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The Impact of Information and Communication Technology on Commercial Banks' Performance: Evidence from MENA

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ABSTRACT

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The importance of information in achieving different organizational goals cannot be overstated since it ensures the rapid distribution of resources required to achieve desirable goals. The banking industry's environment is incredibly dynamic and undergoes quick changes because of creativity, innovation, technological advancements, altered perceptions, and customer expectations. The center of the change curve is information and communication technology (ICT). Business organizations, particularly those in the banking sector, operate in a complex and competitive environment defined by shifting conditions and a volatile economic climate. Data for 20 MENA countries has been collected from the World Bank database between 1997 and 2021. Two-step System (Generalized Method of Moments) GMM were used to evaluate the influence of intrinsic features of individuals in a panel data set and avoid bias caused by omitted variables. The impact of the relationship between banks' performance and their use of ICT was evaluated in this study. The data analysis revealed that the impact of ICT on bank performance in MENA is positive. This suggests that a little shift in the banking industry's investment and adoption of ICT will result in a corresponding rise in profit levels.

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1. Introduction

Presently, information and communication technology (ICT) is an essential component of the banking sector, which in turn forms the backbone of any economy in operation. To continue growth in a highly competitive market, banks must adopt ICT as a strategy to enhance the quality and efficiency of client services, as well as to enhance managerial decision-making and operational procedures, in most current technological advancements of the last decade of the twentieth century (Mushtaq et al., 2022). ICT uses computer, digital, and/or electronic methods to gather, store, retrieve, process, estimate, and transfer information (Vu, 2011). In other words, ICT entails the gathering, preparation, storage, and dissemination of data, including text, audio, video, and photographs, which are accessed and extracted using computers and telecommunications technology (Niebel, 2018). Numerous studies have demonstrated that using information technology in general, applying Fintech techniques enables users to manage their payment commitments more effectively and deliver financial services to customers at a fair cost, all of which might contribute to increasing economic growth (Al-Naimi & Yousef, 2021; Arner et al., 2020). Additionally, Qasaimeh et al. (2022) investigated the effect of Artificial Intelligence (AI), which is a type of ICT, on financial performance in Jordanian Banks via questionnaire, where they found Genetic algorithms, Intelligent agents, Neutral Networks, and Expert systems with high relative relevance. This demonstrates Jordanian commercial banks' commitment in utilizing cutting-edge techniques, software, and technologies.

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It is noteworthy that the world has transitioned to a knowledge-based economy currently, with ICT operating as one of the primary driving factors. This is especially true given the dynamism in the drivers of economies around the globe (San Jose et al., 2009). Prior research has mostly concentrated on how ICT or the effectiveness of governance affects economic growth, but very little attention has been paid to the implications of their interactions. Additionally, countless researchers have looked into how ICT affects banking performance. Studies on this topic, particularly those pertaining to the Middle East and North Africa (MENA) area, have been scarce as opposed to studies on the subject in developed nations. The primary goal of this research was to quantify the impact of ICT on financial development, involving a panel of 20 MENA countries between 1997 and 2021. Using aggregate data from the 20 MENA nations, the impact of technology adoption and dissemination on banking risk and profitability was analyzed. More precisely, this study looked at how ICT spread influences the penetration of IT endowments like ATMs and then assessed how it impacts the stability and profitability of banks.

The Hypothesis mentioned below was investigated to determine the nature of the link between ICT and bank profitability in 20 MENA countries.

H₀: There is no statistical relationship existing between ICT adoption and Banks Profitability in MENA.

