank. If the bank's management is rational and has a vision, and if the banks do not respond to these developments, they will lose their competitive position, especially in the face of emerging companies that invest in financial technology. More clearly, communication technology is reshaping the role of financial service providers. Fundamentally, it is reshaping the banking industry. As a result, financial services and how they are provided are evolving. Payment and lending functions are carried out by banks in an economic system. It is now possible for communication technology to assist and even undertake these tasks. There used to be an information gap between banks and their borrowers (clients), but this is rapidly closing. Due to its intimate understanding of its clientele, one bank was able to gain an advantage over the competition. Because this information can be

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evaluated digitally, the digital revolution in financial technology diminishes this advantage. (Broby, 2021).

Banks in emerging countries should invest in financial technology to be able to compete in the era of the Fourth Industrial Revolution, when the business environment changes to reduce human intervention by relying on artificial intelligence methods and big data mining (Wagdi, Tarek, 2022). It requires an investment in technology that includes tangible assets (machines, equipment) in addition to intangible assets (software, employee training). The current study aims to investigate the impact of Arab banks' investment in financial technology on their profitability. Technological developments have contributed to providing opportunities for innovations in the banking industry. These innovations included serving employees in addition to clients. The current study is concerned with innovations of both types. If a bank doesn't have a way to understand its employees and client's needs, it can't offer technology services with benefit for these employees and clients.

The study begins with an introduction by presenting a brief overview of technological infrastructure as used in the banking sector. The study then discusses the banking financial technology business model, focusing on its repercussions on the economy, the bank's clientele, and the bank's performance. The study will be divided into four sections beside introduction; that includes "Literature review and theoretical framework" in second section; "Study Methodology and Design" in the third section; "Quantitative

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Analysis “inthe fourth section, “Qualitative Analysis “in fifth section. “Discussion “In the sixth section, the seventh and final section displays “Conclusions and recommendations”

## **2. Literature Review and Theoretical framework**

On one hand; there interest about how technological structures of the economy respond to the use of monetary and fiscal policy tools (Sukharev et al., 2023). On other hand; in numerous industries, the introduction of information technology has altered business models. Presently, banks are increasingly employing financial technology as a subtype of information technology to accomplish their diverse objectives and to create a flexible and adaptable banking environment that can swiftly respond to evolving business requirements. Technology plays a crucial role in enhancing the client experience, improving operational efficiency, and driving revenue growth. Banks are leveraging the latest technologies to offer innovative products and services, automate manual processes, and improve security and compliance measures. According to Rodrigues et al. (2022), artificial intelligence (AI), digital transformation, and cyber security are hot topics currently, in the banking industry. Today; the impact of technology has extended to central banks as well to issue digital and Crypto currency as well (Korobeynikov, 2023)

Banks are investing heavily in digital channels to offer a seamless and personalized banking experience to their clients. Some of the popular digital banking services include mobile

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banking apps, online banking portals, digital wallets, and chat bots. Another area where technology is transforming the banking industry is in payment systems. Digital payment systems such as mobile payments, contactless payments, and online payments are becoming increasingly popular among clients. These payment systems offer faster and more secure transactions, eliminating the need for physical cash and reducing the risk of fraud, Artificial intelligence (AI) making significant contributions to the banking industry (Doumpos et al., 2023). Banks are using AI technologies to automate manual processes, reduce operational costs, and enhance the client experience. Furthermore, AI helping banks to detect and prevent fraud by analyzing large volumes of data and identifying suspicious transactions. This enhances the security of client data and builds trust with clients.

The banking industry heavily relies on information technology to operate efficiently and provide high-quality services to clients. In general, the types of banking investments in the technology infrastructure can be classified into two areas: investment in technology equipment and technology software. Some of the key ways that information technology is used in the banking industry include: Customer Relationship Management (CRM) Systems (Chen et al., 2021); Online and Mobile Banking terminal equipment like ATM and POS (Duarte et al., 2017), Data Analytics Systems (Al-Dmour et al., 2023), artificial intelligence Systems (Rodrigues et al. 2022),

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cloud computing (Asadi et. Al., 2017), and security systems (Verma, 2013).

Banks' investments in technological infrastructure based on many motives, it's include the distribution channels like ATMs, POS and wallets (Fouillet et al., 2021), to provide added value to the banking client like service reliability and time savings (Ding et al., 2007), to facilitate administrative operations like reduce transaction costs and data transfer speed (He et al., 2023), to support banking decision-making like credit decision support (Wagdi and Tarek, 2022), to manage banking risks like market risk, operational risk and liquidity risk (Leo et al., 2019), to manage banking Cyber security (Shulha et al., 2022), or provide data and information to regulators and government agencies like for the purpose of oversight, intelligent real-time oversight (Yang and Li, 2018).

Banks are increasingly investing in technological infrastructure as a means of improving their operations, expanding their client base, and remaining competitive in the rapidly evolving financial services industry. Financial technology is the time used to describe the use of present day applied sciences and/or creative business models to supply financial offerings using already-existing facts and communications technologies. Access to lower priced financing, high net penetration rates, and the use of brand-new technologies such as huge data analysis, synthetic intelligence, and block chain are all contributing factors to the rise of the Financial Technology sector. (Muganyi et al., 2022).

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The financial industry remained in the main unaffected until recently. Financial technology companies, or "companies that use technological know-how for banking, payments, monetary data analytics, capital markets, and private economic management," have revolutionized this. Global financial technology investment increased, and it is nevertheless growing. Existing retail banks are at threat from this rising range as a new wave of start-ups in digital banking has developed. (Li et al., 2017).

In the typical banking model, banks compete for deposits through imparting extraordinary prices of interest. This makes the transactional element reliant on the resultant debits and credits that they handle, essentially transforming banks into accounting entities performing the intermediation role. Since this is completed in response to aggressive pressures, the normal equilibrium is a passive one. As a result, the business mannequin for banks can be changed, specifically when new financial applied sciences come out (Broby, 2021).

Recent traits in economic science have altered the standard financial landscape. The use of choice information and enormous modeling through economic science lenders has allowed them to extend access to these clients besides taking on immoderate risk. Financial technology lenders have grown and seized market share away from the banking sector. (Hughes, et al., 2022).

As a result of the economic technology phenomenon, the economic offerings sector has been disrupted through the emergence of new players, products, and commercial enterprise models. Since

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2000, numerous financial technology companies have been founded, particularly following the world economic crisis of 2007–2008. The quantity of financial science corporations globally, the amount invested in the industry, and the quantity of clients, amongst different factors, all endure on the enlargement of the monetary science ecosystem. While most of these corporations provide modern day economic solutions to end users (business-to-consumer, or B2C Financial Technology) or to other agencies (business-to-business, or B2B Financial Technology), many have bother turning a profit. (Carbó-Valverde et al., 2022)

This environment is conducive to an increase in demand for financial technology services in tested banks. Therefore, shifting a substantial portion of transactions to financial technology helps banks to lower operational expenses, branch count, and employment. Employees, on the other hand, may experience job insecurity as a result of this. The COVID-19 epidemic has had a considerable influence on the banking sector's use of financial technology. (Pandey, Pal, 2020).

