

# The Impact of Digital Financial Inclusion on Bank Profitability: Evidence from Developing Countries

\*Sumayyah Abdul Aziz<sup>1</sup>, Lutfi Abdul Razak<sup>1</sup>, Ly Y. Slesman<sup>2</sup>, Muhamad Abduh<sup>1</sup>

<sup>1</sup>School of Business and Economics, University of Brunei Darussalam, Bandar Seri Begawan, Brunei Darussalam

<sup>2</sup>Centre for Advanced Research, University of Brunei Darussalam, Bandar Seri Begawan, Brunei Darussalam

**Correspondence\*:**

Address: Universiti Brunei Darussalam Jalan Tungku Link, BE1410 Brunei Darussalam | e-mail: [sumayyahabdulaziz85@gmail.com](mailto:sumayyahabdulaziz85@gmail.com)

## Abstract

**Objective:** This study aims to evaluate the impact of Digital Financial Inclusion (DFI) on the profitability of banks in developing countries, by constructing a novel comprehensive DFI index and employing dynamic panel analysis.

**Design/Methods/Approach:** The research involves a sample of 111 banks across nine developing nations from 2016 to 2020. A new DFI index was constructed to encapsulate both the access and usage dimensions of DFI, along with demographic and geographical considerations, using Principal Component Analysis (PCA). The empirical framework adopted a dynamic panel model, applying two-step system Generalized Method of Moments (GMM) estimators to analyze the data.

**Findings:** The findings indicate a positive and significant relationship between DFI and bank profitability. This relationship highlights the beneficial impacts of DFI on the financial performance of banks within the studied contexts.

**Originality/Value:** This research broadens the current understanding of Digital Financial Inclusion (DFI) by focusing on its impacts not only on bank stability but also on profitability and efficiency, areas not extensively covered by prior studies. Additionally, it contributes to the literature by integrating demographic and geographical dimensions into the construction of a comprehensive DFI index. This approach provides a nuanced understanding of DFI's effects on bank profitability and represents a significant deviation from traditional studies that focus mainly on access and usage.

**Practical/Policy implication:** Based on the findings, it is recommended that bank managers and financial service providers establish strategic partnerships to strengthen the integration of traditional banking with digital financial services, thereby boosting bank profitability. Regulators must update policies to foster an environment that supports the integration of digital innovations, while ensuring robust consumer protection and data privacy standards. Continuous investment in digital infrastructure and financial literacy is crucial, alongside rigorous policy monitoring and adaptation, to maintain a regulatory framework that promotes the sustainable expansion of DFI and addresses emerging security challenges.

**Keywords:** Bank Profitability; Developing Countries, Digital Financial Inclusion.

**JEL Classification:** O11, O33, O43



DOI: <https://doi.org/10.20473/jmtt.v17i2.57508>

Received: Received: May 12, 2024; Revised: June 29, 2024; Accepted: July 20, 2024; Available online: August 21, 2024

Copyright © 2024, The Author(s)

Published by [Universitas Airlangga](https://www.unair.ac.id/), Department of Management, Faculty of Economics and Business

## 1. Introduction

The advent of the digital age has radically transformed the global financial landscape, significantly expanding the purview of traditional banking services. The emergence of digital financial inclusion (DFI) - the use of digital means to boost financial services access and usage - has engendered a new wave of opportunities for banking institutions and their customers alike (Allen et al., 2016). Notably, DFI has evolved to become a strategic focus area for banks, especially in developing nations where financial exclusion remains prevalent.

Financial inclusion (FI) has long been recognized as a pivotal element in fostering economic resilience and reducing disparities. International bodies like the World Bank and the International Monetary Fund advocate for FI to combat poverty and boost economic development (World Bank, 2015). Central to FI is the accessibility of financial resources for all segments of society, including the most vulnerable (Honohan, 2008; Beck & Demirguc-Kunt, 2006). The role of banking institutions is particularly crucial, as they are the primary conduits of FI, facilitating essential services such as deposits, credit, and payments (Busch et al., 2017).

