THE NEXUS BETWEEN ONLINE BANKING AND FINANCIAL PERFORMANCE IN SAUDI ARABIA BANKS

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Abstract:

Since the 1980s, the financial sector has known significant transformation, due to technological innovation and the massive use of the web, mobiles and online services, which were used during the Corona period. This investigation examines the effect of E-banking service on banks performance in Saudi Arabia. To accomplish this purpose, we applied a regression estimation technique appropriate for panel data analysis combined with the Hausman test (1978). We investigate several control and bank-specific variables that affect return on assets (ROA) and return on equity (ROE). The study is based on a sample of 37 commercial banks for the period 2012–2023. The results validate all most of our hypotheses, which confirm the positive relationship between digitalization specifically E-banking and the performance indicators of banks in Saudi Arabia.

Keywords: Saudi Arabia Banks, E-banking, Performance, ROA, ROE.

1.GENERAL INTRODUCTION

The economics growth of all developed nations highly relies on the financial sector. Internet technology has drastically changed the banking system (PwC, March 2016). As a result, most financial institutions now offer their services via the internet. They know that digital adoption in banking is rapidly accelerating, and if they want to remain competitive, they need to regularly upgrade their information and communication technologies to meet changing customer demands.

Following the rise of digital technologies, most banks have turned to the internet to deliver their services. This evolution is driven by the need to save time and money while meeting the expectations of a new group of customers, often referred to as digital service users. Previous studies have shown that banks' adoption of the internet has a significant positive impact on their performance, as digital technology helps reduce administrative costs and enhance profits. Research by Aral and Weill (2007), Beccalli (2007), and Wang (2010) highlights the positive relationship between IT investment and business performance. Earlier findings support that investments in research and development (R&D) positively drive a company's performance and market value (Griliches & M. Cockbrun, 1981). In fact, according to the French Banking Federation's report on "Banking and Innovation", over 80% of the French population prefers carrying out their transactions through digital channels, thus interactive exchanges with bank advisors are more efficient and easier to carry out. In that regard, technology serves as a bridge between banks and their customers.

Digital technology is redefining the entire economic process, translating in higher productivity and new jobs. Nevertheless, evolution also poses a threat to job loss for certain industries. The past couple of years has shown an overwhelming shift in the financial sector of the kingdom with the use of cash withdrawal machines, electronic payment cards, and mobile banking applications becoming common practice among citizens.

Here, we assess the present economic settings in this ongoing digital era and look at the effects of digitalization on the banking industry in Saudi

Arabia. More precisely, we will try to assess the impact of online banking on the overall performance of Saudi banks.

Our central research question is:

How does internet banking affect the financial performance of Saudi banks?

Hypothesis:

Digitalization is an important topic in today's fast-changing environment, especially in the banking sector, which has experienced significant changes in the delivery of financial services. These transformations not only impact how banks operate but also deeply affect customer behavior. In this context, we focus on the banking sector for this research is deliberate, as it offers a unique lens through which we can explore the broader implications of digitalization. To address our research question, we propose the following hypotheses:

H1: There is a positive and significant relationship between online transactions and its return on assets (ROA) and return on equity (ROE).

H2: The amount of loans issued by a bank has a positive and significant impact on its ROA and ROE.

H3: A positive and significant correlation exists between the level of deposits and both ROA and ROE.

H4: The size of the bank is positively and significantly related to the independent variables.

1. LITERATURE REVIEW

2.2. Overview of the banking sector in Saudi Arabia

The banking sector in Saudi Arabia is witnessing strong growth, primarily due to a combination of favorable macroeconomic conditions and transformative government policies. A significant driver of this expansion is the rise in energy prices, which has greatly improved the financial health of hydrocarbon exporters. This economic momentum is further bolstered by the Kingdom's Vision 2030 initiative, aimed at reducing oil dependence by diversifying the economy through strategic investments in sustainable development, infrastructure, and innovation. As a result, the environment is dynamic, fueling growth in the banking industry and positioning it to

play a crucial role in the broader economic transition, with a focus on modernization, digitalization, and financial inclusion.

2.2. Internet connectivity for the Saudi population

As of January 2024, Saudi Arabia has a significant level of internet connectivity among its population. The total number of internet users in the country reached 36.72 million, which corresponds to an impressive 99.0 percent penetration rate relative to the total population of 37.473 million. This strong connectivity suggests that nearly all residents can access the internet, highlighting the country's dedication to digital infrastructure and technology.