The word "innovation" may be used to describe a new product or a new method. In the banking industry, financial technology that meets clients' demands is associated with more facilities, including availability, speed, and accuracy as a service innovation. Even today, there is still a significant amount of financial technology in the banking industry; the developments in information technology have had a role in providing opportunities for innovations in the

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banking industry. In the previous four decades, the phrase "financial innovation" has been a significant study field in financial studies. This has happened because new financial approaches have been devised and/or adopted swiftly by financial organizations. In a nutshell, scholars agree that structural changes in financial systems throughout the globe are to blame for financial innovation. These have been driven by increased competitive pressures, changes in legislation, technology improvements, and macroeconomic shifts. Such traits are also connected.

According to Wagdi and Fathi (2023), banks' investments in technology have an effect on how much market share they get; with an interpretation capacity of 14% of the market shares of Egyptian banks based on quantitative methodology, on other hand there is a reflection of financial technology on the market shares of banks through influencing the level of client satisfaction, in addition to improving the perceived mental image of banks; With an interpretation capacity of 68.19% of clients' preferences for banks based on qualitative methodology in Egypt.

The previous study agrees with Kumar (2023), that bank's investment in technological can improve the customer's satisfaction that ultimately have the positive ripple effect on the business growth.

But the Wagdi and Fathi (2023) results differ from the Liu (2022) result in Taiwan's banking industry. Liu found a financial patents and financial innovation investment are not directly and significantly related to the operating performance of banks.

On other hand, according to Ong et al. (2023), technology banking services contribute to influencing retail behavior among clients, as they support retail behavior in Malaysia, while retail behavior does not affect the use of technology banking services.

Figure 1 show how the business model for technological infrastructure investments in banking can be summed up by the study.

<p>The supervisory and regulatory authorities, which include the central bank, non-banking financial regulators, and technology intermediaries, are the starting point for providing financial technology tools in addition to both local and international communication and payment service providers, as well as business units, especially specialized in the field of financial technology.</p>	<p>Facilitating financial transactions, whether with the banking unit itself or in partnership with external parties, while providing instant support (7/24) for such transactions and ensuring the security of information and balances.</p>	<p>A multi-point financial transaction platform integrates with intermediate devices (like ATM, POS, computers, mobile phones ...etc.) over the internet or intranet that ensures the confidentiality and security of transactions and financial balances.</p>	<p>The market available for the application of financial technology tools is characterized by diversity, whether between business units and individual customers (B2C), between business units and each other (B2B), individual customers and each other (C2C), between business units and government units (G2B), and finally the individual customer with government units (G2C).</p>	<p>Effective and efficient application of financial technology tools results in many sources of customer value, including availability, flexibility, and reliability.</p>
<b>Key partners      Key activities      Customer relations      Customers segments      Value proposition</b>				
<b>Technological infrastructure investments in banking</b>				
<p>Each of the communication channels rather than the scope of saving data customers, transactions, and balances (Cloud computing-Distributed ledger technology) and processing that data (Artificial intelligence-Big Data analytics) are the resources and platforms for providing banking services through financial technology tools, in addition to information security and intrusion prevention systems (Anti-Virus - Firewall - Anti-Spyware).</p>	<p>Banking service distribution channels through financial technology tools include each of the branches of banking units, as well as a website, social media, partner programs, and finally, intermediate devices (like ATM, POS, computers, mobile phones ...etc.) .</p>	<p>The cost structure resulting from the adoption of a banking unit to implement one of the financial technology tools includes the commissioning of creating and maintaining the platform, in addition to all of the costs of data preservation and related peripheral devices, in addition to transaction security costs and expenses, and finally, marketing costs and expenses.</p>	<p>The revenue structure from providing financial services through financial technology tools includes both the annual service fee as well as transaction commissions, in addition to the income generated from the investment of financial balances without burdens on the banking unit.</p>	
<b>Key Resources      channels      Cost structure      Revenue structure</b>				

**Figure No. (1): Business model for technological infrastructure investments in banking**

Figure No. 2 shows the general framework for providing financial technology services, but the study doesn't stop there. There are many standards that financial technology tools must meet, such as reliability, speed, cost, insurance, flexibility, availability, ease of use, and the ability to use them in more than one language. There are also standards for communication lines, such as reliability, speed, cost, insurance, and a certain number of hops.

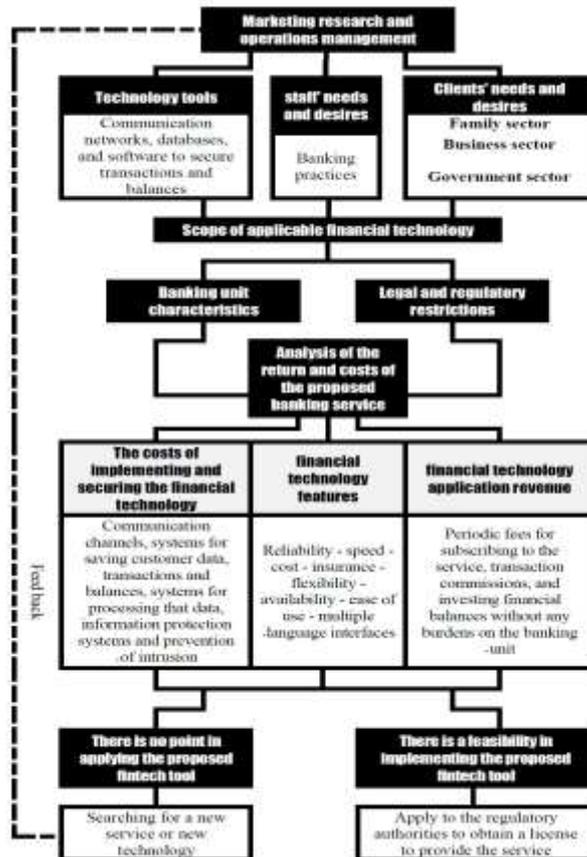


Figure no. (2) Proposed framework for providing banking financial technology tools

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This can be achieved through the interaction of three main aspects in light of four sets of constraints, and these aspects are represented by "the returns of the application of the financial technology tool," "the costs of providing and securing the financial technology tool," as well as "the characteristics of the service provided." Based on the "needs and wants of clients," "characteristics of technology tools," "legal and regulatory restrictions," and "characteristics of the banking unit," the proposed framework for providing banking financial technology tools can be presented figure No. 2:

In figure No. 2, the study talks about the many stages of giving banks financial technology tools, which include:

***Step 1: Determine the scope of relevant financial technology tools:***

In this step, the task of finding a financial technology tool falls on the shoulders of the marketing department—specifically market research—in addition to the operations department—specifically the management of banking operations. This is done through the available technological capabilities, which requires that the organizational climate prevails by supporting the practices of creativity and administrative innovation in addition to empowering workers with organizational citizenship behaviors, which is achieved through an effective leadership style.

