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Leveraging Artificial Intelligence for Enhanced Bank Performance: Evidence from Gulf Banks

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Abstract This study focuses on how artificial intelligence (AI) affects Gulf bank performance using data from 36 banks listed on 6 financial markets between 2015 and 2022. The study employs textual analysis to capture AI and return on equity (ROE) for performance, demonstrating how artificial intelligence technologies boost profitability. Technologies like chatbots, machine learning, and robotic process automation seem to not only raise profitability but also shareholder value by cutting expenses, minimizing mistakes, and improving decision-making. These findings show the strategic importance of artificial intelligence for the banking sector, which inspires managers to give AI investments top attention if they are to remain competitive. The result supports more general AI adoption in service sectors outside of banking and calls for initiatives to increase employee and stakeholder AI literacy. The study offers interesting implications, but it also acknowledges certain limits, including its small sample size and regional focus, which leaves space for next studies to look at this relationship in other contexts.

Keywords Artificial intelligence · Bank performance · Gulf countries

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1 Introduction

Artificial intelligence (AI) is one modern technology that is transforming many different disciplines. Its quick acceptance has resulted in remarkable expansion in different fields [1, 2]. Artificial intelligence could completely transform banking systems and improve general performance [3]. Since they can replicate human judgment while reducing errors and improving their capacity to meet needs, these systems are a great tool in a complex and highly competitive sector. Among the several sectors embracing artificial intelligence, banking has shown particularly a startling degree of acceptance and use of it [4].

Banks are increasingly utilizing artificial intelligence for tasks such as risk assessment, fraud detection, chatbots, and anti-money laundering systems. By means of performance enhancement and cost cutting, these initiatives mostly seek to improve the customer experience, lower costs, and strengthen risk management and regulatory compliance [5]. Artificial intelligence simplifies operations, lowers running costs, and lessens demand for human resources for repetitive tasks by changing business processes. Its inclusion into banking services has improved operational efficiency, customer satisfaction, and decision-making ability, as well as operational effectiveness. Still, there are many issues, including concerns regarding algorithmic bias, data confidentiality, credit data management, and moral and responsible use [6].

With China, Europe, and the United States setting the benchmark for general adoption, artificial intelligence has seen a significant global investment rise. However, the development of artificial intelligence has differed significantly among Arab countries. While some nations are aggressively developing artificial intelligence technologies, others are slowing down their development due to various challenges. Moreover, tight rules and concerns about data privacy have limited the use of artificial intelligence in banking, despite its potential to revolutionize the financial services sector. However, the advantages of artificial intelligence, especially its capacity to enhance profitability and optimize performance, are indisputable. Banks must quickly adopt artificial intelligence if they are to maintain their competitive edge as tech giants and FinTech startups challenge accepted banking models, driving increased competition [1, 7, 8].

This paper investigates how artificial intelligence and bank performance interact in Gulf countries. It seeks especially to answer the following question: What effect on bank performance does artificial intelligence bring? This study holds significant importance as it highlights the application of artificial intelligence in Gulf banks, an area that has received minimal scholarly investigation. While earlier studies mostly concentrated on adoption in global markets or advanced economies, this paper closes the gap by analyzing the impact of AI adoption in developing and Gulf country environments.

Analyzing the AI's influence on banking in this particular area helps the study add empirical data to the body of knowledge. It highlights distinctive regional traits, including regulatory systems, reliance on oil exports, and cultural considerations

that affect AI acceptance in the Gulf banking sector [9, 10]. The results also provide banks and legislators with pertinent knowledge about the benefits and drawbacks of including artificial intelligence in Gulf financial services.

2 Theoretical Framework

Taken together, Dynamic Capabilities Theory (DCT) and Resource Dependency Theory (RDT) provide important ideas on how banks might use artificial intelligence to manage dependencies, increase performance, and change with the times. DCT is able to grasp AI's role in banking since it stresses an organization's capacity to adapt and reorganize resources in dynamic environments [11]. Predictive analytics and resource optimization tools are two artificial intelligence technologies that enable banks to rapidly adapt to changing customer needs, control regulatory changes, and compete in the market. These characteristics directly influence performance, agility, and creativity.