Despite the growing recognition of DFI's potential in improving access to financial services, its effect on the performance of banking institutions, particularly in terms of profitability, has remained largely understudied, necessitating more empirical research to ascertain this impact. This study addresses this gap by building upon and extending the existing body of literature, which predominantly examines the role of DFI in enhancing bank stability (Khattak et al., 2023; Banna & Alam, 2021; Banna et al., 2021). By focusing explicitly on profitability, this research hypothesizes that DFI initiatives enhance service accessibility and operational efficiency, thereby directly contributing to improved bank profitability. Secondly, building upon existing literature, this research investigates the influence of DFI on bank profitability at a micro level, recognizing profitability as key indicator of a bank's operational effectiveness and vital for its competitive performance (Garcia-Herrero et al., 2009; Athanasoglou et al., 2008). Additionally, this research challenges existing findings by examining DFI's role across multiple countries, rather than single-country studies with limited generalizability (El-Chaarani & El-Abiad, 2018). By analyzing data from 2016 to 2020 across 111 banks in nine selected developing nations and employing two-step system Generalized Method of Moments (GMM) estimators, this study offers a comprehensive and robust analysis of DFI's impacts on bank profitability and efficiency, enhancing the generalizability and applicability of its findings.

This paper consists of five parts, starting with an introduction. The second section provides a literature review and sets forth the research hypotheses. The methodology is detailed in the third section, while the fourth section reports the findings and provides discussion. The final section serves as the conclusion.

## 2. Literature Review and Hypotheses Development

### 2.1 Review of Relevant Theoretical Literature

The theoretical framework of this study is underpinned by two key theories: the Constraint-Induced Financial Innovation Theory and the Transaction Cost Theory, each providing insights into the dynamics of DFI and its impact on bank profitability in developing countries.

The Constraint-Induced Financial Innovation Theory, originating from Silber's seminal works in 1983, suggests that financial institutions primarily innovate to overcome operational and regulatory constraints that impede their profitability and competitiveness. Innovations in the digital arena, such as internet banking and mobile financial services, are seen not just as operational enhancements but as strategic responses to these constraints. This theory highlights that by adopting digital strategies, banks can navigate around traditional barriers, reducing costs and reaching wider markets more efficiently. Such strategic adoption is posited to lead to enhanced profitability and market reach, suggesting that initial investments in digital technologies, while costly, may result in long-term gains by enhancing customer outreach and service innovation (DeYoung, 2005; Akhisar et al., 2015).

On the other hand, the Transaction Cost Theory, developed by Williamson (1981) and later expanded by Hicks and Niehans (1983), provides a framework for understanding the adoption of digital strategies to reduce transaction costs associated with economic exchanges. This theory argues that digital platforms significantly lower the costs of transactions, facilitating a more distributed model of financial services that can reach underserved or inaccessible populations. By reducing traditional barriers such as high service fees and extensive documentation, digital strategies enable financial institutions to offer more efficient and inclusive services, thereby broadening their customer base and enhancing financial participation (Mishkin & Strahan, 1999; Jack & Suri, 2014).

Integrating these theories, this study hypothesizes that DFI technologies not only streamline operations but also strategically position banks to better manage risks and engage customers. The reduction in transaction costs and the strategic overcoming of operational constraints together enable banks to offer more accessible, efficient, and diverse services. Thus, DFI is viewed as a transformative strategy that not only meets the immediate financial needs of individuals but also enhances the overall profitability and sustainability of banks in developing countries.

## 2.2 Review of Empirical Literature

The empirical literature on DFI reveals a nuanced understanding of how digital innovations in the banking sector can influence bank performance, particularly in developing countries. Research indicates that technological innovations within the banking industry, such as internet banking, mobile financial services, and automated teller machines (ATMs), are pivotal in reaching untapped markets and enhancing financial performance (Eljelly, 2013; Demircuc-Kunt & Huizinga, 2010). These innovations not only improve the accessibility of financial products and services but also increase the efficiency, profitability, and stability of banking institutions.

Studies like those by Zins and Weill (2016) and Aker et al. (2016) specifically highlight the positive correlation between mobile banking usage and key performance metrics such as return on assets (ROA). These studies underline the significant role DFI plays in enhancing performance metrics by facilitating increased deposits and lowering transaction costs. On the technological front, El-Charani & El-Ebiad (2018) demonstrated that investments in digital innovations like internet banking and ATMs significantly boosted the performance of Lebanese banks, though the impacts of mobile banking were less pronounced.