***Step 2: Determine the requirements for activating the technology tool:***

During this step, the banking unit's interest is focused on determining each of the technical requirements by the supervisory and

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regulatory authorities like the central bank, in addition to estimating the suitability of that tool with its own characteristics.

***Step 3: It examines the proposed banking services' revenues and costs:***

Through this step, the banking unit's interest is focused on determining the investment feasibility of providing the technology tool, and in this regard, the aspects to be addressed include the investment cost of the technological tool (physical equipment/service management software proposed to provide/software from intrusion and espionage/software compatibility with operation systems applied in the banking unit/training of the human element), in return for the benefits generated for each client, the banking unit, as well as society as a whole. In this way, the study think it's important to point out the importance of this stage, which can be affected in many ways by personal biases or resistance to change, which slows down the application process.

***Step 4: Decision-making:***

This is the last step in determining the extent of the trend toward the application of the proposed financial service by the banking unit, either towards the supervisory and regulatory authorities, to obtain the necessary licenses and start implementation, or to return to the search for a new application opportunity for the results of the banking unit based on a good study of the market the banker.

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Banks must invest in technology infrastructure in order to remain competitive and relevant in a continually evolving industry. With the development of fintech startups, traditional banks are under greater pressure to innovate and provide services that match clients' evolving expectations. Investments in technology infrastructure can help banks stay ahead of the curve by equipping them with the tools required to deliver innovative services and enhance the client experience.

Investing in technology infrastructure offers several benefits for banks. First, it can help banks reduce operational costs by automating routine tasks and streamlining processes. This can free up resources that can be used to invest in other areas, such as marketing or product development. Second, investing in technology infrastructure can help banks improve their risk management practices. With the use of advanced analytics and machine learning, banks can better identify and mitigate risks, such as fraud or credit risk. Third, investing in technology infrastructure can help banks improve their client experience. By offering digital banking services and personalized services based on data analytics, banks can enhance client satisfaction and loyalty.

Therefore, investment in the technological infrastructure can be seen as one of the entrepreneurship mechanisms for banking units, according to the benefits it creating benefits for the economy, clients, employees, and bank (which is consistent with Wagdi and Hasaneen, 2019), Addition to, investments in the technology in-

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frastructure support the efficiency of banks and its Profitability. Their impact of banking expansion according to technology banking on profit efficiency of the banks.(Alber, 2011). That agree was with Idowu et al.(2002), where clearly indicate that IT has contributed immensely to the growth of the banking industry.

### **3. Study Methodology and Design**

#### **3.1 Study questions and hypotheses Formulation**

Banks provide financial products and payment services that offer investment vehicles for savings and access to credit, enabling their clients to engage in the broader economy. Arab banks have expanded their activities, which are reflected by the growing assets during the last five-decade, number of credit and debit cards, number of ATMs, number of e-wallets, and number of POSs have been increased.

This study addresses the main question of whether Arab banks' profit under technological infrastructure investments to be examined are variables related to banking expansion based on innovations regarding using financial technology to substitute for or help with branches as traditional marketing channels. So, we have questions as follows:

Q<sub>1</sub>: Is there a significant impact of technology infrastructure investment on the return on assets of Arab banks?

Q<sub>2</sub>: Is there a significant impact of technology infrastructure investment on the return on equity of Arab banks?

In addition to the previous questions, the study has another question

Q<sub>3</sub>: Is there a difference in the importance of investment motives in the technological infrastructure of the Arab banks between marketing, operational, and regulatory reasons?

Q<sub>4</sub>: Is there a difference in the investment motives in the technological infrastructure based on marketing reasons between the Arab banks?

Q<sub>5</sub>: Is there a difference in the investment motives in the technological infrastructure based on operational reasons between the Arab banks?

Q<sub>6</sub>: Is there a difference in the investment motives in the technological infrastructure based on regulatory reasons between the Arab banks?

The study can answer the first and second questions based on analysis of the financial reports of Arab banks, but there many determinants of banks' performance and profitability, which are multiple and can be taken as control variables; they include bank size, its style, and its ownership. For a long time, Arab banks have played an important role, and not just as financial middlemen who help depositors and borrowers; they also advance the economy which is why it is essential to analyze their profitability under technological infrastructure investments. So, the study can test the following hypotheses:

H<sub>1</sub>: There isn't a significant impact of technological infrastructure investments on Arab banks' profitability according to the return on assets.

H<sub>2</sub>: There isn't a significant impact of technological infrastructure investments on Arab banks' profitability according to the return on equity.

The study can answer the third and fourth questions by surveying the opinions of senior managers (department heads and above) in Arab banks about the motives for investing in the technology infrastructure. Because of the huge amount of these investments, it is necessary to understand these motives with their comparison between Arab banks in order to test next hypotheses.

H<sub>3</sub>: There isn't a significant a difference in the importance of investment motives in the technological infrastructure of the Arab banks between marketing, operational, and regulatory reasons.

H<sub>4</sub>: There isn't a significant difference in the investment motives in the technological infrastructure based on marketing reasons between the Arab banks.

H<sub>5</sub>: There isn't a significant difference in the investment motives in the technological infrastructure based on operational reasons between the Arab banks.

H<sub>6</sub>: There isn't a significant difference in the investment motives in the technological infrastructure based on regulatory reasons between the Arab banks.

From the foregoing, the current study relied on each of the quantitative analysis to test the first and second hypotheses, as opposed to using the qualitative analysis to test the third and fourth hypotheses.

### ***3.2. Test Methodology and Variables of Quantitative Analysis***

The banking industry in the Arab countries has not reached full efficiency and effectiveness, so a methodology called Hierarchical Multiple Regression (HMR) was used to determine the additional contribution of variables in the interpretation of the banks' profitability. In addition, the study used a cross-sectional analysis as a confirmatory test.

