JISEL

UNIVERSITAS MUHAMMADIYAH SURAKARTA

Journal of Islamic Economic Laws Vol. 8 (2) 152-170 (2025)
Received 04 25 / Revised 10 25 / Accepted 10 25

P-ISSN: 2655-9609; E-ISSN: 2655-9617
https://journals2.ums.ac.id/index.php/jisel/index

The Impact of Financial Technology on Advancing Banking Services and Promoting Financial Inclusion in Libya

Mustafa Etorbi[1]

*[1]University of Tripoli, Libya, m.etorbi@uot.edu.ly

Abstract. This research examines the impact of Financial Technology (FinTech) on advancing banking services and financial inclusion in Libya. The study aims to foster financial inclusivity and advance fintech development in Libya, relying on the Innovation Diffusion Theory. Utilizing a quantitative approach in this research, data is collected from Libyan bank customers through structured questionnaires and is analyzed using the Statistical Package for Social Sciences (SPSS). The findings of this research support the hypothesis that the adoption of Alternative Payment Methods (APMs) and automation by banks positively impacts financial inclusion and service quality. The results of this study intend to assist policymakers and financial institutions in devising targeted plans to support Libya's recovery through FinTech, modernizing its banking system, and improving the quality of services offered to citizens. This study informs the debate on developing technology-based mechanisms to tackle the specific banking problems in Libya, improve financial inclusion and assists the key stakeholders by providing them with an elaborate roadmap on enhancing service delivery.

Keywords: Financial Technology, Alternative Payment Methods, Automation, Service Quality, Financial Inclusion.

***Corresponding Author**

INTRODUCTION

Financial technology, commonly referred to as FinTech, is reshaping the global financial services landscape by improving the efficiency, access, and inclusion of banking services (Josyulam & Expert, 2021; Gomber et al., 2018). The innovation of FinTech like mobile wallets, digital payment systems, and the economical electronic know-your-customer (e-KYC) platforms have helped millions around the world, especially in developing countries with poor banking systems, to avail economical financial services (Arner et al., 2022; Kadaba et al., 2023).

Unfortunately, the cash-based economy, fragmented regulatory frameworks, and poor access to formal financial services stifles the development of the banking sector in Libya (Mohammad et al., 2021). While new initiatives like the mobile wallet and digital payment applications (One

Pay and LyPay) have been introduced, Libyan users engaging in online payments sit at merely 21%, in stark contrast to 33% of cash circulating outside the banking system due to lack of trust in financial institutions (David & Williams, 2022). These obstacles highlight the pressing need to investigate the role of FinTech in improving the banking system of Libya and closing the inclusion gaps for its unbanked population.

Libya's banking inefficiencies are systemically intertwined with conflict, dual central bank systems, and technological lag (Selmi, 2025). The sector continues to operate with legacy systems characterized by lengthy waits, slow services, and an inadequate branch network that does not service rural or economically disadvantaged populations. Although some FinTech initiatives like instant payments and e-KYC systems are being tested in Libya, wide implementation is stifled by weak regulatory frameworks, high cybersecurity risks, low public interest, and limited awareness (Boubaker & Zammel, 2025). As an illustration, Al Saraya Bank's exclusion from the One Pay network showcases the lack of interoperability among banks and resides within a digital services delivery (Hussainey & Dalwai, 2024). In addition, a large informal economy significantly affects Libya's financial system; around 20% of cash will be outside the financial system by 2024 (Boubaker & Zammel, 2025). If these challenges to adoption and integration are not solved, Libya is at risk of deepening financial exclusion and perennially stagnating its economy.

The research conducted on FinTech's effect on enhancing the quality of banking services and assisting with financial inclusion in places with developed financial systems like Morgan (2022) and Danladi et al (2023) is lacking when it comes to conflict-ridden or fragile economies, Libya for example. To illustrate, Wachira and Njuguna (2023) showed how the M-Pesa mobile money system in Kenya improved financial inclusion which aided in mitigating poverty levels. In the same manner, Santhosh Kumar and Aithal (2024) showed how FinTech start-ups in India began providing microloans and savings schemes to people from low-income households using digital platforms. Furthermore, in sub-Saharan Africa, it was reported by Ashenafi and Dong (2022) that the use of FinTech has been linked to lowered income inequality in conjunction with enhanced access to credit for low-income groups.

Despite efforts such as the EU-sponsored E-nable project that aims to build a digital finance framework for Libya by 2025, the results remain unassessed, creating a significant research gap (EU, 2025). Without these assessments, Libya's policymakers are left without means to construct strategies based on FinTech innovations that could drive the country's economic

recovery. Even though a number of studies have identified various cultural, regulatory, and technological barriers to e-banking in Libya (Alnaas, 2021), none have explored the impact of FinTech on the banking service quality and financial inclusion of the users. This research seeks to examine the potential of FinTech to transform banking services in Libya and broaden their accessibility to unserved populations.

The foundation of this study relies on the theoretical framework of the Innovation Diffusion Theory (IDT). Rogers (1983) developed the theory, which describes how innovation is adopted in a certain society and provides useful information regarding the process of change. It accounts for motivation to adopt innovation technology constructs as models for executing various activities.