Despite these positive findings, the empirical literature reveals gaps, particularly in comprehensive understanding how DFI directly affects bank profitability in developing contexts. Most studies have focused on stability and risk management, with less attention given to how DFI could specifically enhance profitability through operational efficiencies and market expansion (Dong et al., 2020; Banna et al., 2021). This study aims to fill this gap by developing testable hypotheses that examine the direct effects of DFI on bank profitability. By extending the investigation beyond stability to include profitability, this research seeks to provide a more holistic view of the benefits that DFI can offer to banks in developing countries, thereby contributing to the broader discourse on FI and economic growth.

## 2.3 Research Hypothesis

The significance of DFI in enhancing bank performance has become increasingly evident, especially in the wake of global financial disruptions such as the 2008 crisis and more recently, the COVID-19 pandemic. These events have catalyzed banks to reassess and intensify their digital strategies to not only keep up with competitive pressures but also to improve their financial performance. By integrating DFS, banks are able to facilitate information sharing, reduce transaction costs, and extend the reach of their financial services, consequently boosting transaction volumes and broadening customer access to financial resources (Yang & Zhang, 2020).

Banks are adopting innovative technologies as part of their strategic response to market demands and competitive challenges, leveraging new platforms and processes to enhance the efficiency and effectiveness of their operations. This shift towards DFI not only supports the inclusion of previously unbanked populations but also enhances profitability and operational efficiency by enabling economies of scale and reducing costs. The existing empirical and theoretical literature underscores a strong link between the level of DFI implementation and improved bank performance, suggesting that DFI can significantly contribute to profitability in banking institutions. Thus, this study proposes to explore how DFI impacts bank profitability, hypothesizing that greater integration of DFI leads to improved financial performance in this dimension. Given the theoretical underpinnings and limited empirical evidence, the following hypotheses are proposed for the study:

**Hypothesis: DFI has a positive impact on bank profitability.**

This hypothesis will be tested using robust statistical techniques, and the results will contribute to the growing body of knowledge on the impact of DFI on bank profitability, particularly in the context of developing countries.

## 3. Method

### 3.1 Model Specification

To investigate the impact of DFI on bank profitability, the following baseline regression analysis is used:

$$Y_{ijt} = \beta_0 + \beta_1 Y_{ijt-1} + \beta_2 DFI_{jt} + \beta_3 X_{ijt} + \beta_4 Z_{jt} + \varepsilon_{ijt} \quad (1)$$

Where,  $Y_{ijt}$  is the proxy for the bank profitability of bank  $i$  of country  $j$  in year  $t$  which is the Return on Asset (ROA).  $Y_{ijt-1}$  indicates a one-year lag value of profitability to make the model dynamic.  $DFI_{jt}$  refers to the DFI index, whereas  $X_{ijt}$  refers to the bank-specific control variables of bank  $i$  of country  $j$  in year  $t$  (such as LSIZE, LCAP, LAQ, and LLIQ); and  $Z_{jt}$  refers to the macroeconomic control variables of country  $j$  in year  $t$  (such as RGDPG and INF).  $\beta_1 - \beta_8$  refers to the coefficients of the variables. Specifically,  $\beta_2$  is the corresponding regression coefficient, representing the marginal effect of DFI on bank profitability.  $\beta_0$  is a constant, and  $\varepsilon_{ijt}$  is an error term comprised of the unobserved bank-specific effect,  $v_{ijt}$ , and the idiosyncratic error,  $u_{ijt}$ , which is assumed to be independent and identically distributed. The full specification of the estimated model 1 is represented in Equation 2-4. The model adds a one-year lag of dependent variables as a determinant of profitability to specify the dynamic nature of the model because the profitability of a bank tends to persist over time (Goddard et al. 2011), which reflects the informational capacity, impediments to competition

in the market and sensitivity to macroeconomic or regional shocks to the extent that these are serially correlated (Berger et al. 2000).

To investigate the impact of DFI on bank profitability, the regression analysis of this model is based on three DFI indices. Firstly, it considers a comprehensive DFI index (as per Equation 2), and then, it takes into account two sub-indices of DFI, namely ACCESS (as per Equation 3) and USAGE (as per Equation 3).