Figure 1: Frequency of Internet use by the Saudi population from 2019 to 2029
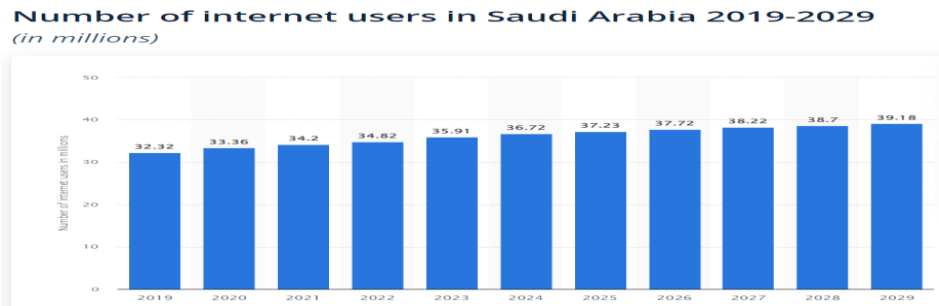
Source: Statista.com

1.3. Share of fintechs in Saudi Arabia in 2024, by sector

In Saudi Arabia, the fintech landscape is primarily shaped by the payments and currency exchange sector, accounting for 32% of all fintech activities. The lending and financing sectors rank as the second-largest segment, making up 19% of the country's fintech operations.

These statistics emphasize the vibrant growth of fintech in Saudi Arabia, highlighting the considerable potential for ongoing development and innovation in these crucial sectors.
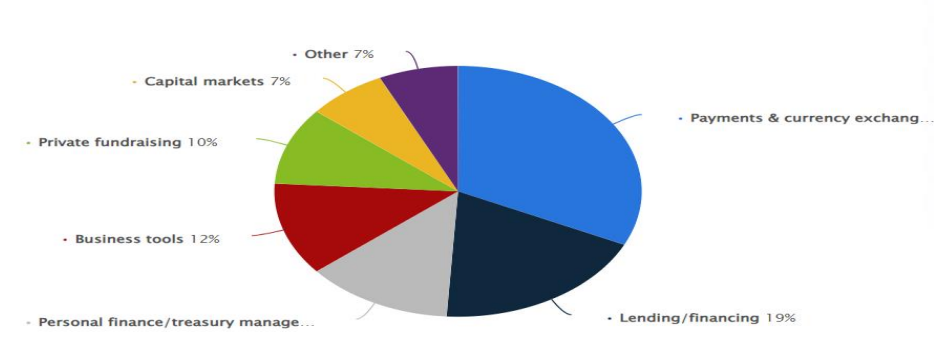
Source: Statista.com
Figure 2: Share of fintechs in 2024

2.3. Payment methods

In recent years, Saudi Arabia has undergone a significant transformation in its payment ecosystem, characterized by a swift move from cash to digital payment methods. This change has been driven by a mix of technological advancements, strategic government initiatives, and shifting consumer behaviors. The following analysis offers a detailed overview of the current landscape of payment methods in the Kingdom.

The main payment methods in Saudi Arabia consist of cash, debit cards, credit cards, mobile wallets, and online banking. Each of these methods occupies a unique position in the market, with adoption rates shaped by demographic factors such as age, income, and levels of urbanization.

1.1.   Cash Payments

Despite the rise of digital payments, cash remains a prevalent method for transactions in KSA. As of 2025, it is estimated that cash transactions still account for approximately 30% of all retail transactions. This is particularly common among older demographics and in rural areas where access to technology may be limited.

1.2.   Card Payments

550

Card payments in Saudi Arabia have seen remarkable growth in recent years, with debit cards becoming more popular than credit cards. This trend can be attributed to debit cards being directly linked to bank accounts and the lower transaction fees they incur. Recent statistics indicate that card payments now represent about 50% of all retail transactions in the Kingdom. The extensive deployment of point-of-sales (POS) terminals across various sectors has been instrumental in facilitating this transition to card-based payments.

1.3.   **Mobile Wallets**
Mobile wallets have quickly become popular in Saudi Arabia, especially among younger users who value the convenience and speed they provide. Services like STC Pay and Apple Pay have experienced a significant increase in usage. By the end of 2023, mobile wallet transactions account for approximately 15% of all payment activity in the country. This growth trend is anticipated to persist as more merchants adopt mobile payment solutions, reinforcing mobile wallets as a favored payment option.