According to Rogers (2003), innovation is defined as an idea, practice, or an object that an individual or unit of adoption considers new. This definition applies well to the banking sector, where innovations like financial technology are altering the methods of service delivery. Rogers notes that the "newness" aspect of an innovation does not merely relate to the time elapsed since a certain thing was discovered, but includes alterations made to the tasks to be performed as well as the processes used to perform them.

For example, robotics technologies such as Robotic Process Automation (RPA) are innovations not just because they are new, but also because they give banks new means of optimizing workflows and improving customer-facing processes (Bhatia, 2022). In this regard, financial technology fulfills Rogers's definition of innovation because it offers benefits over traditional banking services, including greater precision and improved speed, and so is relatively more efficient.

The diffusion of innovation theory emphasizes any innovation needs to undergo a process of social diffusion if it is to be adopted. This diffusion process involves reducing the uncertainty that is associated with the innovation through communication and interactions within the system members (Rogers et al., 2014). Rogers highlighted five attributes that influence adoption; they include relative advantage, compatibility, complexity, trialability, and observability. In the case of the banking industry, the adoption of Financial Technology (FinTech) innovations offer strong relative advantages in operational efficiency and customer satisfaction (Zhao et al., 2019). Moreover, the ease of their integration into existing banking systems enhances their acceptance among financial institutions. Their tangible and immediate enhancement to workflow productivity sustains accelerated adoption due to ease of testing

(trialability) and direct observation of claimed benefits. Innovations that conform to societal standards and meet the customers' expectations regarding digital banking services are more likely to be accepted. The ease with which mobile banking services spread throughout developing countries is an example of the fact that innovations designed according to user expectations can be widely adopted due to system compatibility and observability (David-West et al., 2022). Thus, applying Rogers' diffusion theory allows one to comprehensively understand the impact of financial technology on the transformation of banking service quality alongside financial inclusion

In addition to this, capturing the adoption of online banking and other automated technologies in Libya has received scant attention (Brydan & Abdulnabi, 2021; Almansour & Elkrghli, 2023). These studies, alongside other works of Dakduk and associates (2023), highlight the influence of demand-side and supply-side thinking in adopting such technologies in developing regions. It is nevertheless clear, that the use of FinTech tools to improve the quality of services offered and the level of access to financial services in Libya is still lacking. The current analysis aims to bridge this gap and, in doing so, attempts to prepare a guide to those in charge of the Libyan banking sector on how best to upgrade the country's banking services through FinTech.

LITERATURE REVIEW

Financial Technology and Bank Service Quality

FinTech is transforming the banking industry with new innovations that enhance quality of service and customer satisfaction (Josyula & Expert, 2021). In Libya, regardless of the hurdles in the acceptance of digital financial services, there are prospects for FinTech to improve the inefficiencies within the banking sector (Elghwail et al., 2023).

Financial technology has several components such as Alternative Payment Methods (APMs) and automation Baker et al. (2023). APMs are defined as payment types that do not involve cash, which are transactions made through credit or debit cards, loyalty points, money transfers, direct debit, e-wallets, mobile platforms, local card schemes, prepaid and postpaid, e-invoices, and even cryptocurrencies. Conversely, automation relates to work process mechanization, which in itself equates task assignment to machines as opposed to human operators. Strategies like robotic process automation and cognitive automation, together with others, are capable of streamlining operational costs and improving efficiency in a multitude of locations. In Libya, online banking is still in its early stages of acceptance, but these developments have the

potential to enhance customer satisfaction through technology-driven service quality improvements.

Bouthahaba and Khaled (2021) pointed out that although Libyan banks' use of technologies like ATMs and telephone banking, their traditional methods of doing business, still preclude them from fully enjoying the advantages of FinTech. These studies highlight the role of FinTech in improving the quality of services in the banking industry in Libya with regard to ease, accessibility, and efficiency of operations.

There is substantial evidence to support the claim that FinTech improves service quality in banking (Sharma et al., 2024; Verma, 2023). Chen et al. (2023) demonstrated that FinTech enhances customers' financial satisfaction by lowering the interest rates on loans as well as enabling better financial management. Murinde et al. (2022) showed FinTech's impact on the business world as it accelerates service delivery, thus disrupting traditional business models and achieving operational boosts of 20-30% among European banks. Al-Sowaidi and Faour (2022) also reported that collaboration between banks and FinTech companies results in greater innovations, allowing banks to offer more customized and timely services. It can, therefore, be concluded that the adoption of FinTech leads to significant improvement in service quality in various parts of the world by increasing operational ineffectiveness and meeting the changing desires of consumers.

Theoretical frameworks, like disruptive innovation theory, help explain the impact of FinTech on the quality of banking services offered. This is because, according to Nguyen (2022), "disruptive innovation theory asserts that FinTech startups leverage technology to provide services that are easier and cheaper to access, thereby competing with traditional banks."

