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The effect of digital banking on commercial bank performance in Jordan: a mediation analysis of technological infrastructure cost

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Abstract

This study aims to investigate how technological infrastructure costs mediate the relationship between digital banking and the performance of Jordanian commercial banks. Data were collected through a structured questionnaire distributed to relevant banking personnel, and the analysis was conducted using Structural Equation Modeling (SEM). The results reveal that the adoption of digital banking leads to increased investment in technological infrastructure, which in turn significantly enhances bank performance. Furthermore, the study confirms that technological infrastructure costs have a significant and positive mediating effect on the relationship between digital banking and the performance of commercial banks in Jordan. These findings highlight the importance of strategic investment in infrastructure to fully realize the benefits of digital banking. Bank managers and policymakers are advised to prioritize technological infrastructure within their digital transformation strategies to improve operational efficiency, service quality, and overall competitiveness.

Keywords: Commercial banks, Digital banking, Digital transformation, Digitalization, e-banking, Jordan, Performance.

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1. Introduction

In today's globalized and rapidly evolving economic landscape, businesses across all sectors are under pressure to remain profitable while delivering efficient, reliable, and innovative services to customers. This necessity has led organizations worldwide to embrace digital transformation, particularly in the financial sector. Technological advancements have reshaped global financial systems, leading to the rise of digital banking (DB), which encompasses services offered via the Internet, mobile applications, and other electronic platforms. According to Scott et al. [1], digitalization has not only transformed banking services but has also altered organizational structures, introduced new financial products, globalized financial markets, and revolutionized financial intermediation.

Digital banking allows customers to access a wide range of services, such as money transfers, bill payments, and balance inquiries, through electronic communication networks [2, 3]. As digital economic models continue to evolve, new opportunities for innovation and competitiveness arise, particularly in developing countries like Jordan, where the banking sector has shown significant progress toward digitalization. A report by Halaiqah and Ghannam [4] reveals that 68% of Jordanian financial institutions are actively investing in digital technologies, allocating a significant portion of their budgets to digital transformation initiatives.

Despite this momentum, challenges remain. A substantial proportion of institutions still question the sufficiency of available technological resources for enabling full digital integration. While previous studies [5, 6] have linked digital banking to enhanced bank performance, there is limited understanding of how the associated costs of technological infrastructure influence this relationship, particularly in emerging economies like Jordan.

This study addresses the knowledge gap concerning the mediating role of technological infrastructure costs in the relationship between digital banking and commercial bank performance. We propose that the lack of insight into this relationship hinders banks' ability to balance cost efficiency, profitability, and competitiveness amid the ongoing digital shift.

Accordingly, the objective of this study is to analyze the impact of digital banking on the performance of Jordanian commercial banks, with a focus on how technological infrastructure costs mediate this relationship. The study aims to answer the following research questions:

- Q1: What effect does digital banking have on the performance of Jordanian commercial banks?
- Q2: How does the cost of technological infrastructure mediate the relationship between digital banking and commercial bank performance in Jordan?

This research contributes valuable insights to bank managers and policymakers, enabling them to make informed decisions about investments in digital infrastructure. These insights are particularly relevant as Jordan's banking sector continues to pursue operational efficiency, customer satisfaction, and sustainable financial growth through digital transformation. Such efforts will further support innovation, enhance digital readiness, and strengthen long-term financial sector resilience.

In addition, the findings of this study have broader implications beyond Jordan. As many emerging economies face similar challenges in balancing the costs of digital transformation with expected performance outcomes, this research can serve as a model for evaluating the effectiveness of infrastructure investment strategies in banking. It also highlights the critical need for financial institutions to develop long-term digital roadmaps that align with national digital economy goals. Moreover, insights from this study can assist international development agencies and regional regulators in designing supportive policies and incentives that accelerate digital adoption without compromising financial stability. By understanding the mediating role of technological infrastructure costs, stakeholders can better manage resource allocation, reduce inefficiencies, and support innovation in the financial sector.

The remainder of this paper is structured as follows: Section 2 presents the literature review; Section 3 outlines the research methodology; Section 4 discusses the results and their implications; and Section 5 concludes with policy recommendations and future research directions.

2. Literature Review

The banking industry has been significantly impacted by the technological revolution; this has influenced almost all areas of society. The way banks used to operate has been altered and redefined with the advent of digital banking. E-business has grown to be a crucial part of corporate strategy and an effective driver of economic growth, much like the global economy, as technology is now seen as a key component of organizational success and one of their fundamental competencies.