**Table No. (1): Study variables**

Types of Variables	Symbol	Variable	Measurement or classification methodology
Independent Variables	TIF <sub>j,t</sub>	Total technological Infrastructure investment	The logarithm of total investment in technology in year (t) - total depreciation in a given year (t)
	NIF <sub>j,t</sub>	New technological Infrastructure investment	The logarithm of additional investment in technology in a given year (t)
Control variables	B <sub>zi</sub>	Bank size	B <sub>z1</sub> The logarithm of total assets B <sub>z2</sub> The logarithm of total equity B <sub>z3</sub> The logarithm of net loans B <sub>z4</sub> The logarithm of net deposit
	B <sub>s</sub>	Bank style	Traditional bank Islamic bank
	B <sub>t</sub>	Bank ownership	Public bank Private bank
Dependent Variable	ROA	Returns on assets	Net income <sub>(jt)</sub> ÷ Total assets <sub>(jt)</sub>
	ROE	Returns on equity	Net income <sub>(jt)</sub> ÷ Total equity <sub>(jt)</sub>

The study proposes two models to explain the performance of banks based on the return on assets and the return on equity. A set of control variables has been selected according to the studies of: Size of a bank (Sufian 2009; Rizwan et al., 2018; Alber 2014; Adusei, 2015 Phan et al., 2016; Gupta and Mahakud, 2020), Style of a bank (Rashid, Khalid 2017; Rizwan et al., 2018; Khan et al.,

2021), ownership of a bank (Griffith et al., 2002; Sathye 2005; Arora 2014; Rizwan et al., 2018; Gupta and Mahakud, 2020; Gupta et al., 2022). Those models can be built as follows:

### ***3.2.1 The impact of investing in technological infrastructure on the rate of return on assets:***

$$ROA_{JT} = \beta_0 + \beta_{j,tif} TIF_t + \beta_{j,nif} NIF + \beta_{J,Z1} BZ1 + \beta_{J,Z2} BZ_2 + \beta_{J,Z3} BZ_3 \\ + \beta_{J,Z4} BZ_4 + \beta_{J,T} BT + \beta_{J,S} BS + e_{j,t}$$

Equation no.1

### ***3.2.2 The impact of investing in in technological infrastructure on the rate of return on equity:***

$$ROE_{JT} = \beta_0 + \beta_{j,tif} TIF_t + \beta_{j,nif} NIF + \beta_{J,Z1} BZ1 + \beta_{J,Z2} BZ_2 + \beta_{J,Z3} BZ_3 \\ + \beta_{J,Z4} BZ_4 + \beta_{J,T} BT + \beta_{J,S} BS + e_{j,t}$$

Equation no.2

The study tested two hypotheses; equations (1) and (2) were drafted to test these hypotheses. Where (J) represents the bank and (t) represents time. In equation (1), ROA represents returns on assets as a dependent variable, but in equation (2), ROE represents returns on equity as a dependent variable vs. total investment in financial technology (TIF) and new investment in banking financial technology (NIF) as an independent variable. On the other

hand, bank size:  $\beta Z_i$  (total assets:  $B_{z1}$ , total equity:  $B_{z2}$ , net loans:  $B_{z3}$ , net deposit:  $B_{z4}$ ); bank style:  $\beta_S$ ; bank ownership:  $\beta_T$  is used as a control variable, but  $\beta_0$  is a constant term.

### 3.3. Test Methodology and Variables of Qualitative Analysis

According to the sample of quantitative analysis, there are 28 Arab banks under investigation (Bahrain, Egypt, Kuwait, Qatar, Saudi Arabia, and the UAE). The study distributed the questionnaire randomly through social networking sites on the basis of the banks under investigation. A questionnaire from different administrative levels was based on Google Forms with sponsored ads. To target the segment of managers working in the banks under investigation (see table No.1) which makes the sample size and characteristics of each bank require a non-parametric statistical analysis. The questionnaire was formulated in three dimensions, as shown in Table 2.

**Table No. (2):** Questionnaires variables

No.	Dimensions	Sub motives
D1	Marketing Reasons	D11: Banks' distribution channels
		D12: Provide added value to the bank's clients
D2	Operational Reasons	D21: Facilitate banks' operations
		D22: Support banks' decision-making
		D23: Manage banking risks
		D24: Manage banking Cyber security

<b>D3</b>	<b>Regulation Reasons</b>	<b>D32: Financial solvency support</b>
		<b>D33: Capital Adequacy</b>
		<b>D34: Anti-money laundering</b>
		<b>D35: Prevention of terrorist financing</b>
		<b>D36: Reduce tax evasion</b>

The questionnaire was designed according to what each of them indicated Anagnostopoulos, 2018; Ding et al., 2007; Fouillet et al., 2021; He et al., 2023; Leo et al., 2019; Shulha et al., 2022; Turki et al., 2020; Wagdi and Tarek, 2022; addition to Yang and Li, 2018.

## 4-Quantitative Analysis

### 4.1 Study Sample

The study involved 28 banks from 6 Arab countries, including Bahrain, Egypt, Kuwait, Qatar, Saudi Arabia, and the UAE. The study covers the period 2017–2021.

**Table No. (3): sample components**

No.	Bank name	Country	Bank style
1.	Alinma bank	Kingdom Saudi Arabia	Islamic bank
2.	Al rajhi bank		Islamic bank
3.	Albilad bank		Commercial bank
4.	Arab national bank - Saudi Arabia		Commercial bank
5.	The national commercial bank - Saudi Arabia		Commercial bank
1.	Emirates NBD bank- UAE	United Arab Emirates	Commercial bank
2.	Mashreq bank		Commercial bank

**Table No. (3): sample components**

No.	Bank name	Country	Bank style
3.	Dubai Islamic bank		Islamic bank
4.	Commercial bank of Dubai		Commercial bank
5.	Ajman bank		Commercial bank
1.	Commercial bank of Qatar	Qatar	Commercial bank
2.	Doha bank		Commercial bank
3.	Qatar national bank QNB- Qatar		Commercial bank
4.	Al Rayan Bank		Islamic bank
5.	Qatar islamic bank "Al Masraf"		Islamic bank
1.	Ahli united bank - Bahrain	Bahrain	Commercial bank
2.	National bank of Bahrain		Commercial bank
3.	Arab banking corporation - Bahrain		Commercial bank
4.	Bank of Bahrain and Kuwait		Commercial bank
5.	Al Baraka bank - Bahrain		Commercial bank
1.	Commercial bank of Kuwait	Kuwait	Commercial bank
2.	Gulf bank		Commercial bank
3.	National bank of Kuwait		Commercial bank
4.	Warba bank		Commercial bank
5.	Boubyan bank		Commercial bank
1.	Qatar national bank QNB - Egypt	Egypt	Commercial bank
2.	Commercial international bank - CIB		Commercial bank
3.	Banque du caire		Commercial bank

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Through the previous table, it is clear that the weight of commercial (traditional) banks is greater than that of Islamic banks in the study sample. The sample of the study is balanced across all six countries, with five banks for each country except for Egypt, which is represented by only three banks (according to the available data).

#### ***4.2 Data Stationary***

The assumption of stationary (constant variance) exists in many time series methods. According to the constant level, the study examined the data stationary to ensure that the mean and variance were invariant, and the stationary of the time series of the basic independent and dependent indicators at level zero was evaluated. This was done through "the Augmented Dickey–Fuller (ADF)", "Philips–Perron (PP)", "Pesaran and Shin W-stat (IPSW)", "Levin", and "Lin and Chu (LLC)" tests at a significance level of less than 0.05. In addition to the Tau-statistic, the Z-statistic criteria were at a significance level of less than 0.05.

#### ***4.3 Testing the impact of Technological Infrastructure Investments on the return on assets of Arab banks:***

According to HMR; the outputs of the statistical analysis are shown in the following table (4).