2. Literature review

Since the findings of Gallup et al. (1998), who hypothesized that open economies are more likely to import cutting-edge technology and ideas from around the globe, there has been research on the relationship between financial development and growth. They can also grow faster because they are more likely to have a larger division of labor and production practices that better match their comparative advantages. The word “performance” in bank performance means “to carry out”. Since, bank's performance reflects its success in terms of capital, profitability, and shareholders' equity, banks typically use a variety of instruments to increase their chances of succeeding. Furthermore, improving performance of the firms requires a stable and powerful IT infrastructure, well-implemented software to support operations, and effective IT management (Alkhazali et al., 2021; Kaddumi et al., 2021, Al-Zoubi et al., 2023). Commercial banks are critical to the financial system and the economy. Banks act as financial mediators, converting savings into investments and processing loans in an efficient way, with bigger banks providing more confidence (Rumler et al., 2010). The financial services industry (banking, insurance, and real estate) has historically been the most intense consumer of ICT, followed by the telecommunications sector. as a strategy for the most recent technological advancements of the last decade of the twentieth century in order to maintain growth in a highly competitive environment (Laudon & Marr, 1995). According to numerous studies, shifting from a traditional to an automated banking system has a positive impact on business operations and serves as a competitive advantage for realizing higher branch productivity, operational control, customer service, accurate fund transfers, risk management, customer maintenance, real-time information systems, reduction in branch offices, reduction in branch staff, and improvement in branch quality (Abubakar Aliyu & Bin HJ Tasmin, 2012; Beccalli, 2007; Hammoud et al., 2018). Consequently, bank performance would be improved through decreased expenses and increased earnings (Japparova & Rupeika-Apoga, 2017; Laudon & Marr, 1995; Salim et al., 2010).

Contrariwise, other experts have argued that while e-banking offers advantages, it also has significant drawbacks that might lower service quality and hurt Banking Performance (BP). Therefore, even though e-banking offers banks new opportunities, it also presents several challenges, including the challenges associated with the development of innovative IT applications, the blurring of market boundaries, the breaking of industrial barriers, the possibility of customer account fraud, the entry of new competitors, the creation of new business models, the challenges related to the hiring of staff, and the high direct and indirect costs associated with training, installation, and service. The aforementioned factors could cause profitability of banks to decline (Alber, 2011; Okibo & Wario, 2014). The banking industry has been the focus of most empirical studies on how IT investments affect short-term accounting performance. Overall, these studies offered contradictory results, and many were unable to establish a direct link between IT spending and financial success. Previous research has looked at the relationship between IT spending and operating profitability in the non-financial sector as shown by ROA (Phan et al., 2020; Shin, 2001). Furthermore, the influence of ICT on the bank's performance in Nigeria between 2001 and 2011 has been investigated, with the use of fixed and random effects to show how the performance of the bank was negatively impacted by ICT (see: Abubakar Aliyu & Bin HJ Tasmin, 2012). Further research into the factors influencing economic growth in Ghana revealed that labor, financial development, and debt servicing all negatively affected production, while both foreign aid and human capital had a favorable impact (Ho & Iyke, 2020).

Over the years, academics from many different nations have paid close attention to the link between ICT investment and corporate performance. However, the findings of the research by these academics have been notably erratic. Therefore, whether the degree of ICT investment genuinely benefits the banks is still a subject of debate in academic circles. Notably, some claimed that performance and investments in ICT are positively correlated (Adolfo Barajas et al., 2011; Becchetti et al., 2003). According to Sassi and Goaid (2013b), ICT proxies positively and significantly impact economic growth directly. As a result, MENA nations must strengthen their ICT policies and better their use of modern ICT. Hassan (2004) investigated the significant elements that lead to global Foreign Direct Investment (FDI) and economic growth and contrasted them with MENA using a panel data of 95 countries and 8 MENA countries over the 1980–2001 period. This study discovered that a

wide range of ICT, macroeconomic, and globalization variables were related to both growth and FDI, and concluded that there was no discernible impact of ICT infrastructure and its use on GDP growth among the infrastructure factors, and yet, ICT was found to have a large favorable effect on FDI.

Additionally, Agbolade (2011) used the Ordinary Least Square approach econometric techniques along with a questionnaire distributed to banks listed in south-west Nigeria to investigate the relationship between the adoption of ICT and banks' profitability. The data analysis showed that ICT and bank profitability in Nigeria were positively correlated. Using dynamic models, Khan et al. (2022) examined the connection between institutional strength and financial development in a sample of 189 emerging and developing nations. Results indicated that political institutions, the prevention of corruption, and regulatory excellence all had a favorable impact on financial development, but the rule of law had a detrimental impact because of its flaws. Therefore, further research is required to add to the ongoing discussion on the nature of the connection between ICT investment and bank performance in the MENA region.