Hence, the full specification of the estimated model 1 is represented in Equation 2-4:

$$ROA_{ijt} = \beta_0 + \beta_1 ROA_{ijt-1} + \beta_2 DFIA_{jt} + \beta_3 LSIZE_{ijt} + \beta_4 LCAP_{ijt} + \beta_5 LAQ_{ijt} + \beta_6 LLIQ_{ijt} + \beta_7 RGDPG_{jt} + \beta_8 INF_{jt} + \varepsilon_{ijt} \quad (2)$$

$$ROA_{ijt} = \beta_0 + \beta_1 ROA_{ijt-1} + \beta_2 DFIS_{jt} + \beta_3 LSIZE_{ijt} + \beta_4 LCAP_{ijt} + \beta_5 LAQ_{ijt} + \beta_6 LLIQ_{ijt} + \beta_7 RGDPG_{jt} + \beta_8 INF_{jt} + \varepsilon_{ijt} \quad (3)$$

$$ROA_{ijt} = \beta_0 + \beta_1 ROA_{ijt-1} + \beta_2 DFID_{jt} + \beta_3 LSIZE_{ijt} + \beta_4 LCAP_{ijt} + \beta_5 LAQ_{ijt} + \beta_6 LLIQ_{ijt} + \beta_7 RGDPG_{jt} + \beta_8 INF_{jt} + \varepsilon_{ijt} \quad (4)$$

This study also explores the relationship between DFI and bank profitability by using individual components of DFI, which are collated in the index. This analysis will give a clearer picture of the relationship between each component of DFI on bank profitability.

### 3.2 Research Method

To ensure a robust analysis, this study employed the novel approach of building a comprehensive DFI index. This index offers a holistic perspective on DFI, factoring in access and usage dimensions, as well as demographic and geographical considerations. In constructing this index, Principal Component Analysis (PCA) was utilized, a statistical procedure renowned for its efficacy in reducing complex data sets into principal components without losing significant information (Jolliffe, 2011). Through the PCA-based DFI index, this study advances the understanding of DFI's scope and its multi-faceted impact on banking operations.

To substantiate the analysis, this research relies on the estimation of a dynamic panel model utilizing two-step system Generalized Method of Moments (GMM) estimators. This sophisticated econometric technique, as advocated by Arellano and Bond (1991), facilitates the management of potential endogeneity problems often associated with dynamic panel data models, thus ensuring reliable estimates. By applying this robust statistical tool, the study delivers consistent results that reveal a positive and substantial direct impact of DFI on bank profitability. These results underscore the importance of well-regulated DFI strategies to enhance bank profitability, thereby reiterating the need for DFI implementation in banking institutions.

### 3.3 Data Proxy Description

To investigate the effects of DFI on bank profitability in the selected countries, this study incorporates proxies for bank profitability, DFI, and other control variables. The following discussion comprehensively describes the variables used in the analysis and their respective measurements and notations.

#### 3.3.1 Bank Profitability Variable

This study considered Return on Asset (ROA) as a proxy for bank profitability following these previous empirical studies that examine the relationship between bank performance and economic growth (Athanasoglou et al., 2008; Liu & Wilson, 2010; Dietrich & Wanzenried, 2011; Chronopoulos et al., 2013; Garcia & Guerreiro, 2016). ROA is employed for bank profitability, as this is a widely used and well-accepted proxy for bank profitability in banking literature. ROA is a general measure of bank profitability that reflects the bank's ability to achieve a return on its sources of funds to generate profits. ROA measures how efficiently a bank manages its asset base, typically funded by equity and loan holders. It is stated as a percentage and is determined by dividing net profit by total assets.

#### 3.3.2 Digital Financial Inclusion Variable

Proxies for DFI are estimated by selecting variables specifically related to digital financial activities, including mobile and internet-based financial services, which can be utilized using electronic devices. A comprehensive DFI index was developed, incorporating various DFI aspects, to evaluate the impact of DFI on bank profitability.

##### 3.3.2.1 The Construction of the DFI Index

To evaluate the impact of DFI on bank profitability, this study develops a comprehensive DFI index consisting of two dimensions: penetration (supply-side, indicating accessibility to digital finance by banks) and utilization (demand side, indicating the use of digital financial products and services) and also incorporating the geographical and demographic outreach of digital financial services. The DFI index in this study offers several benefits over previous measures, providing a detailed view of DFI by incorporating various components related to digital finance and distinguishing between access and usage of digital financial services. This distinction is crucial, as high access to DFS does not necessarily translate to high DFI levels if the services are not utilized.