RDT enhances this viewpoint by stressing how businesses control outside dependencies [12]. The banking industry primarily relies on external data infrastructure and technological systems. By supporting acquisitions of technology companies, internal system investments, or strategic alliances, artificial intelligence helps banks lower their reliance. These acts so confirm competitive advantages by strengthening decision-making procedures, service delivery, and control over vital resources.

AI is also transforming the management of human resources in banks. Artificial intelligence lets workers concentrate on strategic, high-value tasks by automating repetitive ones [13]. This change does, however, also provide a new challenge: the need for AI-aware expertise. By supporting up-to-date skill-building initiatives and selecting experts qualified to effectively control and exploit artificial intelligence technologies, banks are meeting this demand. By automating tasks including risk analyses, anti-money laundering checks, and fraud detection, artificial intelligence also increases regulatory compliance, improving operational accuracy and efficiency. Apart from cost control, these developments enhance operational stability and regulatory interactions [14].

3 Literature Review and Hypothesis Development

In recent years, the banking industry has shown significant interest in adopting artificial intelligence (AI) due to its revolutionary potential to transform operations and influence strategic decision-making. Studies repeatedly show how important artificial intelligence is for increasing productivity, reducing costs, and improving decision-making—all of which directly influence better financial performance [2].

Despite these benefits, the banking sector faces a complex picture of artificial intelligence's influence, which includes reliance on external systems, privacy concerns, and potential disruption to the workforce [5].

Doumpos et al. [15] have noted six primary areas—efficiency, risk management, performance enhancement, regulatory compliance, mergers and acquisitions, and customer-oriented research—where artificial intelligence has revolutionized banking activities. Their research reveals how combining modern artificial intelligence tools such as neural networks with conventional data analysis techniques helps AI solve operational difficulties. However, their findings also highlight gaps, particularly in understanding non-financial risks and the regulatory implications of artificial intelligence. This underscores the necessity for further comprehensive research to fully comprehend the implications of AI.

Tang and Tien [5] focus on how artificial intelligence could provide customized services, process automation, and reduce human error. Their analysis of Vietnamese banks shows unequivocally improved fraud prevention and service quality, proving the good impact of artificial intelligence on banking performance. Although these results confirm the idea that artificial intelligence can streamline processes, the regional focus of the study highlights the need to extend such research to other banking environments to ensure greater applicability.

Al-Ababneh et al. [13] also examine performance metrics of artificial intelligence and underline unambiguous advantages, including lower customer service costs, higher worker productivity, and more operational efficiency. Their results confirm the theory that using artificial intelligence is necessary to reach cost-effective and higher production. But the study on big businesses begs questions about whether smaller banks—with fewer resources—can use artificial intelligence with efficiency.

Husain et al. [4] show, using Credit Agricole Bank's case study, how artificial intelligence reduces costs by improving operational efficiency, resource availability, and customer service quality. Their efforts support the general application of artificial intelligence, which conforms to the concepts of this research. They warn, meanwhile, that depending too much on artificial intelligence could expose banks to cybersecurity risks and other technological disruptions, negating performance improvements.

Kaya et al. [16] look at how artificial intelligence lowers inefficiencies, improves customer targeting, and streamlines operations, raising profitability. They do, however, recognize outside variables, including macroeconomic effects like inflation and data collection difficulties that might restrict artificial intelligence's ability to produce consistent results. These results highlight the need for contextual elements in determining the direction of artificial intelligence acceptance.

While they address issues about workforce displacement, Umamaheswari and Valarmathi [17] stress AI's strategic relevance in credit information, cybersecurity, and fraud prevention. Their research emphasizes the need for proactive actions to upskill workers and overcome resistance to technological change in order to balance the benefits and social consequences of including artificial intelligence.

Other research supporting artificial intelligence's capacity to lower costs, improve decision-making, and increase operational efficiency includes Singh and Pathak [18], Jain [6], and Haddad [3]. These studies taken together warn against ignoring moral

quandaries, privacy concerns with data, and reliance on outside artificial intelligence vendors. Jain [6], for example, stresses the need for accountability and transparency in the use of artificial intelligence to assist in the building of confidence among relevant parties.