Further supporting the argument made by Nguyen (2022) and Chen et al. (2019) also believes that service quality and structure optimization in an organization increases transaction affordability and thus, enhances financial services available through FinTech. This helps explain the phenomenon on how FinTech transforms the banking service delivery system in Libya and other parts of the world. Based on empirical evidence from Libya and other regions, the following hypotheses are proposed:

H1: Bank adoption of financial technology (a)APMs (b) Automation positively impacts bank service quality

Financial Technology and Financial Inclusion

As described by Polishchuk & Ishchuk (2022), financial inclusion is the access and equality for needed opportunities to personal and business financial services such as banking, loans, equity and insurance, within a reasonable cost and timeframe. It seeks to eliminate obstacles that disenfranchise certain groups predisposed to financial exclusion or those who are un- and underbanked, such as women, low-income families, and rural populations. Promoting financial inclusion helps accelerate economic growth and reduce income disparity while empowering vulnerable populations by equipping them with critical financial resources to manage risks, accumulate wealth, and invest in enterprises (Lal, 2021).

In Libya, financial inclusion is still a restraining issue because of the lack of political stability, developed financial infrastructure, and insufficient access to formal financial services. The World Bank (2020) notes that the Libyan financial sector suffers from having two central banks, poor governance, and documenting systems for credit information, which serve to limit intermediation and financial inclusion. Even with these obstacles, the available opportunities provided by digital financial services (DFS) could help accelerate financial inclusion. Other initiatives, such as biometric identification and e-KYC, also strive to overcome some of the structural barriers to reach the populations that have been overlooked. Such initiatives indicate that FinTech might be able to profoundly change the landscape of the financial inclusion gaps present in Libya.

In a global context, both Adelaja et al. (2024) and Danladi et al. (2023) have documented that FinTech is essential for solving the problem of financial inclusion by extending low-cost and easily-accessible services to neglected segments of the population.

Dewantoko (2025) cites examples of mobile money and digital payments as FinTech innovations that expand the formal financial system's reach to the periphery in a more sustainable manner than traditional banking because these systems alleviate some of the restraints posed by the banks. In addition, newer technologies like AI credit scoring and automated onboarding improve the ease of obtaining financial services, thereby promoting equitable participation in economic activities (Iddrisu et al., 2025). Zhao et al. (2023) also highlighted how FinTech allows central banks to control the credit ceiling and apply macroprudential policies aimed at supporting lower and inclusive growth. These pieces of research illustrate the ability of FinTech to confront fundamental obstacles to development and bring social change for disadvantaged populations.

The two theoretical frameworks: the disruptive innovation theory and the consumer demand theory assist in analyzing the effect of FinTech on financial inclusion. Based on the theory posited by Nguyen (2022), it appears that FinTech startups operate on the concept of technology as a tool to create lower-cost solutions that provide a direct challenge to traditional banking systems. This aligns with Libya's attempts to utilize mobile wallets and eKYC systems that surge over physical branch visit requirements (Bouthahaba & Khaled, 2021). This indicates that the adoption of FinTech is aligned with user preferences towards accessibility and convenience. Based on the following hypotheses are proposed:

H2: Bank adoption of financial technology (a)APMs (b) Automation positively impacts financial inclusion

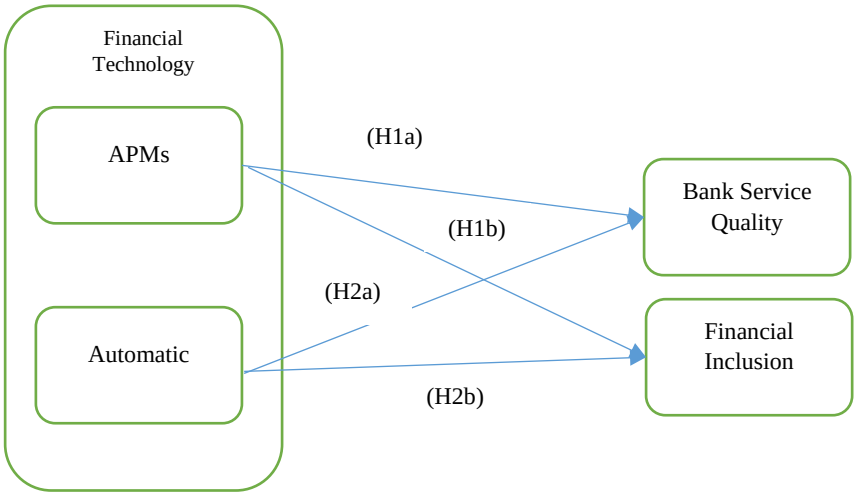

Figure 1. Conceptual Framework

METHOD

Sampling and Data Collection

This study uses a quantitative research design to gather information from customers of banks in Libya. As a reminder from previous lessons, quantitative research is the collection and analysis of numeric data for the purpose of identifying patterns, relationships, and trends in a population. This type of research focuses on collecting objective data and employs highly structured instruments such as surveys, polls, or experiments that can yield statistically significant results (Ghanad, 2023). Participants for this study were selected through convenience sampling, meaning only those who were easily accessible and willing to complete the questionnaire were included. Participants. Data was collected using a structured

questionnaire which was designed on Google Forms. Despite the multilingual nature of the region, the questionnaire was drafted in English, as it is the most universally understood language in the area.

Measurement of Study Variables

Questions from valid and related studies were adopted, and used in developing the study questionnaire electronically, through the Google form platform. Financial technology was measured with two dimensions APMs and automation, both measured with five items each from Baker et al. (2023).