**Table No. (4):** Outputs of HMR test for ROA

<b>Model Summary</b>				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.500 <sup>a</sup>	.250	.245	6.390E-03
2	.522 <sup>b</sup>	.272	.261	6.319E-03
3	.625 <sup>c</sup>	.391	.363	5.869E-03
4	.702 <sup>d</sup>	.492	.460	5.401E-03

a. Predictors: (Constant), TIF

b. Predictors: (Constant), TIF, NIF

c. Predictors: (Constant), TIF, NIF, TD, TE, TA, TL

d. Predictors: (Constant), TIF, NIF, TD, TE, TA, TL, OT, BT

#### Source: Statistical Package for Social Sciences outputs

Through the statistical outputs, there is the contribution of investment in banking technology to the interpretation of a return on the bank's assets by (26.1%) based on adjusted R-Square, and the control variables contributed to raising the interpretation to 46.1% of the change in ROA based on adjusted R-Square. On the other hand, the same data can be re-tested using another presumptive method, which is cross-sectional analysis, see tableNo. (5)

**Table No. (5): Outputs of cross-sectional test for ROA**

Model 1: WLS, using 137 observations					
Included 28 cross-sectional units					
Dependent variable: ROA					
Weights based on per-unit error variances					
	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>	
const	-0.00941204	0.00465158	-2.023	0.0451	**
TIF	0.0169085	0.00366110	4.618	<0.0001	***
NIF	0.000812479	0.000434724	1.869	0.0639	*
B <sub>s</sub>	0.00642283	0.000925611	6.939	<0.0001	***
B <sub>1</sub>	-0.000615130	0.00104750	-0.5872	0.5581	
B <sub>21</sub>	0.00425130	0.00463523	0.9172	0.3608	
B <sub>22</sub>	0.00599105	0.00155213	3.860	0.0002	***
B <sub>23</sub>	-0.000439762	0.000989870	-0.4443	0.6576	
B <sub>24</sub>	-0.0246842	0.00552930	-4.464	<0.0001	***
Statistics based on the weighted data:					
Sum squared resid	123.6191	S.E. of regression	0.982738		
R-squared	0.661321	Adjusted R-squared	0.640154		
F(8, 128)	31.24242	P-value(F)	1.14e-26		
Log-likelihood	-187.3544	Akaike criterion	392.7088		
Schwarz criterion	418.9887	Hannan-Quinn	403.3883		
Statistics based on the original data:					
Mean dependent var	0.013210	S.D. dependent var	0.007353		
Sum squared resid	0.004018	S.E. of regression	0.005603		

source: Gnu Regression, Econometrics and Time-series Library.

Through Table No. 5, the study found that, based on cross-sectional analysis under weighted least squares (WLS) methodology, within control variables, technological infrastructure investments were significant for banks' profitability based on

the return on assets of Arab banks. There is the contribution of investment in banking technology within the control variables to the interpretation of a return on the bank's assets by (64%) based on adjusted R-Square under cross-sectional analysis. Thus, the results of the previous inferential tests (HMR test and cross-sectional analysis) of the first hypothesis agree. Now, the study rejects the Null hypothesis and concludes that accepts the following alternative hypothesis:

**There is a significant impact of technological infrastructure investments on Banks' Profitability according to the return on assets.**

#### ***4.4 Testing the impact of Technological Infrastructure Investments on the return on equity of Arab banks***

According to HMR, the outputs of the statistical analysis are shown in the following table (6).

**Table No. (6):** Outputs of HMR test for ROA

<b>Model Summary</b>				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.011 <sup>a</sup>	.000	-.007	.1251
2	.136 <sup>b</sup>	.018	.004	.1244
3	.674 <sup>c</sup>	.454	.429	9.422E-02
4	.689 <sup>d</sup>	.474	.441	9.317E-02

a. Predictors: (Constant), TIF

b. Predictors: (Constant), TIF, NIF

c. Predictors: (Constant), TIF, NIF, TD, TE, TA, TL

d. Predictors: (Constant), TIF, NIF, TD, TE, TA, TL, OT, BT

**Source: Statistical Package for Social Sciences outputs**

Based on adjusted R-Square, the statistical outputs show that investment in banking technology led to an interpretation of a return on equity of 0.4%. The control variables led to an interpretation of 44.1%, also based on adjusted R-Square. On the other hand, the same data can be re-tested using another presumptive method, which is cross-sectional analysis, see table No. (7)

**Table No. (7): Outputs of cross-sectional test for ROE**

Model 2: WLS, using 137 observations					
Included 28 cross-sectional units					
Dependent variable: ROE					
Weights based on per-unit error variances					
	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>	
const	-0.000741713	0.00861139	-0.08613	0.9315	
TIF	0.234690	0.0556138	4.220	<0.0001	***
NIF	0.152958	0.0353824	4.323	<0.0001	***
B <sub>5</sub>	0.0439482	0.00699695	6.281	<0.0001	***
B <sub>7</sub>	-0.0136406	0.00843102	-1.618	0.1081	
B <sub>21</sub>	0.221838	0.0575177	3.857	0.0002	***
B <sub>22</sub>	-0.152245	0.0357836	-4.255	<0.0001	***
B <sub>23</sub>	0.00418272	0.00338766	1.235	0.2192	
B <sub>24</sub>	-0.202895	0.0550163	-3.688	0.0003	***
Statistics based on the weighted data:					
Sum squared resid	123.3137	S.E. of regression	0.981524		
R-squared	0.611256	Adjusted R-squared	0.586960		
F(8, 128)	25.15822	P-value(F)	6.17e-23		
Log-likelihood	-187.1850	Akaike criterion	392.3700		
Schwarz criterion	418.6498	Hannan-Quinn	403.0495		
Statistics based on the original data:					
Mean dependent var	0.117552	S.D. dependent var	0.124641		
Sum squared resid	1.199513	S.E. of regression	0.096805		

Source: Gnu Regression, Econometrics and Time-series Library.

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Through Table No. 7, the study found that, based on cross-sectional analysis under weighted least squares (WLS) methodology, within control variables, technological infrastructure investments were significant for banks' profitability based on the return on equity of Arab banks. There is the contribution of investment in banking technology within the control variables to the interpretation of a return on the bank's equity by (58.7%) based on adjusted R-Square under cross-sectional analysis. Thus, the results of the previous inferential tests (HMR test and cross-sectional analysis) of the first hypothesis agree. Now, the study rejects the Null hypothesis and concludes that accepts the following alternative hypothesis:

**There is a significant impact of technological infrastructure investments on Banks' Profitability according to the return on equity.**

## 5. Qualitative Analysis

### 5.1 Data Collection

A questionnaire from different administrative levels was based on Google Forms with sponsored ads via Face book as the leading platform in the Arab region to attract the target segment of the Arab bankers under investigation from Bahrain, Egypt, Kuwait, Qatar, Saudi Arabia, and the UAE. A total of 421 questionnaires were received. They were collected between May 2022 and March 2023.