Even with the overwhelming evidence that artificial intelligence improves bank performance, we cannot overlook these difficulties. Long-term risks include workforce disturbance and cybersecurity threats, while depending on outside vendors and systems could result in a loss of control over significant operations. To allay these concerns and ensure banks actively reduce risks while optimizing the benefits of the technologies, a balanced approach to AI adoption is necessary.

Considering the overwhelming evidence demonstrating the transforming ability of artificial intelligence as well as the related pragmatic difficulties, we suggest the following hypothesis:

H1: Artificial intelligence and bank performance have a positive relationship.

4   Research Methodology

4.1   Data

This study utilizes data from annual reports to assess the integration of artificial intelligence (AI) in banking operations and financial statements, thereby evaluating bank performance. The targeted sample includes Gulf banks listed on stock exchanges, showcasing their transparency in business practices and ease of access to financial information. Table 1 displays the study's sample.

Table 1   Sample of the study

Country	Annual observations from 2015–2022	Total observations
Bahrain	6	48
United Arab Emirates	4	32
Kuwait	7	56
Qatar	6	48
Sultanate of Oman	7	56
Saudi Arabia	6	48
Total	36	288

4.2 Measurement of Variables

a. **Dependent Variable.** Measured by ROE, bank performance acts as the dependent variable in this study. While it neglects other dimensions of performance, ROE gauges how well the management of the bank uses shareholder equity to create profits [19]. Given the low ROA for financial service providers, banks typically employ financial strategies to increase ROE, thereby aligning it with industry standards [20].

b. **Independent Variable.** Content analysis methods quantify the study's independent variable, artificial intelligence (AI). We can measure the degree of AI integration in banking operations by examining the frequency of specific AI-related keywords and terms in annual reports. These terms include artificial intelligence, data analysis, AI information, AI customer experience, chatbots, machine learning, data mining, blockchain integration, RPA, AI learning, cybersecurity, fintech, automation, and robots. The frequency and context of these terms serve as an indicator of the bank's widespread adoption and use of AI technologies. For robustness, we also used the natural logarithm of these terms' frequency.

c. **Control Variables**. We include several control variables to ensure an accurate relationship between AI and bank performance. We calculate bank size using the natural logarithm of total assets, as larger banks typically possess more resources and advanced AI capabilities [10, 21]. Using the equity-to-total-assets ratio, the capital ratio assesses financial stability and examines the relationship between bank capitalization and profitability [10]. The ratio of non-performing loans to total assets is known as the Non-Performing Loan Ratio (NPL), and it accounts for credit risk. This could potentially impact the overall performance [13, 22]. By dividing liquid assets by total assets, the liquidity ratio determines the bank's capacity to meet short-term obligations. Liquidity is necessary to maintain operational continuity, particularly during uncertain financial times [23].

By accounting for these variables, the study aims to distinguish between the effects of AI on bank performance and institutional variables that might influence the results. We also take time and country variations into account by including dummy variables. This methodological approach ensures that the results are reliable and accurate. Table 2 displays the measurements of the variables.

Table 2 Measurement of variables

Type	Name	Measurement
Dependent variable	Return on equity (ROE)	Net income/shareholder equity
Independent variable	Artificial intelligence	Frequency of keywords
		Ln of the frequency of keywords
Control variable	Bank Size	ln(Total bank assets)
	Capital Ratio	Equity/Total assets
	Liquidity Ratio	Cash and cash equivalent/Total assets
	Non-performing loan	Non-performing loan/total assets

5 Results

5.1 Descriptive Analysis and Correlation Analysis

By giving an overview of the main variables in the dataset, the descriptive indicators in Table 3 help one understand the varieties and traits of the chosen banks. These indicators set the stage for investigating how bank performance relates to artificial intelligence (AI) acceptance.

Return on equity (ROE), a measure of profitability, has a mean of 0.406 and a wide standard deviation of 2.092, reflecting significant variation among banks. Negative returns, with a minimum value of -1.894, point to problems including inefficiencies or outside pressure; the maximum of 23.424 identifies cases of extraordinary performance.

The AI-related frequency, which indicates relatively consistent integration levels across banks, has a mean of 150.4 and a standard deviation of 109.13. Reflecting differences in priorities, infrastructure, or resources, some banks show high engagement with AI technologies—a maximum of 700—while others lag behind—a minimum of 0. This variation provides a unique context for comprehending the relationship between artificial intelligence and bank performance in future research. We interpret other factors accordingly.