As a result, Jordanian commercial banks now commonly use digital banking [7]. This is because the use of this banking system has improved the effectiveness of banking in providing customer service. As a result, both local and international banks are making greater investments to give customers access to new technology through digital banking. Digital banking is the electronic conduct of banking operations that employs ICT to promote banking operations for both short- and long-term objectives, according to Alrawashedh and Shubita [8].

The idea that the performance of banks will suffer as financial technology advances was proposed by Phan [9] and others. They researched financial technologies and the expansion of the Indonesian market using data from 41 commercial banks and concluded that digital technology had a detrimental effect on banks' performance.

Research conducted worldwide has indicated that the implementation of self-service technologies, such as Automated Teller Machines (ATMs), results in lower operational expenses and improved banking system cost efficiency [10]. Banks

that adopt cutting-edge technology can benefit from scale and experience economies, increased lending capacity, and customer benefits. In particular, it is largely focused on the efficiency of foreign commercial banks.

According to Gumar et al. [11], many banks, in order to sustain profitability, have prioritized services that generate fees. In the future, banks will need to process transactions made using cryptocurrencies or Central Bank Digital Currencies (CBDC) to accept deposits.

More significantly, the evolution of banks coincided with advancements in technology, which resulted in changes in bank operations and processes. Due to digital progress, consumers' methods of accessing financial goods and services are evolving [12]. Internet penetration has brought up new possibilities and scenarios for the financial services sector.

Nowadays, the majority of financial organizations' services are delivered through electronic channels. To put it simply, the digitalization of the banking system was centered on the performance of the bank and its satisfaction of its existing and potential customers. As a result, e-banking allows customers of banks or other financial institutions to perform a variety of transactions using e-channels and methods rather than traditional in-person visits. Unlike conventional banking, which provides financial services in tangible form, internet banking links to the bank's main banking system Olaiya and Adeleke [13].

Motwan and Vora [14] investigated e-banking usage and banks' profitability. The study found that internet banking banks had higher ROA and ROE than their counterparts. However, the findings were not statistically significant. Furthermore, return on both assets and earnings was shown to be statistically significant and declined when online banking was implemented. According to this study, non-online banks are more profitable overall, though this might be because it takes a few years to recover the initial investment made to enable online banking services [15].

In related research, Eze and Egoro [16] used frequency tables and charts to analyze the profitability of Nigerian commercial banks and electronic banking. They studied data from 2010 to 2015. Estimated POS and ATM transactions, as well as EBIT (earnings before interest and tax), served as the study's variables. Tables, charts, and OLS (V.20) were used to analyze the collected data. Based on their study's findings, they concluded that, while the effects of the various channels differed, electronic banking had a major impact on commercial banks' profitability.

Kairiza et al. [17] investigated how well electronic banking ensures service efficiency in commercial banks in Zimbabwe. The study's time frame was 2010–2016. The study's variables included POS banking and automated teller machines. The data was analyzed using OLS. They discovered that the quality of services provided by commercial banks has improved because of electronic banking channels. Nevertheless, they also discovered that, throughout the study period, POS banking had no beneficial impact on Zimbabwean banks' efficiency.

Ibrahim and Daniel [18] investigated how digital banking affected the growth of Nigeria's banking industry. The SPSS analytical program was used to examine the questionnaires. Based on their research, they found that electronic banking affects the Nigerian banking industry in both positive and negative ways. In an ideal sense, it has significantly enhanced service delivery; however, on the negative side, it is susceptible to online fraud and illegal use of data, despite the fact that it has greatly improved service delivery.

The findings of the study, which was also conducted by Jarah et al. [19], demonstrated that the increase in the performance of the upgraded AIS system for Jordanian banks is statistically significantly impacted by communications technology networks.

To assess how cybercrime-related expenses affect the development of innovative financial products and services in Kenya, Mehmood et al. [20] found that the development of innovative banking costs was largely driven by the costs of detection and prevention.

Khalil et al. [21] evaluated how investments in cybersecurity affected e-banking's profitability and innovation in products. The target demographic consisted of management-level employees of Pakistani e-banks. The findings demonstrated that the link between safety costs and e-banking financial success is considerably mediated by product innovation performance [22] and that both characteristics are significantly impacted by cybersecurity costs. According to the study's findings, banks' operations have clearly benefited from the introduction of cutting-edge technology as well as innovative services and goods.