Bank service quality was measured with 15 items from dimensions of tangibility, responsiveness, reliability, assurance and empathy adopted from Mukherjee et al. (2003). Financial inclusion adopted from Amnas et al. (2024) was measured with 5 items. The questions seek to know if the bank strives to provide its customers with access to useful and affordable financial products and services that meet their needs (e.g., transactions, payments, savings, credit, and insurance) and are delivered responsibly and sustainably. All question was measured in Five-point Likert scale ranging answers 1 for strongly-disagree to 5 strongly-agree.

Data Analysis Procedure

The chosen methodology focuses on testing relationships between variables within the framework of quantitative data. For rigorous statistical evaluation, the researcher relied upon SPSS (Statistics Program for the Social Sciences) 22.0 to ensure optimum precision, accuracy, and validity within the results obtained. The researcher established the measurement scales' reliability and validity by performing confirmatory factor analysis (CFA) alongside the Kaiser-Meyer-Olkin (KMO) test to evaluate sampling adequacy. These methods confirmed that the data and the scales employed were aligned with the study objectives and sufficiently rigorous for the intended evaluation.

To determine the relationships among varied factors, this study utilized correlation and regression analysis, as they are well documented for assessing both linear and types of nonlinear relationships such as exponential, polynomial, and logistic. Variable relationships were first explored using correlation analysis (associations), and subsequently causation was explored using regression analysis (Dufera et al., 2023). Simple effect relationships were assessed through linear regression, whereas polynomial regression and other nonlinear models

captured the complexity of interrelationships. This enabled a comprehensive deep examination concerning the ways in which FinTech adoption affects provided banking services alongside financial inclusion.

RESULTS

Demographics

Participants' demographic characteristics are summarized in the table, which describes the sample fully. It shows that, in the sample, the majority of participants were male (63%) while females were 37%. Also, there was a wide range of ages, with the largest cohort aged 26 to 35 years (31%) followed by those aged 36 to 45 years (27%). Regarding marital status, married individuals represent the highest group (44%) in comparison to those who identify as single (38%). Most participants reported holding at least a Bachelor's Degree (51%), followed by Master's Degrees (23%). These demographic characteristics help to gauge the level of sample representativeness and to analyze the study's findings relative to the objectives within the research framework

Table 1. Demographic Profiles of the Respondents

Demographic	Frequency	Percentage (%)
	Gender	
Male	196	63
Female	114	37
	Age	
18 - 25 years old	54	17
26 - 35 years old	96	31
36 - 45 years old	82	27
46 - 55 years old	71	23
Above 55 years old	7	2
	Marital Status	
Single	119	38
Married	135	44
Widow	50	16
Divorced	6	2
	Educational Level	
Diploma	52	17
Bachelor's Degree	159	51
Master's Degree	72	23
PhD's Degree	21	7
Professional Certificate	6	2

Reliability and Validity of Construct

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy provides an index between zero and one. An index of one is achieved when each variable is perfectly predicted without error by reproducing how the other variables are predicted (under 0.5 is unacceptable). This data's KMO index was 0.895 (In Table 1) which is considered 'meritorious' (Hair et al., 1998). Bartlett's test produced significant chi-square results (4835.169) with 435 degrees of freedom and a significance value of $p<0.000$. Reliability statistics and mean and standard deviation of items grouped under four constructs: APM, Automation, Bank Service Quality and Financial Inclusion are presented in Table 3. Cronbach's alpha values for each construct ranging from 0.716 to 0.920 indicates good internal consistency across items (Izah et al., 2023).

With regards to each item's factor validity, average to better than 0.5 with most individual item factor loadings being greater than 0.5 (Tavakol & Wetzel, 2020). The mean scores and standard deviations indicate that responses are variable, with Automation having higher mean values and lower variability than other constructs such as Financial Inclusion (e.g., FI1: mean) demonstrating differences in participant perceptions across measured dimensions.

Table 2. KMO and Bartlett's test

Bartlett's test of sphericity			
KMO measure of sampling adequacy	Approx. x^2	df	Sig.
.681	4835.169	435	.000

Table 3. Reliability, Mean and Standard Deviation

Items	Factor Analysis	Cronbach's Alpha	Mean	Standard Deviation
APM	.840	.920	3.41	1.359
APM1				
APM2	.878		3.35	1.335
APM3	.824		3.31	1.375
APM4	.793		3.02	1.306
APM5	.841		3.50	1.117
Automation (AU)	.604	.716	3.95	.852
AU1				
AU2	.628		3.60	1.043
AU3	.842		4.08	.898
AU4	.715		4.13	.768
AU5	.823		4.05	.780
Bank Service Quality	.756	.737	4.10	.786
BSQ1				
BSQ2	.812		3.98	.820
BSQ3	.679		4.11	.797
BSQ4	.730		3.76	1.040
BSQ5	.822		4.17	.840
BSQ6	.765		4.13	.723
BSQ7	.872		3.53	1.219
BSQ8	.645		3.80	.972
BSQ9	.740		3.94	1.021
BSQ10	.806		3.40	1.194
BSQ11	.645		4.02	.892
BSQ12	.614		3.99	.798
BSQ13	.606		3.71	1.001
BSQ14	.633		3.76	.996
BSQ15	.736		3.55	1.130
Financial Inclusion (FI)	.735	.785	3.03	1.174
FI1				
FI2	.726		3.61	.975
FI3	.642		3.75	1.043
FI4	.801		3.17	1.077
FI5	.793		3.80	1.067