1.4.   **Online Banking**
Online banking services are gaining popularity in KSA, fueled by higher internet access and smartphone adoption. Numerous banks provide strong online banking platforms that enable users to make payments directly from their accounts without the need for physical cards or cash. Currently, online banking accounts for approximately 5% of total transaction volume, but it is expected to increase as e-commerce continues to grow.

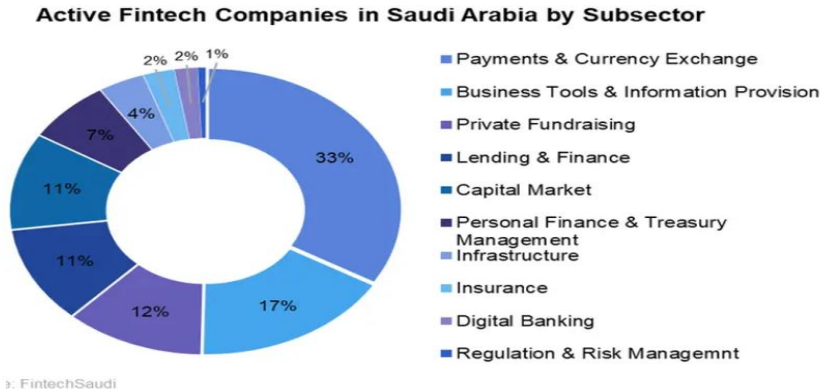## 2.4. **Overview of the Saudi Fintech Market**
The fintech market in Saudi Arabia knows a significant growth, driven by the government's Vision 2030 initiative, which aims to diversify the economy and reduce reliance on oil. This transformation has led to an increase in digital banking services, mobile payments, and innovative financial solutions that cater to a tech-savvy population.

- **Market Size and Growth**

The Saudi Arabia fintech market size is projected to grow from USD 63.90 billion in 2024 to USD 87.14 billion by 2029, at a compound annual growth rate (CAGR) of greater than 6.07%. The rapid adoption of smartphones and internet services has made financial services more accessible, contributing to this growth.

Figure 4**: Active fintech companies in Saudi in 2023.**

Active Fintech Companies in Saudi Arabia by Subsector

- Payments & Currency Exchange — 33%
- Business Tools & Information Provision — 17%
- Private Fundraising — 12%
- Lending & Finance — 11%
- Capital Market — 11%
- Personal Finance & Treasury Management — 7%
- Infrastructure — 4%
- Insurance — 2%
- Digital Banking — 2%
- Regulation & Risk Managemnt — 1%

≥: FintechSaudi

Source: FintechSaudi.com

3. METHODOLOGY AND DATA COLLECTION

3.1. Theoretical framework

Numerous studies have been conducted to evaluate the commercial value of investing in digitalization, with initial research mainly concentrating on the relationship between these investments and productivity improvements. This area of study was famously highlighted by Solow (1987), who expressed concerns about the "IT productivity paradox," a situation where substantial investments in information technology did not consistently result in immediate or obvious productivity gains... Over time, however, subsequent research has highlighted the long-term benefits of digitalization in fostering efficiency, innovation, and profitability in various sectors, including banking. Agarwal, R., and Prasad, J. (1998)

552

contribute significantly to understanding personal innovation in the context of information technology adoption. Their article presents a conceptual framework that can be applied to analyze how individuals and banks adopt internet banking. By focusing on personal factors influencing technology adoption, this framework helps contextualize the decision-making process for both customers and financial institutions in embracing digital banking services.

The empirical evidence regarding the link between digitization initiatives and organizational performance remains mixed. Hitt and Brynjolfsson (1996) conducted a study with 370 American companies between 1988 and 1992, revealing a positive correlation between digitization efforts and improved productivity.

For their part Furst et al. (2002) found that banks offering internet banking were more profitable than those not offering internet banking. In contrast, England et al. (1998) conducted a major study, which estimated the number of US banks offering internet banking services and analyzed the characteristics of the banks' performance structure. However, they found no evidence of differences in the performance of the group of banks offering internet banking compared to those not offering it in terms of profitability, efficiency and credit.