3. Empirical study

3.1 Data

This research was obtained from the World Bank's Global Financial Development and World Development Indicators Databases. From 1997 to 2021, the dataset includes annual statistics on the banking industry in 20 MENA countries. The variables included were: Domestic credit to private sector refers to financial resources provided to the private sector (C/PV) which was used as a proxy for financial development, bank's return on assets (ROA) (%), after taxes, bank cost to income ratio (CIR), and Z-score to measure It captures the probability of default of a country's commercial banking system. A country's commercial banking system's buffer (capitalization and returns) was compared with the volatility of those returns (ROA+(equity/assets)/sd (ROA), Commercial bank branches (per 100,000 adults), Market capitalization of listed domestic companies (% of GDP) (MKT), and Bank Non-Performing Loans to total gross loans (%). (NPL). In addition, we utilized the percentage of Internet users, the number of mobile phone users, the ratio of ICT export to total service export and other metrics for ICT indicators, MobilePaying representing the percentage of using a cell phone to pay utilities (% of those who are 15 or older), MobileSending representing the percentage of domestic remittances through a mobile phone (per 100,000 adults aged 15 and over), automated teller machines (ATMs), Internet users (as a percentage of the population), and the ratio of ICT imports to total service imports (ICT imports). Table 1 below shows the descriptive statistical outcomes for the panel data.

Table 1

Summary figures for panel data covering the MENA 20 nations between 1997 and 2022

Variable	Obs	Mean	Std. Dev.	Min	Max
CIR	550	.495	.308	.077	2.015
ROA	550	.017	.027	-.04	.13
Z-score	550	.223	.119	0	.666
MobilePaying	44	.063	10.36	0	42.604
MobileSending	14	.048	4.239	.74	15.164
MKT	550	.628	.756	.001	5.262
ATM	545	.3	.181	0	.887
Mobile	548	.68	.589	0	2.126
Internet	504	31.931	31.017	.003	100
Branches	550	16.382	11.334	.17	67.5
NPL	538	.075	.049	0	.477
ICTImport	436	6.334	7.279	.001	42.367
ICTExports	316	4.724	13.467	0	63.636
C/PV	550	.491	.495	0	2.552
ATMRatio	544	.031	.111	0	1.774

Based on some mathematical tests such as Link test and Multivariate test of correlation and according to the missing data, the MobilePaying and MobileSending variables were excluded (Gulski et al., 2000; Pregibon, 1980). Meanwhile, the information and communication technology variables (ICT) are a vector that alternatively enters the regression to prevent potential multicollinearity problems (See Table A.1 in the appendix which shows a Pearson correlation matrix). Accordingly, Table 2 displays the sample characteristics for ICT dissemination and the banking channels affected by IT changes, year by year. The findings indicate a noticeable increase in the banking industry's use of IT and financial technology. The statistics highlight the fast development of portable technology and the rise in the number of traditional banking locations with human tellers.

3.2 Methodology

A dynamic panel model is needed because the research's data is dynamic, and the subjects' present behavior is influenced by their past behavior. Standard Ordinary Least Squares (OLS) estimators are ineffective due to the model's dynamic character, which makes them susceptible to bias and inconsistent results from the relationship between the unobserved panel-level effects and the lag in the dependent variable. In this study, a two-step system GMM was used to investigate the impact of ICT on

bank performance. Because GMM is designed from the ground up to address endogeneity, autocorrelation, and heteroscedasticity, it can be used without the need for diagnostic tests. Two-step system GMM is more dependable and effective than difference GMM due to that difference GMM can be asymptotically weak, and the instruments used can be biased. The following expressed equation was used to estimate the Banking Performance model:

$$y_{it} = \beta_0 + \beta_1 x_{1,it} + \dots + \beta_k x_{k,it} + u_{it} \quad (1)$$