E-banking usage was the subject of another research conducted in Pakistan. Afroze et al. [23] discovered that the use of e-banking impacts its performance in Pakistan, which is substantially predicted by privacy and security expenses, website design, and trust. We formulated the following hypothesis based on the literature listed above.

The integration of digital technologies in the banking sector has attracted significant scholarly attention, particularly regarding its influence on financial performance. Ali Alqararah et al. [24] investigated the role of digital transformation capabilities in enhancing the performance of Jordanian commercial banks. Their study revealed that adaptability to digital technologies had a significant positive impact on bank performance ($\beta = 0.310$), explaining 68% of the variance. This finding highlights the importance of technological investments as a core component of digital strategy. Similarly, Ali Alqararah et al. [24] reported that 68% of Jordanian financial institutions are channeling substantial financial resources toward digital transformation, while 26% expressed concerns about the availability of sufficient technological infrastructure. These insights underscore the infrastructural challenges associated with digital adoption in emerging markets like Jordan.

Irawan et al. [25] and Salim et al. [26] explored the mediating effect of the Balanced Scorecard in the relationship between digital banking adoption and bank performance. Conducted among Malaysian banks using structural equation modeling, the study found that digital banking significantly improved performance through better risk management, suggesting that internal institutional mechanisms can mediate digitalization outcomes. On a broader scale, a recent study published in MDPI examined how digitalization impacts banking performance across Eastern European countries,

emphasizing that investment in digital infrastructure is a crucial determinant of improved return on equity (ROE), particularly in competitive or saturated markets. Collectively, these studies emphasize the critical role of technological infrastructure and strategic investment in translating digital banking efforts into measurable improvements in bank performance.

$H_{1:}$ DB positively influences the technological infrastructure cost of Jordanian Commercial Banks

$H_{2:}$ DB positively influences the Jordanian Commercial Banks' performance.

$H_{3:}$ Technological infrastructure costs affect bank performance. As costs increase, the performance of Jordanian commercial banks decreases.

$H_{4:}$ Technological infrastructure costs mediate the relationship between DB and Jordanian Commercial Bank's performance.

3. Methodology

Structural Equation Modeling (SEM) is a comprehensive multivariate statistical technique that is widely used in the social sciences, behavioral sciences, and business research to examine complex relationships among observed and latent variables. Unlike traditional regression models, SEM allows for the simultaneous estimation of multiple interrelated dependence relationships and accounts for measurement error through the inclusion of latent constructs.

SEM combines two key components: the measurement model, which specifies how observed variables represent underlying latent constructs (usually assessed via confirmatory factor analysis), and the structural model, which depicts the hypothesized relationships among those constructs. This makes SEM particularly suitable for testing theoretical models involving mediating and moderating effects, such as examining how a variable (e.g., technological infrastructure cost) mediates the relationship between digital banking and bank performance.

In this study, SEM was employed to validate the measurement model, ensure construct reliability and validity, and assess the hypothesized causal pathways among digital banking, technological infrastructure costs, and bank performance. The use of SEM enhances the robustness of the analysis by capturing both direct and indirect effects within the same analytical framework.

We have based our analysis on the quantitative technique because of its relationship to many forms of information and the process of evaluating data. This technique is increasingly used in empirical research of empirical banking [14]. In order to produce reliable results, we collected cross-sectional data. Random sampling procedures were used to collect data so that every respondent was equally likely to participate.

Prior to collecting data for the final analysis, pilot research is conducted to ensure the reliability and validity of the survey items and to allow for appropriate authorization of the results. Participants' responses are kept private and confidential by adhering to all study ethical procedures. A Google Form was used to distribute 360 survey questions to banking employees of 13 commercial banks in Jordan. Some forms were also sent via email and post. The response rate was 94.4%. In the end, results were calculated from 340 valid samples.

4. Results and Findings

Table 1 shows the demographic analysis. It indicated that in our total sample of 340 individuals, 230 (67%) were male and 110 (33%) were female. Among our respondents, 30% were between the ages of 25 to 30, whereas 34% were between the ages of 31 to 40, 25% were in the age group of 41 to 50, and 11% were above 50. In terms of educational degrees, the majority of respondents held a master's degree, and only 15 individuals held a PhD degree.

Table 1.
Demographic Characteristics of Participants.