Technological advancements significantly affect how banks perform, as noted by Beck (2001) and Foster (2001). These innovations improve operational efficiency and help financial institutions grow and remain competitive in a digital landscape. In this regard, Dyoung (2005) examined the performance of 36 American banks that integrated the Internet into their operations. His research revealed that the emergence of digital start-ups has a notable impact on the overall performance of these banks, highlighting the crucial role of adopting technology in the evolution of banking.

Nieto (2007) explored how the internet impacts bank performance, particularly as a distribution channel. His findings indicated that adopting internet banking has a positive effect on bank profitability, highlighting the financial advantages of utilizing digital platforms. This shows that digital

channels not only expand operational reach but also boost profitability by drawing in new customers and lowering overhead costs.

For However, the findings of Wang (2010) presented a contrasting view, as his research did not show short-term empirical evidence of financial performance improvements due to digitization. Nonetheless, Wang suggested that the full benefits of digital initiatives might be realized over the long term, hinting at the potential for sustained growth once digital adoption matures.

Mutua (2010) carried out a study examining the connection between mobile banking and the financial performance of commercial banks in Kenya. The results showed a weak positive correlation between the adoption of mobile banking and the performance of banks. This variance in results can be attributed to differences in variables, such as regional market dynamics and varying sampling methods, as well as the stage of technological adoption within the Kenyan banking sector. While the impact was modest, it suggests the potential for mobile banking to improve financial outcomes, albeit at a different pace than expected.

 Sana Haider Sumra (2011) posits that the rise of e-banking has significantly boosted the profitability of banks, enabling them to cover operational costs and generate profits within a relatively short period. Interestingly, customer illiteracy is not considered a major barrier to this growth, highlighting the accessibility and effectiveness of digital banking services. Then, Internet banking, commonly known as online banking or e-banking, refers to the provision of banking services and transactions over the internet. This system allows customers to perform a range of financial activities from anywhere, such as checking account balances, transferring money, paying bills, and applying for loans online. The rise in popularity of internet banking can be attributed to its convenience, accessibility, and time-saving features. It includes platforms that enable bank customers to manage their accounts and access general information about products and services through websites or mobile apps (Panida and Sunsern 2012).

In a similar vein, Batutunaya (2015) explored the connection between internet banking and bank performance, emphasizing important financial metrics like Return on Assets (ROA) and Return on Equity (ROE). His research, which focused on the European banking sector, found a strong

and statistically significant link between the use of internet banking and enhanced financial performance, indicating that digital banking plays a significant role in boosting bank profitability. Further exploring the impact of digitalization, Magaret Mateka (2016) studied its effect on the performance of commercial banks in Kenya. The research findings show that digitalization has a positive impact on various important areas of banking performance, such as revenue generation, operating costs, loan portfolios, and customer deposits. This highlights the transformative power of digital technologies in improving operational efficiency and fostering growth within the banking sector.

In contrast, Mithas et al. (2012) found a significant positive impact of digitalization on organizational performance, suggesting that digitization can indeed lead to measurable improvements. Kohli et al. (2012) further explored this dynamic, discovering that while digital investments may not directly boost Return on Assets (ROA), they do increase the market value of companies, indicating that the benefits of digitalization are more likely reflected in market perceptions and shareholder value than in traditional financial metrics.

Gupta, A., & Chauhan, S. (2016) focused on the relationship between internet banking adoption and bank performance in India. Their study employed a quantitative approach to analyze data from Indian banks, exploring how internet banking adoption impacts key financial indicators such as profitability, cost efficiency, and risk management. This research underscores the growing influence of digital banking on the operational efficiency and financial health of banks in emerging markets, highlighting the importance of digital innovation in driving long-term success within the banking sector.

Gupta, A., & Kumar, V. (2019) propose an integrated model that combines trust, risk perception, and the Technology Acceptance Model (TAM) to explain the adoption of internet banking. This model provides valuable insights into the factors influencing individuals' and institutions' decisions to embrace digital banking. By incorporating trust and risk considerations alongside technological factors, the study offers a comprehensive framework to assess how internet banking adoption affects both bank

555

performance and associated risks. This approach helps us to understand the broader implications of digital banking on financial institutions, beyond adoption rates, by considering the nuances of customer behavior and operational risk management.

3.2. Empirical framework:

The aim of this article is to assess the impact of internet banking on the performance of Saudi banks. Financial management theories provide several key factors for measuring control variables, with accounting ratios used to evaluate metrics such as bank size, deposits, and loans. The study relies on published statistics and annual reports to gather the necessary evidence for testing the hypotheses, meaning that the data employed in this research is quantitative in nature.