Ten DFI indicators falling under these categories were considered. Four indicators accounted for the degree of penetration of DFI: (1) the number of Automated teller machines (ATMs) per 1,000 km<sup>2</sup> (ATM\_KM), (2) the number

of Automated teller machines per 100,000 adults (ATM\_AD), (3) the number of mobile money agent outlets: active per 1,000km<sup>2</sup> (MMAO\_KM) and (4) the number of mobile money agent outlets: active per 100,000 adults (MMAO\_AD). For the utilization dimension, this study uses six indicators: (1) the number of mobile and internet banking transactions per 1000 adults (MIBT\_AD), (2) the number of mobile and internet banking transactions (during the reference year, commercial banks) (MIBT\_CB), (3) the value of mobile and internet banking transactions (during the reference year) (% of GDP) (VMIBT), (4) the number of active mobile money accounts per 1,000 adults (MM\_AD), (5) the number of mobile money transactions dealing with financial services (during the reference year) per 1000 adults (MMT\_AD) and (6) the value of mobile money transactions dealing with financial services (during the reference year). The inclusion of drivers of DFI was guided by previous studies and theoretical frameworks (Banna et al., 2021; Khera et al., 2021)

Additionally, apart from using the index as a DFI proxy, the study explores the impact of DFI on bank profitability by breaking down and individually analyzing the components of DFI, allowing a more precise understanding of each element's impact on bank profitability. This detailed analysis can inform policy decisions to enhance DFI implementation.

### 3.3.2.2 Methodology of Constructing the DFI Index

A parametric approach, principal component analysis (PCA), is employed to normalize and aggregate variables in creating this composite index. PCA addresses the correlation between proxies and reveals the data structure, effectively managing multicollinearity issues and over-parameterization (Jolliffe, 2011). It has been used extensively in DFI research, usually by modifying Financial Inclusion Index methodologies, incorporating several DFI variables, and combining all digital finance access and usage components.

The DFI index construction involves a three-stage PCA for each selected country, calculating access and usage sub-indices separately and then combining them to create a comprehensive DFI measure. These indices are then normalized using a global minimum-maximum technique to avoid unnecessary negative values and compared data across indicators. This process mirrors approaches used in other indices, such as the Sustainable Development Goals Index (SDGI) and the Human Development Index (HDI). This DFI index gives a more thorough view of DFI, separating access and usage into two sub-indices, which can provide useful disaggregated information for policy analysis. However, the analysis has limitations due to the lack of extensive time-series data on DFI indicators and a relatively small sample size of nine developing countries. These constraints should be taken into account when interpreting the findings.

### 3.3.3 Control Variables (Bank-specific and Macroeconomic Variables)

In analyzing the study, both bank-specific and macroeconomic variables are controlled to determine their impact on bank profitability. Four key bank-specific characteristics serve as internal determinants: bank size, asset quality, liquidity, and capital adequacy. Each of these variables is log-transformed to provide more robust estimates, even after adjusting for potential publication bias (Bijlsma et al., 2018). Bank size is measured using the natural logarithm of total assets, with larger banks typically expected to exhibit higher profitability due to diversified interest-earning sources and economies of scale, although this relationship may become non-linear as banks grow (Smirlock, 1985; Molyneux & Thornton, 1992). Asset quality, indicated by the ratio of total loans to total assets, reflects income potential and risk, with higher ratios indicating poorer quality and higher risk. Liquidity, measured by the ratio of liquid assets to total assets, shows a bank's ability to meet short-term obligations, where higher liquidity may indicate safety but also lower returns (Bourke, 1989; Molyneux & Thornton, 1992). Capital adequacy is captured by the equity to total assets ratio, suggesting that well-capitalized banks can absorb losses better and face lower bankruptcy costs, thus potentially boosting profitability (Bourke, 1989).

The study also incorporates cross-country heterogeneity by including macroeconomic variables such as the annual real GDP growth rate and inflation rate. The real GDP growth rate reflects economic activity and is expected to positively influence bank profitability as economic expansion boosts demand for banking services (Demirguc-Kunt & Huizinga, 1999; Lee & Kim, 2013). The inflation rate measures the yearly increase in the consumer price index and its impact on bank profitability can vary; anticipated inflation allows banks to adjust interest rates beneficially, potentially enhancing profitability, while unanticipated inflation may erode real earnings (Perry, 1992; Flamini et al., 2009). These macroeconomic factors are crucial for understanding the broader economic influences on bank profitability within different countries.