Table 2
The usage of ICT indicators in 20MENA nations from 1997 to 2021

Year	ATM	Mobile	Internet	Branches	ICTImport	ICTExports
1997	.	3.624	1.095	.	.	.
1998	.	5.032	1.968	.	.	.
1999	.	6.833	3.076	.	.	.
2000	.	10.747	4.44	.	7.436	5.53
2001	.	17.072	5.743	.	7.285	5.938
2002	.	22.214	7.999	.	7.044	5.159
2003	.	26.972	10.077	.	7.372	5.218
2004	18.624	34.356	11.881	15.49	6.968	5.852
2005	20.526	43.835	14.066	16.756	7.69	9.077
2006	20.884	54.059	16.752	15.557	6.64	5.81
2007	22.757	65.493	20.838	15.762	6.159	5.303
2008	22.913	75.038	25.212	17.508	5.84	5.38
2009	26.392	88.818	29.428	17.937	6.331	5.191
2010	28.354	99.407	35.683	17.986	6.034	5.857
2011	29.263	103.018	38.522	17.977	6.787	5.632
2012	29.953	108.183	42.559	16.448	4.408	5.953
2013	31.189	118.933	46.651	15.038	6.342	4.945
2014	33.361	121.404	50.334	15.759	4.168	2.162
2015	34.399	121.589	55.314	15.489	4.775	2.35
2016	38.081	117.528	59.34	16.102	4.79	2.265
2017	38.807	114.113	65.758	17.518	7.007	2.522
2018	39.804	113.888	73.327	17.468	7.184	2.507
2019	38.856	111.62	77.852	14.932	8.346	3.596
2020	37.139	106.901	82.711	14.151	4.243	1.295
2021	39.35	113.49	100	12.83	5.09	8.61
AVG	30.59	72.17	35.23	16.15	6.27	4.83

From the above equation: Y_{it} is the banking profitability (BP) such as ROA and Z- score (DV) where i = entity (1, 2, 20) and t = time (1997, 1998, 2021) while X_k represents ICT (IV) which includes the variables that measure investments in ICT. Three indicators were used as IVs of ICT variables: Internet, Mobile, and ICT imports. Furthermore: β_k is the coefficient for the IVs, FD measures bank development using only credit to the private sector as proxy, while u_{it} is the error term. Panel data may be analyzed very simply to obtain reliable regression findings under a set of presumptions.

Table 3 presents the results of the GMM model impact on ROA as dependent variable and ICT as independent variable, while Table 4 shows the results of the GMM model impact on Z-score as dependent variable and ICT as independent variable.

Table 3
Two-Step System GMM with Dynamic Panel Data Estimation to Examine the Impact of ICT on Bank Performance Dependent Variable ROA

ROA	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
MKT	.243	.05	4.88	0	.145	.341	***
ATM	.874	.183	4.77	0	.515	1.233	***
Mobile	.092	.066	1.40	.161	-.037	.221	*
Internet	-.065	.037	-1.78	.076	-.137	.007	*
Branches	-.827	.17	-4.87	0	-1.16	-.494	***
C/PV	.094	.017	5.68	0	.061	.126	***
ICTExports	.016	.005	3.48	0	.007	.025	***
ICTImport	.033	.014	2.27	.023	.004	.061	**
NPL	-.067	.143	-0.47	.637	-.347	.213	.
CIR	-.207	.114	-1.81	.07	-.431	.017	*
ATMRatio	-15.025	5.224	-2.88	.004	-25.263	-4.787	***
Constant	.362	.962	0.38	.707	-1.523	2.247	.
Mean dependent var			-4.269	SD dependent var		0.712	
Number of obs			168	Chi-square		7089941.157	

*** $p < .01$, ** $p < .05$, * $p < .1$

Arellano-Bond test for AR(1) in first differences: $z = -2.93$ $Pr > z = 0.003$

Arellano-Bond test for AR(2) in first differences: $z = -1.95$ $Pr > z = 0.052$

Sargan test of overid. restrictions: $chi2(27) = 213.27$ $Prob > chi2 = 0.000$

Table 4

Dynamic Panel-Data Estimation, Two-Step System GMM for the impact of CIT on Bank Performance Dependent Variable Z-score