The study follows a deductive approach, where hypotheses are derived from existing theoretical frameworks, and data is subsequently collected to either support or challenge these hypotheses. Below, the article outlines the sample selection process, data sources, methods for collecting and quantifying variables, as well as the techniques used for data analysis.

◆ **Data collection**

The financial data and relevant information for this study were gathered from the annual reports of Saudi banks, covering the period from 2012 to 2023. These reports provide the explanatory variables for the banks under consideration. The final sample consists of 37 banks, resulting in a total of 444 bank-year observations.

✧ **Model Specification**

To assess the influence of digital banking on performance levels, we propose the following analysis model.

Our model is as follows:

ROA= f (Online payment, control variables).
ROE= f (Online payment, control variables).
In other words, our two models can be summarised as follows:

$$ROA_{it} = \alpha_0 + \beta_1 Online\ payment_{it} + \beta_2 Loans_{it} + \beta_4 deposits_{it} + \beta_5 size_{it} + \varepsilon_{it} \qquad (1)$$

$$ROE_{it} = \alpha_0 + \beta_1 Online\ payment_{it\ t} + \beta_2 Loans_{it} + \beta_4 deposits_{it} + \beta_5 size_{it} + \varepsilon_{it} \qquad (2)$$

i : The number of the bank

t : The number of years

y_{it} : ROA

y_{it} : ROE

❖   Summary of variables

Variables	Measure
	Dependent variables
ROA	The ratio of bank's earnings t total assets
ROE	The ratio of earnings to equity holders
	Independent variables
Online payment	The number of online transactions.
SIZE OF BANK	The natural logarithm of total assets.
DEPOSITS	The ratio of total deposits to total assets.
LOANS	The ratio of total loans to total assets.

Source: Authors

3.3. The statistical approach

The goal of this study is to investigate the impact of internet banking on the financial and economic performance of Saudi banks. To achieve this, a three-stage statistical approach will be employed: descriptive analysis, bivariate analysis, and multivariate analysis.

3.3.1. Descriptive analysis

Descriptive statistics form the foundation of data analysis by offering key insights into the dataset's characteristics. These statistics are categorized into two main types: measures of central tendency (such as the mean, median, and mode) and measures of dispersion. Each of these metrics helps summarize and describe the data in a meaningful way, providing an overview of the dataset's general patterns and variability.

3.3.2. Bivariate analysis

To explore the relationship between two continuous variables, correlation analysis will be applied. The most used method is Pearson's correlation coefficient (r), which quantifies the strength and direction of the linear relationship. This coefficient ranges from -1 to +1: a value of +1 signifies a perfect positive correlation, -1 indicates a perfect negative correlation, and 0 suggests no linear correlation between the variables. Pearson's r will allow us to determine how closely related internet banking is with key performance indicators.

3.4. Multivariate analysis

Multivariate analysis will be used to test the hypotheses and identify the variables that explain banking performance, factoring in control variables specific to Saudi banks. This will provide a deeper understanding of the relationships between internet banking and performance, considering multiple variables simultaneously.

3.4.1. Estimation methods

Two primary panel data models will be considered to analyze the relationships: the fixed-effect model and the random-effect model.

Fixed-Effect Model

The fixed-effect regression method is employed to estimate relationships in panel data while controlling for unchanging, individual-specific characteristics over time. However, this model does not account for inter-individual variability when estimating structural parameters, and it cannot capture the impact of time-invariant factors.

Random-Effect Model

In contrast, the random-effect regression model is suitable for datasets with multiple observations over time for the same subjects. This method is particularly useful when analyzing panel data that has both cross-sectional and time-series dimensions. To determine which model to use, we will apply for the Hausman test (1978). This test assesses whether the individual-specific effects are correlated with the explanatory variables.

The null hypothesis suggests no correlation between the individual characteristics and the explanatory variables. If the null hypothesis is rejected, the fixed-effect model is chosen; if not, the random-effect model is adopted (Kangni Kpodar, 2007).

3.4.2. Empirical Results:

◆ Descriptive statistics table

Table 1 presents the descriptive statistics, including the mean, minimum, and maximum values for the variables ROA, ROE, online payment (OP), loans, deposits, and bank size.