Correlation Analysis

In Table 4, although the dependent variable is not mentioned, the description summarizes its components as focus unit APM, Automation, Bank Service Quality, and Financial Inclusion. The correlations reveal the enhancement of these variables is associated through significant positive relationships. Concerning APM, it is moderately correlated with BSQ (0.420, $p<0.000$) and FI (0.326, $p<0.001$), indicating that higher automation of processes is linked to greater

bank service quality and financial inclusion. Automation also has significant correlations with BSQ (0.467, p<0.000) and FI (0.301, p<0.000), signifying that more of what is considered automation enhances service quality and financial inclusion.

Moreover, the correlation between BSQ and FI (0.334, p<0.000) strengthens the argument regarding the relationship these constructs have with one another. All in all, the relationships reveal that improvement in one area is likely to enhance others, thereby illustrating synergy among the variables in question.

Table 4. Correlation Coefficient of Independent Variables and Dependent Variable

	APM	AU	BSQ	FI
APM	1			
AU	.214**	1		
	.000			
BSQ	.420**	.467**	1	
	.000	.000		
FI	.326**	.301**	.334**	1
	.00	.000	.000	

*) significant at a real rate of 10%

**) significant at a real rate of 5%

Hypothesis Testing

The results from the regression analyses investigating the associations between different independent and dependent variables are contained in Table 5. It shows the values of R^2 and adjusted R^2, standardized beta coefficients, t-values, and level of significances for each path. Importantly, Automated Process Management to Bank Service Quality (BSQ) and Automation to Financial Inclusion as well as AU to BSQ have statistically significant positive relationships. For example, APM predicts BSQ at a beta of 0.420 (t = 8.112, p<0.000), explaining 17.3% of the variance in BSQ. AUC also significantly predicts FI (beta = 0.301, t = 5.982, p<0.000) and BSQ (beta = 0.467, t = 9.263, p<0.000) where the prediction of BSQ accounted for 21.5% of the variance. The BSV model is supported by the collinearity diagnostics which show no multicollinearity problems since tolerances are 1.000 and VIFs of 1.000 for all paths (Hair et al., 2018).

Table 5. Regression Results

Path	R^2	Adjusted R^2	Beta	T-Value	Sig.	Collinearity Statistics		Result
						Tolerance	VIF	
APM-BSQ	.176	.173	.420	8.112	.000	1.000	1.000	Accepted
AU-FI	.107	.104	.326	6.062	.000	1.000	1.000	Accepted
AU-BSQ	.218	.215	.467	9.263	.000	1.000	1.000	Accepted
AU-FI	.98	.95	.301	5.982	.000	1.000	1.000	Accepted

DISCUSSION

The purpose of this study is to examine the impact of financial technology on advancing banking services and promoting financial inclusion in Libya. As such, the results of the examination, which confirm Hypothesis one and Hypothesis two, can be explained using the Innovation Diffusion Theory. IDT accounts for the adoption of new technologies over time and highlights factors such as relative advantage, compatibility, and observability as primary contributors. In regard to Hypothesis 1, the adoption of fin tech innovations including the Automated Process Management and Automation is consistent with the theory's focus on relative advantage. APM and AU greatly improve operational functions, for example, efficiency, error reduction, and customer service interactions with banking systems. This agrees with Sharma et al. (2024) demonstrated that innovations like internet banking lower marginal cost increases in service provision, resulting in an S-shaped diffusion curve associated with banks adopting these technologies over time. Equally, Chen et al. (2019) confirmed relative advantage significantly affects attitudes toward the adoption of fintech services and validated the importance of technology-enabled service improvements of enhanced value.

Financial technologies like APM and AU significantly influence financial inclusion as per IDT principles, supporting Hypothesis two. The theory's compatibility component is exemplified by automation in mobile banking services and artificial intelligence credit evaluations, which alleviate barriers to financial services (Baker et al., 2023). Adelaja et al. (2024) describes mobile banking’s role in reducing access barriers for rural users, further noting lesser dependency on bank branches. This observation corroborates Rogers' (2003) claim regarding the role of compatibility in the diffusion of innovations. Moreover, this corroborates Danladi et al.'s (2023) finding on service responsiveness within fintech frameworks enhanced by diversified customer needs and efficiency, reinforcing the importance of observability driving

adoption. These findings relate to other diffusion models whose assumptions are based on technological advancements and demand changes (Nguyen, 2022). Altogether, IDT offers a comprehensive explanation on how APM and AU enhance the quality of services offered by banks and deepen servicing gaps alongside emerging access barriers with diminished standards of financial inclusion.

The outcomes of this banking study shed light on the practical functions within the banking industry. To begin, the implementation of Automated Process Management and Automation technologies has the potential to redefine bank operational workflows, resulting in heightened efficiency and precision (Baker et al. 2023). Routine activities, including loan processing, account management, and transaction processing, can be automated by the banks which will streamline workflows, reduce errors, and improve attestation to compliance benchmarks. In addition, automation enhances staff deployment in banks, allowing them to devote more attention to value enhancing activities, which strategically improves customer interactions. In the context of banking services, these improvements elevate service standards and reinforce the competitive stance of banks in the context of the digital ecosystem in which the banking industry operates. This helps to support initiatives like the EU-sponsored E-nable project aim to build a digital finance framework for Libya.