The study's limitation was the lack of diversity among participants from only six Arab countries. The study justified this based on available data for a quantitative study on the performance of Arab banks. This matter caused a bias when reaching the individuals participating in the investigation.

### 5.2 Reliability statistics

Cronbach's alpha-based reliability statistics were used to validate the sample. Through confirmatory factor analysis and structural equation modeling, the Cronbach's alpha coefficient for the questionnaires received was 0.7908. Thus, the study identified stability indicators for the results of statistical analyses.

### 5.3 Descriptive Statistics

The statistical parameters of the questionnaire-collected data are presented in table 8.

**Table No. (8): Descriptive Statistics of the questionnaire-collected data**

Investment motives in the technological infrastructure of the Arab banks	Mean	Std. Deviation	Coefficient of variation
Marketing Reasons	3.8979	0.5703	0.146309551
Operational Reasons	3.9477	0.4165	0.105504471
Regulation Reasons	1.1235	0.6928	0.616644415

**Source: Statistical Package for Social Sciences outputs**

Table 8 shows that the largest agree rate is about investment motives in the technological infrastructure of the Arab banks for operational reasons; the agree rate was 89% among the questionnaire participants. While regulation reasons had the lowest rate of agreement among the participants in the questionnaire, where it was recorded at 38%,

#### ***5.4 Testing the importance of investment motives in the technological infrastructure of the Arab banks***

Through the use of non-parametric statistics based on Friedman test, questionnaire participants' opinions about the importance of investment motives in the technological infrastructure of the Arab banks see tableNo. (9).

**Table No. (9): Outputs of the importance of investment motives in the technological infrastructure**

Ranks		Test Statistics <sup>a</sup>	
	Mean Rank	N	421
MARK	2.44	Chi-Square	698.896
OPE	2.48	df	2
REG	1.07	Asymp. Sig.	.000

a. Friedman Test

#### **Source: Statistical Package for Social Sciences outputs**

Based on the Friedman Test results that have been provided, the sample size (N) is 421, the chi-square value is 698.896, and the degrees of freedom (df) are 2. The asymptotic significance (Asymp. Sig.) is reported as 0, which indicates that the null hypothesis of no difference among the the importance of

investment motives in the technological infrastructure of the Arab banks is rejected at the 0.01 level of significance. Now, the study rejects the Null hypothesis and accepts the following alternative hypothesis.

**There is a significant a difference in the importance of of investment motives in the technological infrastructure of the Arab banks between marketing, operational, and regulatory reasons.**

### ***5.5 Testing the difference in the investment motives in the technological infrastructure based on marketing reasons between the Arab banks :***

Through the use of non-parametric statistics based on the Kruskal-Wallis Test, questionnaire participants' opinions about the difference in investment motives in the technological infrastructure based on marketing reasons between the twenty-eight Arab banks are summarized in Table 10.

**Table No. (10): Outputs of the investment motives in the technological infrastructure based on marketing reasons**

Test Statistics <sup>a,b</sup>	
	MARK
Chi-Square	278.480
df	27
Asy mp. Sig.	.000

a. Kruskal Wallis Test

b. Grouping Variable: BANK

**Source: Statistical Package for Social Sciences outputs**

Based on the Kruskal-Wallis Test results that have been provided, the chi-square value is 278.48, and the degrees of freedom (df) are 27. This indicates that the null hypothesis of no difference among Arab banks is rejected at the 0.01 level of significance. Now, the study rejects the Null hypothesis and accepts the following alternative hypothesis.

**There is a significant difference in the investment motives in the technological infrastructure based on marketing reasons between the Arab banks.**

### ***5.6 Testing the difference in the investment motives in the technological infrastructure based on operational reasons between the Arab banks :***

Through the use of non-parametric statistics based on the Kruskal-Wallis Test, questionnaire participants' opinions about the difference in investment motives in the technological infrastructure based on operational reasons between the twenty-eight Arab banks are summarized in Table 11.

**Table No. (11): Outputs of the investment motives in the technological infrastructure based on operational reasons**

Test Statistics <sup>a,b</sup>	
	OPE
Chi-Square	175.323
df	27
Asy mp. Sig.	.000

a. Kruskal Wallis Test

b. Grouping Variable: BANK

**Source: Statistical Package for Social Sciences outputs**

The Kruskal-Wallis Test results that have been provided indicate that the chi-square value is 175.323, and the degrees of freedom (df) are 27. This suggests that the null hypothesis of no difference among Arab banks is rejected at the 0.01 level of significance. Now, the study rejects the Null hypothesis and accepts the following alternative hypothesis.

**There is a significant difference in the investment motives in the technological infrastructure based on operational reasons between the Arab banks.**

### *5.7 Testing the difference in the investment motives in the technological infrastructure based on regulation reasons between the Arab banks :*

Through the use of non-parametric statistics based on the Kruskal-Wallis Test, questionnaire participants' opinions about the difference in investment motives in the technological infrastructure based on regulation reasons between the twenty-eight Arab banks are summarized in Table 12.

**Table No. (12): Outputs of the investment motives in the technological infrastructure based on regulation reasons**

Test Statistics <sup>a,b</sup>	
	REG
Chi-Square	19.597
df	27
Asy mp. Sig.	.847

a. Kruskal Wallis Test

b. Grouping Variable: BANK

**Source: Statistical Package for Social Sciences outputs**

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Based on the Kruskal-Wallis Test results that have been provided, the chi-square value is 19.597, the degrees of freedom (df) are 27, and the asymptotic significance (Asymp. Sig.) is reported as 0.847. This suggests that the null hypothesis of no difference among Arab banks is not rejected at the 0.05 level of significance. Now, the study accepts the following the Null hypothesis:

**There isn't a significant difference in the investment motives in the technological infrastructure based on regulatory reasons between the Arab banks**

## 6. Discussion

The study investigated the reflections of technological infrastructure investments on banks' profitability and proposed a framework for their motivations for these investments. Under quantitative analysis, evidence was gathered from 28 Arab banks across six countries (Bahrain, Egypt, Kuwait, Qatar, Saudi Arabia, and the UAE) over the period 2017–2021. Based on Hierarchical Multiple Regression (HMR), In addition, a cross-sectional analysis was conducted as a confirmatory test. Under qualitative analysis, the study distributed the questionnaire randomly. A questionnaire from different administrative levels was based on Google Forms with sponsored ads via Facebook. A total of 421 questionnaires were received. They were collected between May 2022 and March 2023.