The descriptive statistics are presented in table 1: the average, minimum and maximum of the variables ROA, ROE, OP, loans, deposits and size.

Table 1: Descriptive statistical result

Variables	observations	Mean	Std dev	Min	Max
ROA	444	0,0541854	0,2867762	-2,750413	2,666074
ROE	444	0,1253289	0,9191138	-3,993211	12,10566
OP Online payment	444	9,778495	4,372687	1	20
Loans	444	0,0747631	0,0505787	0,0002464	0,512478
Deposits	444	0,0047267	0,0013167	0,001365	0,034498
Size	444	16,57493	2,246206	8,898127	21,60862

The variable ROA varies between -2.75 and 2.66 indicates an average value of 0.054.

- ✧ ROE varies between a minimum of -3.99 and a maximum of 12.10, with an average value of 0.125.
- ✧ The online payment shows an average value of 9.77 and varies between 1 and 22.
- ✧ The variable bank loans indicate an average of 0.074 and varies between 0.0002and 0.512.
- ✧ The deposits variable varies between 0.0013 and 0.034 and indicates a mean value of 0.0047.
- ✧ The size variable varies between 8.89 and 21.608 and indicates an average of 16.57.

✧ Correlation matrix table
Table 2: Correlation matrix

	OP	Loans	Deposits	Size
OP	1			
Loans	0,0206	1		
	0,4780			
Deposits	0,0611	-0,1489	1	
	0,1432	0.0000		
Size	-0,0235	-0,3022	-0,0071	1
	0,6456	0,0409	0,7607	

Source: Stata 14

The correlation matrix is used to evaluate whether there is a multicollinearity issue among the variables included in the model. Multicollinearity occurs when two or more independent variables are highly correlated, which can lead to unreliable estimates of the model's coefficients and distort the results.

In this case, the correlation coefficients between the explanatory variables range from -0.1489 to 0.0611, indicating that the variables are only weakly correlated with each other. Since these values are relatively low and do not approach -1 or 1 (which would signify strong negative or positive correlations), we can conclude that multicollinearity is not a significant issue in the model. This suggests that each variable is contributing independently to the model, allowing for more reliable and interpretable results.

✧ ROA regression model:
Table 3: Results obtained using the ordinary least squares (OLS) method

ROA	Coefficient	Std Err	T	p
OP	0,0053403	0,0037681	6,39	0,000
Loans	-0,3798679	0,2632346	-4,50	0,002
Deposits	2,914623	6,8726870	1,57	0,018
Size	0,0125896	0,0062307	2,99	0,088
Constante	-0,1872729	0,1212175	-2,43	0,016
$F_{(4, 439)} = 2,11$				

561

Prob> F = 0,00787	
R-squared = 0,8673	

Source: Stata 14

Table 3 shows that:

The F-statistic tests whether the explanatory variables collectively have a statistically significant relationship with the dependent variable. An F-statistic of 2.11 suggests that the independent variables in the model explain some of the variance in the dependent variable. However, the magnitude of 2.11 implies a relatively modest effect.

The p-value associated with the F-statistics tells us if the model is statistically significant. Since the p-value is 0.00787, which is below the common threshold of 0.05, we can reject the null hypothesis that all regression coefficients are zero. This means that the model is statistically significant at the 1% level, suggesting that the explanatory variables, taken together, significantly explain the variation in the dependent variable.

R-squared measures the proportion of variance in the dependent variable explained by the independent variables. With an R-squared of 0.8673, about 86.73% of the variation in the dependent variable is explained by the four independent variables in the model.

Table 4: Fixed-effects model Result (ROA)

ROA	Coefficient	Std Err	T	P
OP	0,0032336	0,0054532	7,04	0,000
Loans	-0,445603	0,4925421	-2,84	0,029
Deposits	4,407987	7,9873920	0,56	0,567
Size	0,0104061	0,0101252	1,02	0,210
Constante	-0,1345188	0,1951476	-0,78	0,536
F(30,	410)	=	2,19	Prob=0.0005

Source: Stata 14

Table 5: Random-effects panel model result (ROA)

ROA	Coefficient	Std Err	Z	P
OP	0,00363238	0,0034657	1,39	0.000
Loans	-0,4847210	0,3204970	-1,05	0.009
Deposits	3,18890050	7,185345	-0,59	0.019
Size	0,01783001	0,0080634	1,03	0.029
Constante	-0,1087043	0,1589485	1,10	0,298