Second, the study shows how APMs and AUs enable financial inclusion by easing banking services for the unserved customers. Automation makes possible the digital onboarding of customers, the AI assessment of creditworthiness, and mobile banking systems that lessen the need for reliance on physical locations (Adewumi et al., 2024). Such technologies allow banks to provide customized scalable solutions to low income and rural areas that have been traditionally underserved, expanding the frontier of financial inclusivity. For instance, automated systems streamline account creation and the approval of loans, at the same time ensuring compliance with the Community Reinvestment Act (CRA) that promotes access to financial services. Bankers stand to gain by using automation to extend their business and improve service delivery; in so doing, they advance financial inclusion while fueling growth in these underserved markets.

As important as this study's contributions are, it has limitations. To begin with, the use of cross-sectional data prohibits the examination of any potential changes over time or any causative relationships that may exist between the different variables in the context of time. This renders capturing the full extent of the impact of integrating technology into banking processes on the

banking outcomes elusive. Also, the primary focus of the study is on the quantitative aspects of the data which fails to capture the subtleties concerning the qualitative dimension of how automation affects the level of service and financial inclusion. Certain customer perceptions or problems that members of the underserved segments experience may not be captured in the data.

Another possible shortcoming includes selection bias for the sample. It is possible that some banks or regions were omitted from the study, limiting its scope. Additionally, the study does not consider the possible cost, regulatory, or employee-driven APM and AU implementation barriers. Understanding these factors is vital to assessing the actual technological adoption domain in the banking industry. Lastly, the impact of varying automation technologies, such as AI, on service quality and financial inclusion requires deeper exploration. Meeting these limitations could enhance the insights on automation's impact on banking services.

CONCLUSION

The empirical findings of this investigation demonstrate that the implementation of Automated Process Management (APM) coupled with system-wide Automation (AU) within Libyan banking institutions leads to marked gains in service efficiency and measurable advances in financial inclusion. The statistical corroboration of the articulated hypotheses affirms the predictive capacity of the Innovation Diffusion Theory and indicates that the deployment of fintech innovations not only streamlines core operational processes but also lowers barriers to access for previously excluded demographics. Such outcomes afford scholarly confirmation that technology adoption can recalibrate banking configurations and substantiate inclusion programmes within the context of developing economies, thereby underpinning both theoretical discourse and applied extension.

Notwithstanding, critical limitations must be circumscribed, since they condition the interpretation of the empirical results. The research employs a cross-sectional framework, thus eschewing inferences of binding causation, and the explicit confinement to the Libyan banking sector circumscribes extrapolative validity to alternative geographical or industrial settings. Furthermore, the primary reliance upon quantitative indicators evades a more layered comprehension of the socio-cultural determinants that mediate fintech adoption. Collectively, these constraints counsel a subsequent scholarly agenda that foregrounds longitudinal research

designs and integrates mixed-method triangulation, thereby enriching the evidentiary base and safeguarding the validity of future conclusions.

The authorship of this study has illuminated the multifaceted difficulties endemic to the production of disciplined academic inquiry, especially within the nascent domain of financial technology in low-and-middle-income contexts. Scholars and postgraduate researchers contemplating parallel investigations ought to allocate sufficient temporal margins for the sequential phases of outlining, peer-feedback uptake, and substantive revision so that the final document achieves the requisite rigour and clarity. The study aspires to function as an initial anchor for subsequent, more granular investigations that map the confluence of technological advance, financial intermediation, and socioeconomic inclusion, thereby enhancing both the durability of scholarly argument and the evidentiary base for policy formulation in jurisdictions confronting expansive digital transformation.

REFERENCES

Adelaja, A. O., Umeorah, S. C., Abikoye, B. E., & Nezianya, M. C. (2024). Advancing financial inclusion through fintech: Solutions for unbanked and underbanked populations. *World Journal of Advanced Research and Reviews*, *23*(01), 427-438. https://doi.org/10.30574/wjarr.2024.23.2.2379

Adewumi, A., Ewim, S. E., Sam-Bulya, N. J., & Ajani, O. B. (2024). Advancing business performance through data-driven process automation: A case study of digital transformation in the banking sector. *International Journal of Multidisciplinary Research Updates*, *8*(02). https://doi.org/10.53430/ijmru.2024.8.2.0049

Almansour, B., & Elkrghli, S. (2023). Factors influencing customer satisfaction on e-banking services: a study of Libyan banks. *International Journal of Technology Innovation and Management (IJTIM)*, *3*(1), 34-42. https://doi.org/10.54489/ijtim.v3i1.211

Alnaas, H. (2021). The barriers of adoption the e-banking in the Libyan Banks—A case study of commercial banks in Tobruk city. *Open Journal of Business and Management*, *10*(1), 501-524. https://doi.org/10.4236/ojbm.2022.101028

Al-Sowaidi, A., & Faour, A. (2022). Fintech revolution: how established banks are embracing innovation to stay competitive. *Journal of Business and Management Studies*, *5*(5), 166-172. https://doi.org/10.32996/jbms.2023.5.5.14

Amnas, M. B., Selvam, M., & Parayitam, S. (2024). FinTech and Financial Inclusion: Exploring the Mediating Role of Digital Financial Literacy and the Moderating Influence of Perceived Regulatory Support. Journal of Risk and Financial Management, 17(3), 108. https://doi.org/10.3390/jrfm17030108

Arner, D., Buckley, R., Charamba, K., Sergeev, A., & Zetzsche, D. (2022). Governing FinTech 4.0: BigTech, platform finance, and sustainable development. *Fordham J. Corp. & Fin. L.*, *27*, 1. "Governing FinTech 4.0: BigTech, Platform Finance, and Sustainable Deve" by Douglas Arner, Ross Buckley et al.