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During the last five decades, technology has become an important part of the banking industry. Banks use technology to improve client service, cut costs, and work more efficiently. Over the past few decades, banks have invested a lot of money in technology. Financial technology is a combination of "financial services" and "information technology." It is used to describe innovative technology that tries to enhance and automate the delivery and usage of financial services. At its foundation, financial technology is employed to assist corporations, company owners, and individuals in better managing their financial operations, procedures, and lifestyles. Financial technology is the integration of current, mostly Internet-based technology (like the Internet, cloud computing, and mobile) with traditional financial services (like money lending and transaction banks). Financial technology often refers to innovators and disruptors in the financial industry that use pervasive communication, particularly the Internet and automated information processing, without the aid of a human. Clients are becoming more aware of the role financial technology plays in their everyday lives. Figure 3 shows that the banks' motives for technological infrastructure investments are marketing reasons, operational reasons, and regulation reasons (Ding et al., 2007; Fouillet et al., 2021; He et al., 2023; Leo et al., 2019; Shulha et al., 2022; Wagdi and Tarek, 2022; addition to Yang and Li, 2018).

Under Qualitative Analysis; there is a significant a difference in the importance of investment motives in the technological in-

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frastructure of the Arab banks between marketing, operational, and regulatory reasons. The study can explain this to the different characteristics of banks and the difference in the banking system among the Arab countries under investigation. On other hand; there is a significant difference in the investment motives in the technological infrastructure based on marketing and operational reasons between the Arab banks. But, there isn't a significant difference in the investment motives in the technological infrastructure based on regulatory reasons between the Arab banks. The study can explain this through the different characteristics of banks and the differences in the banking system among the Arab countries under investigation.

The types of banking investments in the technology infrastructure can be classified into two areas: investment in technology equipment and technology software; under quantitative analysis that includes 28 banks from six Arab countries. The study covers the period 2017–2021.

According to Hierarchical Multiple Regression, there is a contribution of investment in banking technological infrastructure to the interpretation of a return on the bank's assets of (26.1%), but the control variables contributed to raising the interpretation to (46.1%) of the change in ROA based on adjusted R-square. But under cross-sectional analysis, there is a contribution of investment in banking technology within the control variables to the

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interpretation of a return on the bank's assets of (64%) based on the adjusted R-Square.

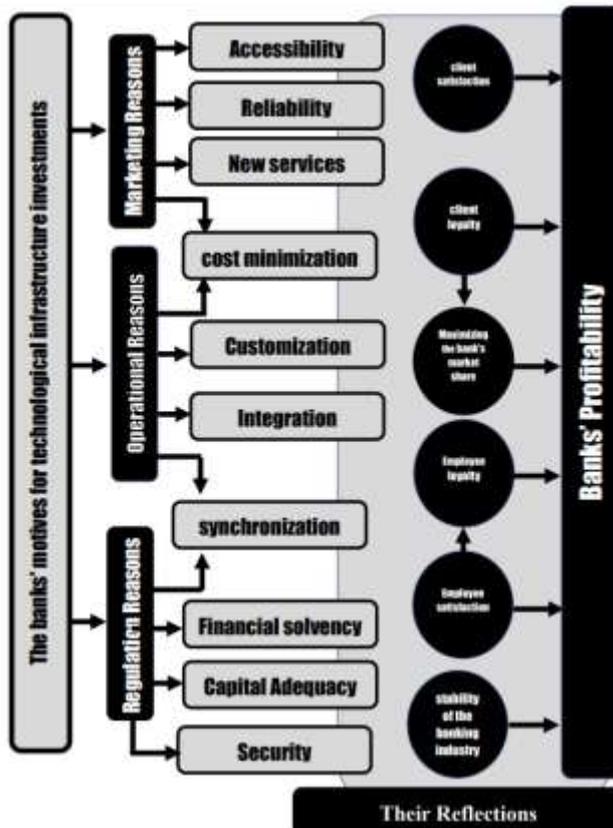
On the other hand, the contribution of technological infrastructure investments of Arab banks to the interpretation of a return on equity was 0.4% based on adjusted R-square, and the control variables contributed to raising the interpretation to 44.1% based on adjusted R-square. But under cross-sectional analysis, there is the contribution of investment in banking technology within the control variables to the interpretation of a return on the bank's equity by (58.7%) based on adjusted R-Square within the control variables.

The previous results are consistent with empirical literature in Egypt (Wagdi and Fathi ,2023) and Saudi Arabia (Alber, 2011), so these are considered, the study is an extension of the generalization of the positive impact of the bank's investment in technology on the profits of banks. The difference in results between ROA and ROE can be justified according to the different characteristics of assets liabilities management (ALM) between banks as well as the different structure of interest rates among Arab countries. This interpretation is in line with the results of studies on both (Wagdi, et al., 2019; Rosalina and Nugraha, 2019; Widichesty and Arief, 2021; Surayya and Kadang, 2022).

On the other hand; in response to problems with anti-money laundering (AML) and combating the financing of terrorism (CFT) regulatory compliance, technological solutions were or are

being developed (Gaviyau and Sibind, 2023); this indicates that investment in technological infrastructure supports risk management and increases compliance with regulatory rules by providing smart systems to combat financial crimes, which is called "regulatory technology" or "RegTech". The current study agrees with Varma et al. (2022), that along with the advantages of financial technology for banks come a number of negatives, such as a greater dependence on technology, higher technological infrastructure investments, an increased number of job losses, security issues connected to data, and so on.

But under qualitative analysis, the study distributed the questionnaire randomly. A questionnaire from different administrative levels was based on Google Forms with sponsored ads via Facebook. A total of 421 questionnaires were received. They were collected between May 2022 and March 2023. According to the Friedman test, there is a significant difference in the importance of investment motives in the technological infrastructure of the Arab banks between marketing, operational, and regulatory reasons. The study can explain this through the different characteristics of banks and the differences in the banking system among the Arab countries under investigation. The motives and Reflections of banking investment in the infrastructure technology can be summarized in the following figure.



**Fig. No. (3): Technological infrastructure investments between their reflections and motives**

Figure No. (3) reveals that there is a relationship between bank investments in technology and the profitability of banks, and the senior management of banks must understand that there are three motives for these investments represented in the marketing, operational, and regulatory reasons, and these investments have repercussions that represent benefits to three sides: the bank client, the banking

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employees, and finally the banking industry, where technology investments come with many benefits, which include accessibility, reliability, new services, and cost minimization of services as marketing benefits for the bank client. Cost minimization of internal operations, customization and integration with traditional banking operations, and synchronization of bank data for risk management as operational benefits for the bank and their employees. Synchronization of bank data for anti-money laundering, prevention of terrorist financing, reducing tax evasion, financial solvency support, capital adequacy, and security issues as regulation benefits central banks, governments, and other regulatory agencies

Finally; banks' technological infrastructure investments have had a positive effect on banks' profitability fluctuations. Technology investments have allowed banks to reduce costs by automating processes and reducing manual labor costs. Additionally, technology investments have enabled banks to offer more efficient services to clients, which have resulted in increased client satisfaction and loyalty. This increased client satisfaction has led to increased revenue for banks, which has helped them maintain higher levels of profitability over time.

## **7. Conclusions and Recommendations:**

### ***7.1 Conclusions and Discussion***

Information technology (IT) plays a crucial role in supporting the competitive position of Arab banks by enhancing the effi-

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ciency of internal operations, improving services to clients, and ensuring compliance with regulatory requirements.