Table 3 Descriptive indicators

Variable	Obs	Mean	Std. Dev	Min	Max
ROE	287	0.406	2.092	−1.894	23.424
AI frequency	287	150.408	109.130	0	700
ln (AI frequency)	283	4.813	0.675	2.398	6.551
Bank Size	287	21.809	3.111	14.279	26.263
Capital Ratio	287	−0.008	1.124	−12.661	0.624
Liquidity Ratio	287	0.165	0.134	−0.714	1.117
Non-performing loans	287	12.689	55.188	−0.206	395.534

Table 4 The correlation coefficients

Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) ROE	1.000					
(2) ln (AI-frequency)	0.098	1.000				
(3) Bank Size	-0.110	0.240	1.000			
(4) capital Ratio	0.033	0.179	0.198	1.000		
(5) liquidity Ratio	0.031	−0.062	-0.148	0.276	1.000	
(6) Non-performing loans	−0.021	0.107	−0.472	0.032	0.092	1.000

The correlation analysis in Table 4 reveals the correlation among operational features, bank performance, and the adoption of artificial intelligence (AI). While the positive correlation between ROE and ln(AI-frequency) (0.098) suggests a connection between AI adoption and profitability, the relationship's weak strength implies that other factors also significantly influence bank performance. The weak positive correlations between ROE and the liquidity ratio (0.031) and the capital ratio (0.033) also show that these factors have little direct effect on profitability in this dataset, even though they do have an effect on financial performance. The weak negative correlation (−0.110) between ROE and bank size suggests that larger banks may struggle to maintain profitability, potentially due to inefficiencies or increased operating expenses.

Larger banks, however, show a greater inclination to use artificial intelligence technologies based on the rather favorable correlation between ln (AI frequency) and bank size (0.240). Larger companies, with their superior infrastructure and resources, are better equipped to invest in and implement innovative artificial intelligence systems. Given the favorable correlation between ln(AI-frequency) and capital ratio (0.179), financially sound banks are also more likely to incorporate artificial intelligence, potentially leveraging their stronger capital positions to foster innovation.

An intriguing discovery is the rather strong negative correlation (−0.472) between bank size and non-performing loans. This suggests that larger banks typically have lower credit risk due to their more diversified loan portfolios or better credit management. But as the weak correlations between non-performing loans and ln(AI frequency) (0.107) and capital ratio (0.032) show, a range of internal and external events shapes the complicated character of credit risk.

5.2 Estimation Result

The regression analysis in Table 5 significantly clarifies the relationship between bank performance as measured by ROE and the adoption of artificial intelligence (AI). The results demonstrate the revolutionary possibilities of artificial intelligence in banking and help clarify the factors influencing profitability.

Table 5 Estimation results

	(1)	(2)
VARIABLES	ROE	ROE
Ln (AI frequency)	0.627**	
	(0.285)	
AI frequency		0.00220*
		(0.00112)
Bank Size	−0.296*	−0.277*
	(0.151)	(0.145)
Capital Ratio	0.0904	0.142*
	(0.0587)	(0.0758)
Liquidity Ratio	0.502	0.333
	(0.699)	(0.745)
Non-performing loans	−0.0131**	−0.0123**
	(0.00601)	(0.00573)
Constant	4.240	6.326*
	(2.595)	(3.378)
Year dummy	Yes	Yes
Country dummy	Yes	Yes
Observations	283	287
R-squared	0.178	0.161

Robust standard errors in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The findings confirm a strong and positive link between artificial intelligence acceptance and bank performance. The beneficial effects of both AI frequency and the logarithmic transformation of AI frequency (ln(AI Frequency)) on ROE support the theory that higher integration of AI technologies increases profitability. These results line up with those of Doumpos et al. [15], who underlined how artificial intelligence might boost customer satisfaction, raise production, and simplify regulatory compliance. Tang and Tien [5] and Al-Ababneh et al. [13] also found that by lowering costs, automating processes, and so minimizing human error, the use of artificial intelligence raises operational efficiency and profitability. Taken together, these studies show how artificial intelligence-using banks save money and concurrently raise customer satisfaction and decision-making.