		Frequency	%
Gender	Male	230	67
	Female	110	33
Age	25-30	103	30
	31-40	114	34
	41-50	85	25
	51 and above	38	11
Education	Graduate	90	26
	Masters	185	54
	MPhil	**50**	**15**
	PhD	**15**	**5**

Note: Percentages represent proportions within each demographic category.

Structural Equation Modeling (SEM) is an advanced statistical technique used to analyze complex relationships between observed and latent variables. Unlike traditional regression, SEM can test multiple relationships simultaneously and account for measurement error.

It combines two parts: the measurement model (how observed variables represent latent constructs) and the structural model (how these constructs relate to each other). SEM is especially useful for examining mediation effects, such as how technological infrastructure costs mediate the relationship between digital banking and bank performance.

In this study, SEM was used to confirm the reliability and validity of constructs and to analyze both direct and indirect effects, thereby enhancing the strength and depth of the findings.

Table 2 shows the descriptive statistics of our research. It is inferred from the table that the minimum value of the mean is 3.97 and the maximum value is 4.41. The values of standard deviation indicate that the data of all variables have smaller variation and are uniform. The values of skewness and kurtosis show that the data distribution of all these variables is symmetric; they are relatively stable with only extreme points or outliers.

Table 2.
Descriptive statistics.

	N	Mean	Std.dev.	Skewness	Std. error	Kurtosis	Std. error
TIC	340	4.22	2.28	-0.311	0.119	0.152	0.251
DGB	340	3.97	2.30	-0.544	0.119	0.768	0.251
BF	340	4.41	1.51	-0.671	0.119	0.237	0.251

The findings highlight the strategic role of digital banking in improving the performance of Jordanian commercial banks. High mean values across all constructs and low variability indicate strong agreement among respondents on the value of digital transformation.

The study confirms that technological infrastructure costs significantly mediate the relationship between digital banking and performance, reinforcing the idea that infrastructure investments are not merely expenses but are essential for value creation. This supports prior findings by Ali Alqararah et al. [24] and aligns with investment patterns observed in Jordan's banking sector [27].

Additionally, the study suggests that the long-term benefits of digital infrastructure extend beyond financial gains to include improvements in compliance and customer trust [28]. The use of SEM enabled a deeper understanding of both direct and indirect effects, offering practical insights into how banks can optimize digital strategies.

Overall, the study emphasizes that technological infrastructure is central to the success of digital banking, especially as Jordan advances its national digital economy agenda.

4.1. Measurement Model

According to Masad et al. [28], structural equation modeling is used to analyze the relationships among variables (direct and indirect). To check internal consistency, we used the factor loadings of the measurement model. Items with factor loadings less than 0.7 were eliminated. Table 3 indicates the presence of construct reliability (all the CR values are greater than 0.7) and validity (all the AVE values are above 0.5) [29]. The value of Cronbach's α ranges from 0.831 to 0.814, which indicates good internal consistency among the items of the constructs.

Table 3.
Result of Factor loading, CR, AVE, α.

Variables	Items	Factor loading	CR	AVE	α
Technological infrastructure cost	TIC1	0.869	0.920	0.722	0.814
	TIC3	0.866			
	TIC4	0.853			
	TIC6	0.872			
	TIC7	0.885			
	TIC8	0.822			
	TIC10	0.899			
	TIC11	0.876			
Digital Banking	DGB 1	0.867	0.911	0.659	0.826
	DGB2	0.892			
	DGB4	0.874			
	DGB5	0.799			
	DGB6	0.796			
	DGB7	0.864			
Banking Performance	BF1	0.893	0.914	0.672	0.831
	BF2	0.880			
	BF3	0.867			
	BF4	0.875			

4.2. Structural Model

In our analysis, we first tested the model fit of our data based on certain indices mentioned in the table. The chi-square value, i.e., 2.74, indicated a good fit for the model. The values of other indices, i.e., GFI, AGFI, NFI, CFI, and RMSEA, which are 0.912, 0.924, 0.952, 0.950, and 0.042, respectively, support this conclusion. It is confirmed through the results

shown in Table 4 that our model is a good fit for the data, which the model appropriately represents the relationship that we are analyzing in our research, i.e., the impact of DB on the performance of commercial banks in Jordan, mediated by technological infrastructure costs.

Table 4.
Model fit Indices.