Ashenafi, B. B., & Dong, Y. (2022). Financial inclusion, Fintech, and income inequality in Africa. *FinTech*, *1*(4), 376-387. https://doi.org/10.3390/fintech1040028

Baker, H., Kaddumi, T. A., Nassar, M. D., & Muqattash, R. S. (2023). Impact of financial technology on improvement of banks' financial performance. *Journal of Risk and Financial Management*, *16*(4), 230. https://doi.org/10.3390/jrfm16040230
Bhatia, M. (2022). Banking 4.0. *Springer Books*.
Boubaker, R., & Zammel, M. (2025). Exploring FinTech Market Landscape in the MENA Region. In *The Palgrave Handbook of FinTech in Africa and Middle East: Connecting the Dots of a Rapidly Emerging Ecosystem* (pp. 1-29). Singapore: Springer Nature Singapore. https://doi.org/10.3390/jrfm16040230
Bouthahaba, I. E., & Khaled, M. H. (2021). The mediating role of socio-economy on the relationship between customer lifestyles and the awareness of MobiCash banking services of Wahda Bank in Libya. *Journal of Emerging Economies & Islamic Research*, *9*(1), 88-107. https://doi.org/10.24191/jeeir.v9i1.11210
Brydan, R. N., & Abdulnabi, M. H. (2021). Factors Affecting Customers' Acceptance of Wahda Bank E-Service in Libya. *Finance and Business Economies Review*, *5*(4), 340-355. https://doi.org/10.58205/fber.v5i4.741
Brydan, R. N., & Abdulnabi, M. H. (2021). Factors Affecting Customers' Acceptance of Wahda Bank E-Service in Libya. *Finance and Business Economies Review*, *5*(4), 340-355. https://doi.org/10.58205/fber.v5i4.741
Chen, F., Du, X., & Wang, W. (2023). Can fintech applied to payments improve consumer financial satisfaction? Evidence from the USA. *Mathematics*, *11*(2), 363. https://doi.org/10.3390/math11020363
Chen, M. A., Wu, Q., & Yang, B. (2019). How valuable is FinTech innovation?. *The Review of financial studies*, *32*(5), 2062-2106. https://doi.org/10.1093/rfs/hhy130
Dakduk, S., Van der Woude, D., & Nieto, C. A. (2023). Technological adoption in emerging economies: Insights from Latin America and the Caribbean with a focus on low-income consumers.
Danladi, S., Prasad, M. S. V., Modibbo, U. M., Ahmadi, S. A., & Ghasemi, P. (2023). Attaining sustainable development goals through financial inclusion: exploring collaborative approaches to Fintech adoption in developing economies. *Sustainability*, *15*(17), 13039. https://doi.org/10.3390/su151713039
Danladi, S., Prasad, M. S. V., Modibbo, U. M., Ahmadi, S. A., & Ghasemi, P. (2023). Attaining sustainable development goals through financial inclusion: exploring collaborative approaches to Fintech adoption in developing economies. *Sustainability*, *15*(17), 13039. https://doi.org/10.3390/su151713039
David, D., & Williams, S. B. (2022). Financial innovations and Fintech solutions for migrant workers in the MENA region. In *Innovative Finance for Technological Progress* (pp. 257-287). Routledge. https://doi.org/10.4324/9781003220220-16?urlappend=%3Futm_source%3Dresearchgate.net%26medium%3Darticle
David-West, O., Oni, O., & Ashiru, F. (2022). Diffusion of innovations: Mobile money utility and financial inclusion in Nigeria. Insights from agents and unbanked poor end users. *Information Systems Frontiers*, *24*(6), 1753-1773.
Dewantoko, T. A. (2025). Banking and Fintech in the Digital Financial Ecosystem for the Unbankable Population. *Journal of Banks and Financial Institutions*, *1*(1/2), 14-25. https://doi.org/10.70764/gdpu-jbfi.2025.1(1)-02
Dufera, A. G., Liu, T., & Xu, J. (2023). Regression models of Pearson correlation coefficient. *Statistical Theory and Related Fields*, *7*(2), 97-106. https://doi.org/10.1080/24754269.2023.2164970
Elghwail, I. K. M., Ngah, B. B., Obad, F. M., & Ateik, A.-H. A. M. (2023). A Conceptual Framework for Adopting Islamic Banking and Finance in Libya. International Journal of Research and Innovation in Applied Science, VIII(IV), 01–10.