Fascinatingly, bank size and return on equity show a strong and negative relationship. This suggests that larger banks may struggle to maintain profitability, potentially due to factors such as rising running costs, inadequate bureaucracy, or rigid systems that hinder innovation. These findings align with the findings of Kaya et al. [16], who posited that smaller, more adaptable companies are typically better equipped to adopt

and implement artificial intelligence technologies, resulting in improved performance. Smaller banks may also find it easier to incorporate AI-driven innovations since their legacy systems free them from some burden.

On the other hand, the capital ratio shows a positive correlation with ROE, indicating the part that financial stability and risk control play in increasing profitability. Larger capital buffer banks seem to be in a better position to invest in artificial intelligence technologies, according to Husain et al. [4], who underlined that operational effectiveness and resource availability are absolutely vital for AI adoption. High capital levels not only show financial stability but also help indicate long-term development and rising investor confidence.

As expected, non-performing loans (NPLs) lower ROE, which emphasizes the important role credit risk management performs in preserving profitability. Bad credit quality erodes earnings, which supports the findings of Elegunde and Oladimeji [24], who underlined how artificial intelligence might improve risk assessment and fraud prevention. By incorporating artificial intelligence into credit scoring systems and loan handling procedures, banks could effectively reduce these risks and enhance their performance.

Still, the liquidity ratio and ROE have no statistically significant link. This suggests that managing short-term liquidity may not be as crucial for profitability as other factors, including risk management, operational effectiveness, or strategic investments in artificial intelligence. Jain [6] supports this point of view by stressing that the adoption of artificial intelligence should give strategic initiatives that boost profitability top priority over current operational measurements.

All things considered, these results confirm the favorable correlation between the adoption of artificial intelligence and bank performance. Reducing risks, raising profitability, and increasing output all depend on artificial intelligence. However, the results also highlight challenges, particularly for larger banks, who might find it difficult to remain effective and apply modern technologies. As Umamaheswari and Valarmathi [17] and Haddad [3] point out, even if artificial intelligence has many benefits, banks must also address issues including workforce adaptation, regulatory compliance, and reliance on outside systems if they are to completely realize its potential.

6   Conclusion

This paper shows how artificial intelligence (AI) is transforming the banking sector as well as how it might enhance operational efficiency, change decision-making, and lower costs. Using artificial intelligence's power via chatbots, machine learning, and robotic process automation helps banks improve performance and get a competitive edge. Using financial data from 2015 to 2022, this study investigates how artificial intelligence influences bank performance with an eye toward 36 commercial and Islamic banks in Gulf countries.

The findings reveal a strong and favorable link between artificial intelligence acceptance and bank performance. This suggests that by raising operational profitability and efficiency, artificial intelligence helps banks maximize shareholder returns. The results confirm the theory that including artificial intelligence enhances financial performance and highlight how it could totally change banking activities.

Practically speaking, this study emphasizes how important it is to apply artificial intelligence technologies in order to reduce expenses, minimize errors, and increase output. Reducing operational and human mistakes helps AI also significantly manage risk, improving general performance. Apart from supporting a legislative framework that promotes innovation and technological development in the financial sector, we also exhort banking leaders and legislators to fund artificial intelligence infrastructure.

Though it offers intriguing results, this study has limits. The sample size of the study is just 36 banks in Gulf countries, restricting the range of applications for the findings. A larger sample, encompassing banks from various geographical regions, could provide a more comprehensive understanding of the impact of artificial intelligence on performance. Moreover, the research mostly focuses on ROE, which is important but overlooks qualitative elements including customer satisfaction and workforce flexibility. The acceptance of artificial intelligence technologies in banking by consumers, including employees, receives insufficient consideration.

Future studies should aim to overcome these constraints by raising the sample size and geographic scope to include banks from many areas. This would enable one to compare the acceptance of artificial intelligence and its consequences among countries. More specifically, one could look at the qualitative features of artificial intelligence—those that affect organizational culture, employee adaptability, and customer experience. Long-term studies could also investigate how artificial intelligence keeps influencing the banking sector over time, offering an understanding of how its integration evolves.

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