Model Indicators	**CMIN/df**	**GFI**	**AGFI**	**NFI**	**CFI**	**RMSEA**
	2.74	0.912	0.924	0.952	0.950	0.042

Next, in order to analyze the impact of digital banking on our dependent variable and to check the mediation effect, we have calculated the critical ratio and standard error using the estimates of maximum likelihood. We employed structural equation modeling to test the hypotheses. The results in Table 5 show that there is a positive and significant impact of digital banking on technological infrastructure costs, with a coefficient of 0.559 and a p-value less than 0.001. This indicates that when a bank adopts digital banking, it implements digital technologies that increase infrastructure costs, such as maintenance, security, and information technology systems. Therefore, we accepted H1. In Table 5, we also observe that digital banking significantly and positively affects Jordanian commercial banks' performance, with a coefficient of 0.315 and a p-value less than 0.001. Based on this, we accepted H2, which suggests that digital banking enhances bank performance, including financial profitability, operational efficiency, and customer satisfaction. Similar results are found by Nwankwo and Agbo [30] and Alshehadeh et al. [31]. The results of our third hypothesis showed that with a coefficient value of 0.426 and a significant p-value, technological infrastructure cost has a positive and significant effect on banking performance, which means that the more spending on technological infrastructure, the better the bank's performance [32]. These results do not support our expected negative relationship between cost and performance; therefore, we rejected H3. Lastly, it is found that technological infrastructure costs significantly and positively mediate the relationship between DB and Jordanian commercial banks' performance, and H4 is accepted. Salim et al. [26] also found similar results.

These findings offer practical insights for banking leaders, emphasizing that infrastructure investment is essential for sustaining digital transformation. Future studies may further explore how these investments translate into long-term performance gains.

Table 5.
Path Analysis.

Direct Path					
Path	**B**	**SE**	**CR**	**p-value**	**finding**
Digital Banking → infrastructure cost	0.559	0.069	7.276	***	Accepted
Digital Banking → Banking performance	0.315	0.058	5.634	***	Accepted
Technological infrastructure cost → Banking performance	0.426	0.062	6.721	***	Rejected
Indirect result					
Path	β	SE	CR	p-value	Finding
Digital Banking → infrastructure cost → Banking performance	0.528	0.074	6.842	***	Accepted

Note: *** p-value is less than 0.001.

5. Conclusion

This study aimed to ascertain how digital banking improves the performance of Jordan's commercial banking industry. Therefore, the following approach was used to examine data on how digital banking affects bank performance, as well as how the cost of technological infrastructure acts as a mediator between digital banking and performance. First, digital banking was empirically examined and proven to improve bank performance. Nwankwo and Agbo [30] found similar results that are in line with our findings.

Second, the cost of technological infrastructure increases as digital banking is implemented. This indicates that when a bank adopts digital banking, it incorporates digital technologies that raise infrastructure costs, such as information technology system expenses, maintenance, and security costs [32].

The study's findings demonstrate that digital banking increases the costs associated with online banking, which in turn enhances bank performance. Overall, it can be concluded that digital banking has a significant impact on the performance of Jordanian commercial banks. We have found results similar to those of Ibrahim and Daniel [18] and Olaiya and Adeleke [13].

5.1. Practical Implications

It is recommended that, in order to decrease the number of unsuccessful transactions and reduce costs, banks should work with network providers to create a standardized network platform specifically for digital banking systems. This is because, even though digital banking is important for the nation and commercial banks, there appear to be numerous challenges in making it simple and widely accepted across the entire country. This will increase performance and lessen network traffic. Since it is expected that the implementation of effective digital banking services will maximize operations, reduce manual processes, and continue to help improve banking performance, certain implications are also examined in this study.

5.2. Limitations

Like earlier studies, this one has its limitations, including issues with technology adoption and the need for constant digital access. Customers may require assistance to deal with problems such as poor internet connectivity and low digital literacy. Cybersecurity is one of the major problems in emerging countries like Jordan that needs proper attention. Other limitations relate to age and income demographics; older customers with lower incomes might require greater access to or familiarity with digital technology. Such individuals may find it challenging to incorporate digital banking services effortlessly.

One of the limitations is related to the banking industry, which may require assistance due to the complex and constantly evolving Central Bank regulations.

5.3. Future Research

Since more and more people have access to smartphones, the internet, and personal computers, the study also suggested that Jordan's commercial banks continue to integrate digital banking into their everyday operations. This is because more deposits and transactions will lead to higher profits.

Future research may focus on addressing technological challenges and the digital divide, particularly among elderly and low-income populations, as well as exploring cybersecurity readiness and regulatory adaptation in emerging economies.

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