Z-score	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
MKT	-.109	.015	-7.08	0	-.139	-.079	***
ATM	-.14	.063	-2.23	.026	-.263	-.017	**
Mobile	.052	.009	5.73	0	.034	.07	***
Internet	-.038	.01	-3.90	0	-.058	-.019	***
Branches	.166	.067	2.47	.013	.034	.297	**
C/PV	-.05	.011	-4.59	0	-.071	-.028	***
ICTExports	.002	.004	0.49	.627	-.005	.009	
ICTImport	.033	.013	2.43	.015	.006	.059	**
NPL	.071	.02	3.55	0	.032	.11	***
CIR	.016	.025	0.64	.524	-.033	.064	
ATMRatio	4.823	2.555	1.89	.059	-.185	9.831	*
Constant	-1.918	.335	-5.72	0	-2.575	-1.261	***
Mean dependent var		-1.489	SD dependent var			0.318	
Number of obs		203	Chi-square			299613.710	

*** $p < .01$, ** $p < .05$, * $p < .1$ Arellano-Bond test for AR(1) in first differences: $z = -2.92$ $Pr > z = 0.003$ Arellano-Bond test for AR(2) in first differences: $z = -0.89$ $Pr > z = 0.373$ Sargan test of overid. restrictions: $chi2(30) = 205.31$ $Prob > chi2 = 0.000$

The following are the definitions of the main statistical tools utilized in studying the model of this research work, according to Agbolade (2011):

In Table 5, performance and risk indicators for the banking sector were reported for the 20 MENA member states, between 1997 and 2021. Cost-to-income ratio (CIR), return on assets (ROA), distance to default (Z-score), non-performing loans to total loans (NPL/TL), net interest margin (NIM), and non-interest income to total revenue are examples of variables (NIIN). As observed, ROA had varied throughout time, but it increased in the three years from 2005 to 2007. The declining trend in recent years may be justified by the outbreak of Covid-19. Obviously, As the Z-score rises over time, there is a decreased likelihood of insolvency and increased bank stability. This conclusion makes it clear that as ICT and IT develop, economies of scale are realized in the back office that processes electronic payments, lowering costs. This improvement seems to increase the profitability of banks. We are looking into a favourable correlation that might lead to a lower likelihood of insolvency.

Table 5

Indicators of the performance and risk of the banking sector for the 20 MENA countries through time, 1997–2021

Year	CIR	ROA	Z-score	NPL	NIIN	NIM
1997	.	.	.	.	.	.
1998	.	.	.	.	.	.
1999	.	.	.	.	.	.
2000	47.842	1.162	20.058	.	27.656	4.098
2001	58.555	0.836	19.886	.	27.956	2.79
2002	56.793	1.048	19.221	.	29.291	3.95
2003	54.779	0.816	20.88	.	30.176	2.763
2004	42.813	1.391	20.422	.	33.191	2.978
2005	43.896	4.238	22.415	8.209	33.714	3.112
2006	37.455	4.16	21.899	6.47	33.998	4.887
2007	37.845	4.533	21.678	4.579	33.897	4.957
2008	37.973	1.121	20.723	5.894	37.145	4.919
2009	41.094	1.216	23.793	7.783	33.378	3.624
2010	51.248	1.817	24.124	7.343	33.738	3.708
2011	51.723	1.521	23.87	6.661	34.97	2.7
2012	42.004	1.737	24.699	6.754	35.47	3.785
2013	49.921	1.683	23.522	9.95	36.116	2.961
2014	51.129	1.066	22.736	9.947	39.106	3.697
2015	50.562	1.488	21.926	9.254	41.072	3.515
2016	38.931	1.895	22.132	9.618	42.49	3.535
2017	68.129	0.667	21.972	9.535	36.633	3.542
2018	59.979	1.154	21.994	7.834	37.167	3.69
2019	51.76	0.881	22.452	7.667	35.499	3.692
2020	55.245	0.901	23.249	5.257	38.402	3.61
2021	62.724	1.145	25.865	7.287	42.035	3.579
Avg	49.65455	1.658	22.25073	7.649529	35.14091	3.640545