EU (2025). EU-funded E-nable Project Concludes with Remarkable Achievements for Libya's Economic Growth. Retrieved from: https://innovation-africa.org/2025/eu-funded-e-nable-project-concludes-with-remarkable-achievements-for-libyas-economic-growth/

Ghanad, A. (2023). An overview of quantitative research methods. *International journal of multidisciplinary research and analysis*, *6*(08), 3794-3803. https://doi.org/10.47191/ijmra/v6-i8-52

Gomber, P., Kauffman, R. J., Parker, C., & Weber, B. W. (2018). On the fintech revolution: Interpreting the forces of innovation, disruption, and transformation in financial services. *Journal of management information systems*, *35*(1), 220-265. https://doi.org/10.1080/07421222.2018.1440766

Hussainey, K., & Dalwai, T. (Eds.). (2024). *Handbook of Banking and Finance in the MENA Region* (Vol. 13). World scientific. https://doi.org/10.1142/q0435?urlappend=%3Futm_source%3Dresearchgate.net%26medium%3Darticle

Iddrisu, K., Yakubu, I. N., & Asongu, S. A. (2025). FinTech Innovations for Sustainable Banking. In *Strategic Approaches to Banking Business and Sustainable Development Goals* (pp. 63-86). Cham: Springer Nature Switzerland.

Izah, S. C., Sylva, L., & Hait, M. (2023). Cronbach's alpha: A cornerstone in ensuring reliability and validity in environmental health assessment. *ES Energy & Environment*, *23*, 1057. http://dx.doi.org/10.30919/esee1057

Josyula, H. P., & Expert, F. P. T. (2021). The role of fintech in shaping the future of banking services. *The International Journal of Interdisciplinary Organizational Studies*, *16*(1), 187-201.

Kadaba, D. M. K., Aithal, P. S., & KRS, S. (2023). Impact of Digital Financial Inclusion (DFI) initiatives on the self-help group: For sustainable development. *International Journal of Management, Technology, and Social Sciences (IJMTS)*, *8*(4), 20-39. https://dx.doi.org/10.2139/ssrn.4674709

Lal, T. (2021). Impact of financial inclusion on economic development of marginalized communities through the mediation of social and economic empowerment. *International Journal of Social Economics*, *48*(12), 1768-1793.

Mohammad, S. S., Prajanti, S. D. W., & Setyadharma, A. (2021). The analysis of financial banks in Libya and their role in providing liquidity. *Journal of Economic Education*, *10*(1), 1-13.

Morgan, P. J. (2022). Fintech and financial inclusion in Southeast Asia and India. *Asian Economic Policy Review*, *17*(2), 183-208.

Mukherjee, A., Nath, P., & Pal, M. (2003). Resource, service quality and performance triad: a framework for measuring efficiency of banking services. *Journal of the Operational Research Society*, *54*(7), 723-735.

Murinde, V., Rizopoulos, E., & Zachariadis, M. (2022). The impact of the FinTech revolution on the future of banking: Opportunities and risks. *International review of financial analysis*, *81*, 102103.

Nguyen, Q. K. (2022). The impact of risk governance structure on bank risk management effectiveness: evidence from ASEAN countries. *Heliyon*, *8*(10).

Polishchuk, V., & Ishchuk, L. (2022, May). The essence of financial inclusion and accessibility to financial products. In *Economic Forum* (Vol. 1, No. 12, pp. 135-143).

Rogers, E. M., Singhal, A., & Quinlan, M. M. (2014). Diffusion of innovations. In *An integrated approach to communication theory and research* (pp. 432-448). Routledge.

Santhosh Kumar, K., & Aithal, P. S. (2024). From Access to Empowerment: The Role of Digital Microfinance–ABCD Evaluation. *International Journal of Management, Technology and Social Sciences (IJMTS)*, *9*(2), 267-282.

Selmi, N. (2025). Libya in transition: governance challenges and civil society's prospects in political and economic reforms. *Global Security: Health, Science and Policy*, *10*(1), 2449614.

Sharma, V., Jangir, K., Gupta, M., & Rupeika-Apoga, R. (2024). Does service quality matter in FinTech payment services? An integrated SERVQUAL and TAM approach. *International Journal of Information Management Data Insights*, *4*(2), 100252.

Tavakol, M., & Wetzel, A. (2020). Factor Analysis: a means for theory and instrument development in support of construct validity. *International journal of medical education*, *11*, 245.

Verma, J. (2023). Embracing fintech applications in the banking sector Vis-á-Vis service quality. In *Contemporary Studies of Risks in Emerging Technology, Part B* (pp. 207-219). Emerald Publishing Limited.

Wachira, G., & Njuguna, A. (2023). Enhancing growth and productivity through mobile money financial technology services: the case of m-pesa in kenya. *International Journal of Economics and Finance*, *15*(12), 1-91.

Zhao, Q., Tsai, P. H., & Wang, J. L. (2019). Improving financial service innovation strategies for enhancing china's banking industry competitive advantage during the fintech revolution: A Hybrid MCDM model. *Sustainability*, *11*(5), 1419.

Zhao, Y., Goodell, J. W., Wang, Y., & Abedin, M. Z. (2023). Fintech, macroprudential policies and bank risk: Evidence from China. *International Review of Financial Analysis*, *87*, 102648.