562

chi2(4) = (b-B)'[(V_b-V_B) ^(-1)](b-B)	
= 0,08	
Prob>chi2 = 0,9995	

Source: Stata 14

◆ **Hausman Test**

The p-value of the Hausman test is significantly greater than 0.05, meaning that we fail to reject the null hypothesis. This suggests that there is no significant difference between the fixed effects and random effects models. As a result, the random effects model is deemed the more appropriate choice. This implies that the individual-specific effects (e.g., effects specific to each bank) are not correlated with the independent variables, allowing the random effects model to effectively capture the variations across different entities. In simpler terms, the random effects model is preferred because it is statistically more appropriate for explaining the data, as confirmed by Hausman test.

Discussion of results (ROA):
Regarding the expected signs of the estimated coefficients for the explanatory variables (OP, loans, deposits, and size), the table compares these expected signs with the actual results obtained from our model's estimation. Below are the findings:
Online Banking (OP):
The coefficient associated with OP is positive ($\alpha_1 = 0.0036$, p = 0.000), and it is statistically significant at the 1% level. This indicates a positive and significant relationship between ROA and OP, meaning that an increase in online banking transactions positively impacts the bank's return on assets (ROA). Therefore, Hypothesis H1 is confirmed, supporting the idea that higher online banking transactions contribute to better financial performance.
Loans:
A negative relationship is observed between loans and ROA, with a coefficient of $\alpha_2 = -0.48$ (p = 0.009), which is significant at the 1% level. This result suggests that an increase in loans has a negative and significant

impact on the ROA. Thus, Hypothesis H2 is rejected, indicating that loans do not positively contribute to the bank's financial performance.

Deposits:

The coefficient for deposits is positive ($\alpha_3 = 3.18$, $p = 0.019$) and significant at the 5% threshold. This implies that deposits have a strong positive effect on ROA, meaning that an increase in deposits is associated with better financial performance for banks. As a result, Hypothesis H3 is confirmed, supporting the notion that higher deposits contribute to improved profitability.

Size:

The coefficient associated with the size variable is positive ($\alpha_4 = 0.012$, $p = 0.029$) and statistically significant at the 10% level. This suggests that larger banks tend to perform better in terms of ROA, supporting the view that bigger banks enjoy economies of scale or other advantages that enhance profitability. Consequently, Hypothesis H4 is confirmed, confirming the positive impact of bank size on financial performance.

These results provide important insights into the dynamics between bank operations and financial performance, with online transactions and deposits showing a positive impact, while loans exert a negative influence.

OP (Online Banking Transactions) has a positive and significant effect on ROA, confirming Hypothesis H1.

Loans exhibit a negative and significant effect on ROA, leading to the rejection of Hypothesis H2.

Deposits show a positive and significant impact on ROA, validating Hypothesis H3.

Size has a positive relationship with ROA, which confirms Hypothesis H4.

ROE regression model

Tableau 6: Ordinary least squares (OLS) results

ROE	Coefficients	Std Err	T	P
OP	0,0361087	0,0145703	3,43	0,001
Loans	4,2923780	0,8077469	2,84	0,004
Deposits	1.176789	1.02435	1,98	0,040
Size	0,0348704	0,0310849	2,95	0,023
_cons	0,1518739	0,4108623	2,37	0,012
F (4, 439) = 6,67				

Prob> F	= 0,0000
R-squared	= 0,8943

Source: Stata 14

Table 7: Results of fixed-effect panel model (ROE)

ROE	Coefficient	Std Err	T	P
OP	-0,0468728	0,0123389	-2,92	0,001
Loans	-0,6649001	1,6757990	-0,53	0,987
Deposits	-4,9892401	28,582170	-0,20	0,219
Size	-0,0029853	0,0234934	-0,08	0,847
Constante	0,58879800	0,6467123	1,09	0,279
F(30,410)=			5,14	Prob=0.0000

Source: Stata 14

Table 8: Results and interpretation of the random effect panel model (ROE)

ROE	Coefficient	Std Err	Z	P
OP	-0,0540232	0,012499	-3,04	0,002
Loans	0,7659826	1,060859	0,73	0,378
Deposits	-11,20162	20,59196	-0,68	0,227
Size	0,0037827	0,024094	0,15	0,529
Constante	0,3757805	0,4949282	0,74	0,372
chi2(4)	=	(b-B)'[(V_b-V_B)^(-1)](b-B)		
	=	5,3		
Prob>chi2	=	0,2572		

Source: Stata 14

◆ **Hausman Test**

Based on the results in Table 8, the p-value of the Hausman test (0.2572) exceeds the 5% threshold, indicating that the random effects model is the more appropriate choice. Regarding the overall significance of the model, it is found to be significant, with an F-statistic of $F(30, 410) = 5.14$.