4. Empirical Result

In this Research, we examined the potential effects of (ICT) dissemination on the banking sector. We chose to investigate the impact of ICT dissemination, adoption, and infrastructure (like Internet) on the efficiency and bank performance of 20 MENA countries using data from the World Bank between 1997 and 2021. The study's findings indicate a connection between ICT

and bank profitability in MENA that is positive. This suggests that a little shift in the banking industry's investment and adoption of ICT will result in a corresponding rise in profit levels. Based on the findings displayed in Tables 3 and 4, banks with high ICT levels would employ experts on several aspects like computer engineering, Web designing and financial system experts, and this would result in increased productivity.

From the results of GMM, the hypothesis was supported: we discovered that ICT spread, including the Internet, mobile devices, and other associated factors, favourably impacts banking profitability, represented by ROA and Z-score. To be more explicit, ICT proxies are important for all aspects of banking performance (see Tables 3, 4 and 5).

From a different angle, ICT advancements may assist banks in achieving economies of scale by lowering the operational expenses and reducing the efforts of banks to create and market in disseminate their financial services and products (FSP). In reality, the acceptance and spread of ICT assists banks in streamlining client interactions while lowering bank transaction costs, which in turn has a beneficial impact on the profitability of the banking industry.

5. Conclusion

This study examined the rise of ICT and banking performance in a sample of 20 Mena countries from 1997 to 2021. Our findings show a statistically significant positive collaboration term between financial development and ICT penetration. This research suggests that in MENA nations, promoting ICT penetration has significantly boosted Banking performance. MENA nations must strengthen their ICT policy, improve their use of modern information and communication technology, and engage talented laborers. Furthermore, signals of the importance of the internet in MENA nations implies that the area should focus on strengthening the E-mobile and Online-contracting. As a result, MENA nations must strengthen the ICT industry and seize the opportunities for leapfrogging even with a poor finance system. Government consumption and inflation, on the other hand, should be kept under check in the long run to avoid a detrimental influence on the economy.

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Appendix

Table A.1

MENA's Countries included in research

Sample Countries of MENA	
Algeria	Malta
Bahrain	Morocco
Djibouti	Oman
Egypt, Arab Rep.	Qatar
Iran, Islamic Rep.	Saudi Arabia
Iraq	Yemen, Rep.
Jordan	Syrian Arab Republic
Kuwait	Tunisia
Lebanon	United Arab Emirates
Libya	West Bank and Gaza

Table A.2
Pairwise correlations

Variables	(CIR)	(ROA)	(Zscore)	(MKT)	(ATM)	(Mobile)	(Internet)	(Branches)	(NPL)	(ICTImport)	(ICTExports)	(CreditPv)	(ATMRatio)
CIR	1.000												
ROA	-0.307*	1.000											
Zscore	-0.103	0.004	1.000										
MKT	-0.195*	0.293*	0.190*	1.000									
ATM	-0.103	0.008	-0.106	0.146	1.000								
Mobile	-0.069	0.004	0.102	0.071	0.619*	1.000							
Internet	-0.025	-0.128	-0.021	0.066	0.729*	0.829*	1.000						
Branches	0.201*	-0.186*	-0.060	-0.105	0.515*	0.197*	0.270*	1.000					
NPL	0.302*	-0.404*	-0.297*	-0.227	-0.125	-0.046	-0.058	0.283*	1.000				
ICTImport	-0.048	-0.040	0.061	-0.017	0.292*	0.144*	0.150*	0.384*	-0.108	1.000			
ICTExports	0.012	-0.090	0.039	-0.045	0.200*	0.047	0.077	0.574*	-0.028	0.846*	1.000		
CreditPv	0.224*	-0.212*	-0.114	0.067	0.608*	0.330*	0.433*	0.838*	0.486*	0.291*	0.405*	1.000	
ATMRatio	-0.027	0.063	-0.068	0.253*	0.148*	0.115	0.119	-0.241*	-0.337*	-0.087	-0.138	-0.106	1.000

** . Correlation is significant at the 0.01 level / * . Correlation is significant at the 0.05 level



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