One of the key areas where IT can enhance efficiency is in back-office operations. By automating routine tasks such as data entry and reconciliation, IT systems can reduce the workload on staff, minimize errors, and speed up processes. This allows banks to process transactions more quickly, reduce costs, and improve the quality of service provided to clients.

Another area where IT can support the competitive position of Arab banks is in client-facing services. For example, online banking platforms, mobile applications, and chat bots can provide clients with convenient access to banking services, reduce wait times, and improve the overall client experience. Additionally, IT systems can enable banks to personalize their services and offers to individual clients based on their transaction history and preferences, which can help to build client loyalty and increase revenue.

In addition to improving operational efficiency and client service, IT can help Arab banks comply with regulatory requirements, such as those related to tax evasion, money laundering, and terrorist financing. IT systems can monitor transactions for suspicious activity, flag potentially fraudulent transactions, and ensure compliance with Know Your Customer (KYC) and Anti-Money Laundering (AML) regulations. This can help banks avoid penalties and reputational damage associated with non-compliance, and build trust among clients and regulators.

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Under quantitative analysis; there is a significant relationship between technological infrastructure investments and banks' profitability, with control variables playing a significant role in explaining this relationship. Specifically, the explanatory power of the change in the rate of return on assets (ROA) was found to be 26.1% without control variables and 46% with control variables. Similarly, the explanatory power of the change in the rate of return on equity (ROE) was 0.4% without control variables and 44.1% with control variables. Under cross-sectional analysis, the contribution of technological infrastructure investments to ROA and ROE was found to be 64% and 58.7%, respectively, with control variables.

The difference in results between ROA and ROE can be attributed to differences in the characteristics of asset-liability management (ALM) and the structure of interest rates across Arab countries. The study concludes that technological infrastructure investments allow banks to reduce costs while also increasing client satisfaction and loyalty, resulting in higher levels of profitability over time. As a result, the study recommends that banks should continue to invest in technology to remain competitive and maximize their profits.

Finally, the study also supports Arab banks in managing risk and improving decision-making. For example, data analytics tools can help banks to analyze client behavior, identify trends, and make data-driven decisions. Additionally, IT systems can enable

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banks to conduct stress tests and simulations to assess the potential impact of various scenarios on their financial health.

In conclusion, IT plays a critical role in supporting the competitive position of Arab banks by enhancing operational efficiency, improving client service, ensuring compliance with regulatory requirements, and managing risk. As such, Arab banks should continue to invest in and leverage IT systems to stay ahead of the competition and meet the evolving needs of clients and regulators.

## **7.2- Study recommendations**

### ***7.2.1 Recommendations to regulators***

The Arabic central banks need to have a regulatory strategy that is flexible and well-balanced and to encourage growth and innovation by fostering the spirit of responsible innovation. This will help create a stable, contributing, inclusive, and sustainable digital financial sector that cares not only about making money but also about people and the environment., According to rapid growth in market share of FinTech companies; the study suggests following:

7.2.1.1 The current crisis caused by the possible spread of the COVID-19 pandemic is a great chance to teach clients how to use technology tools, which help countries and central banks achieve their goals of financial inclusion.

7.2.1.2 Even though the legal environment changed and many laws were passed to regulate financial technology tools, their contributions did not reach the level that they were

needed. This means that more work needs to be done. Based on set strict rules to protect clients, stop money laundering, and stop terrorists from getting money. This is to meet the current challenges, keep the market honest, and take action against any practices that don't follow the rules.

7.2.1.3 The study recommends the Arabic Central Banks to help achieve equal opportunities in the provision of financial services by setting appropriate standards and regulatory frameworks and what this entails by facilitating the orderly entry of new participants—such as financial technology companies—which may expand the range of opportunities available to clients and enhance innovation and competition.

7.2.1.4 The study also recommends that central banks support financial innovations in the field of banking services through the establishment of competitions, workshops, and conferences to encourage young bankers, in addition to university students, to provide suggestions that are suitable for the Arabic business environment and are applicable.

## **7.2.2 Recommendations to Arabic banks**

Banks are changing their business environment not only in emerging markets but in the world as a whole, so the study recommends the following:

7.2.2.1 Today; the Fourth Industrial Revolution and the huge changes it has brought to all industries, including banking services, it can be said that the banking sector has no place except in the presence of innovations based on financial technology. The banks will inevitably lose a lot of their comparative advantages if they don't provide suitable financial technology for their clients. Competition from FinTech companies has an impact in the fields of payment, money transfer, crowd funding, crowd investment, and client finance; microfinance; mortgage; and leasing. FinTech companies offer financial innovations that eat up the market share of banks in the financial services market.

7.2.2.2 Providing banking services based on financial technology is not an easy task. The top management of the bank must understand the impact of the bank's characteristics (size, style, type) on the bank's profitability, based on cost benefit analysis for each technology service

7.2.2.3 In accordance with the changing structure of financial services, in addition to changing contemporary business models, the study advises banks to participate in capital of FinTech companies, This gives customary banks an opportunity to diversify investments and reduce competition with non-banking services, in addition to increasing opportunities for modern financial technology.

### **7.2.3 Recommendations to researchers**

Study recommends the following:

7.2.3.1 The study's limitation was that a quantitative approach was adopted due to the lack of qualitative data; this is due to strict regulatory restrictions in some sample countries. In addition to the lack of diversity of the sample only 28 banks, from just six Arabic countries only from twenty-two Arab countries as a whole with 320 banks, it was according to the state of data availability. The Arab business environment in Egypt and the Gulf differs from many emerging markets, and this opens the way for more future research.

7.2.3.2 The study's limitation was that qualitative analysis Just focus on the banks' motives for technological infrastructure investments; Therefore, it is recommended that future studies cover evaluation methods technological infrastructure investments in banking industry, Therefore, it is recommended that future studies cover technological infrastructure investments evaluation methods in this industry.

7.2.3.3 The study recommends expanding the future studies that are associated with financial innovations to include qualitative analysis along with quantitative analysis, which is in line with behavioral finance.

## List of abbreviations

ADF	The Augmented Dickey–Fuller
AI	Artificial Intelligence
ALM	Assets Liabilities Management
AML	Anti-Money Laundering
ATM	An automated teller machine
CFT	Financing of Terrorism
E-Wallets	Electronic wallets
FinTech	Financial Technology
HMR	Hierarchical Multiple Regression
IPSW	Pesaran and Shin W-stat
IT	Information Technology
LLC	Levin, and Lin and Chu
NIF	New Investment In Financial Technology
POS	A point of sale
PP	Philips–Perron
RegTech	Regulatory technology
ROA	Return on Assets
ROE	Return on Equity
TIF	Total Investment in Financial Technology
$\beta_0$	Constant term
$\beta_s$	Bank style
$\beta_T$	Bank ownership
$\beta_Z$	Bank size

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