◆ Discussion of results (ROE):

The coefficient for OP is $\alpha_1 = -0.054$ (p = 0.002), which is both positive and statistically significant at the 1% level. This indicates a strong positive relationship between ROE and OP, suggesting that an increase in online banking transactions is associated with an improvement in bank profitability. This supports the idea that as more customers engage in online banking, the bank experiences higher operational efficiency and profitability. Therefore, Hypothesis H1 is confirmed, underscoring the importance of digital banking channels in driving financial performance.

The coefficient for loans is $\alpha_2 = 0.76$ (p = 0.005), revealing a positive and significant relationship with ROE at the 1% level. This result suggests that higher loan volumes are positively correlated with improved return on equity, implying that as banks issue more loans, they generate greater profitability. This aligns with the expectation that lending activities are a key source of revenue for banks, enhancing their financial performance. Hence, Hypothesis H2 is confirmed, reinforcing the idea that lending operations contribute positively to bank performance.

The coefficient for deposits is $\alpha_3 = -11.20$ (p = 0.227), indicating a negative relationship with ROE, but with a non-significant p-value (greater than 0.05). This suggests that deposits do not have a statistically significant impact on ROE in the context of this model. Despite the negative sign, the lack of statistical significance means that the relationship between deposits and bank profitability is not robust enough to draw a definitive conclusion. Therefore, Hypothesis H3 is rejected, suggesting that deposits may not be as influential in driving profitability as initially hypothesized. This could indicate that while deposits are crucial for liquidity, they may not directly contribute to equity returns in the same way that other variables like loans or online transactions do.

The coefficient for size is $\alpha_4 = 0.003$ (p = 0.0529), which is positive and significant at the 5% threshold. This result suggests a positive relationship between bank size and ROE, indicating that larger banks tend to generate higher returns on equity. The significant coefficient highlights the potential advantages that larger institutions enjoy, such as economies of scale, broader customer bases, and enhanced access to capital. Consequently, Hypothesis H4 is confirmed, suggesting that the size of a bank plays a meaningful role in improving its financial performance. Although the statistical significance is marginal (at the 5% threshold), the positive coefficient still supports the idea that scale contributes to profitability.

5. CONCLUSION

This study aimed to explore the impact of various factors, particularly online banking transactions (OP), loans, deposits, and bank size, on the financial performance of banks in Saudi Arabia, with a focus on Return on Equity (ROE). Through the application of rigorous statistical methods, including regression analysis and hypothesis testing, the results provide valuable insights into the dynamics of the banking sector in the digital era. The findings revealed several significant relationships:

Online banking transactions (OP) have a positive and significant impact on ROE, confirming that banks with higher levels of digital engagement see improvements in profitability. This highlights the growing importance of digital platforms in driving operational efficiency and customer engagement.

Loans also exhibit a positive and significant relationship with ROE, reinforcing the notion that lending activities are critical for enhancing the financial performance of banks. This finding suggests that loan portfolios are an essential revenue stream for banks.

Deposits, however, do not have a statistically significant impact on ROE, implying that while deposits are crucial for liquidity management, they may not directly contribute to profitability in the same way as other variables.

Bank size is found to have a positive effect on ROE, suggesting that larger banks benefit from economies of scale, enhanced market presence, and greater financial stability, leading to higher returns on equity.

These results underscore the importance of digital transformation in the banking sector, with online banking playing a pivotal role in improving financial performance. Additionally, while loans and bank size emerged as significant contributors to profitability, the role of deposits seems less pronounced in influencing ROE.

In conclusion, this study contributes to the existing literature on banking performance by highlighting key factors that drive ROE in the context of Saudi Arabia's rapidly evolving banking sector. The findings are especially relevant for policymakers, bank managers, and stakeholders seeking to understand the critical factors influencing the financial success of banks in the digital age. Moving forward, further research could explore the long-term effects of digital banking and other emerging technologies on bank performance in the region.

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