Table 1. Summary of the variables

	<b>VARIABLES</b>	<b>NOTATION</b>	<b>PROXY</b>
<b>Bank Profitability</b>	Return On Assets	ROA	Net income / Total Assets
<b>Digital Finance Inclusion – supply side</b>	Number of Automated teller machines (ATMs) per 1,000 km <sup>2</sup>	ATM_KM	
	Number of Automated teller machines per 100,000 adults	ATM_AD	
	Number of mobile money agent outlets: active per 1,000km <sup>2</sup>	MMAO_KM	
	Number of mobile money agent outlets: active per 100,000 adults	MMAO_AD	
<b>Digital Finance Inclusion - demand side</b>	Number of mobile and internet banking transactions (during reference year, commercial banks)	MIBT_CB	
	The value of mobile and internet banking transactions (during the reference year) (% of GDP).	VMIBT	
	Number of mobile money transactions dealing with financial services (during the reference year) per 1000 adults	MMT_AD	
	The value of mobile money transactions dealing with financial services (during the reference year) (%of GDP)	VMMT	
<b>Bank-specific variables</b>	Bank size	LSIZE	Ln (Total Assets)
	Capital Adequacy	LCAP	Total Equity / Total Assets
	Asset quality	LAQ	Loans / Total Assets
	Liquidity	LLIQ	Liquid Assets / Total Assets
<b>Macroeconomic variables</b>	Annual real GDP growth rate	RGDPG	Annual real GDP growth rate
	Annual Inflation Rate	INF	Consumer Price Index

### 3.4 Sample selection

This research utilized secondary data from 111 commercial banks across nine developing countries, ranging from lower-middle to upper-middle income categories—specifically Albania, Bangladesh, Botswana, Cameroon, Fiji, Ghana, Mauritius, Rwanda, and Zambia. These middle-income countries were selected as they represent a transitional stage in economic development where the impact of DFI on bank profitability can be more pronounced and observable. Middle-income countries often have emerging financial sectors that are ripe for digital transformation, making them ideal environments to assess the effectiveness and impact of DFI initiatives on bank performance in developing contexts (World Bank, 2023). The data, collected from 2016 to 2020, was used to achieve the study's objectives. The data originated from multiple databases depending on their availability. For instance, DFI data primarily came from the IMF Financial Access Survey (FAS) database, bank-specific data was obtained from the Bureau van Dijk Bank Focus, and macroeconomic variables were sourced from the World Development Indicators (WDI).

## 4. Result and Discussion

### 4.1 Summary Statistics and Correlation Matrix

Table 2 presents descriptive statistics for variables selected in the study. The analysis reveals significant insights about the bank-specific variables and the DFI index among banks in developing nations. Return on Assets (ROA) for the sampled banks averages at 0.0123 with a standard deviation of 0.0165, indicating a moderate level of profit variability across these banks. This variation in profitability could reflect differing operational efficiencies or market conditions within the sampled regions.

Regarding the DFI Index, which measures DFI through penetration and utilization dimensions, it also shows notable diversity. The average DFI Index stands at 0.2472, spanning from a low of 0.0063 to a high of 0.7658, with a standard deviation of 0.1704. This spread suggests significant disparities in digital financial adoption and infrastructure, influenced by varying regulatory frameworks, technological access, and consumer behavior in digital finance across the countries studied.

Table 2. Summary Statistics

Variable	Obs.	Mean	Std. Dev	Min	Max
<b>Bank Profitability</b>					
Return on Asset (ROA)	555	0.0123	0.0165	-0.0800	0.0742
<b>Bank Efficiency</b>					
Cost to Income Ratio (LCIR)	555	4.0158	0.4966	3.1021	10.2989
<b>DFI Index</b>					
DFI Index Overall (DFIA)	45	0.2472	0.1704	0.0063	0.7658
DFI Index Supply-side (DFIS)	45	0.4506	0.2305	0.0149	1
DFI Index Demand-side (DFID)	45	0.1233	0.1146	0.0026	0.5102
<b>DFI Components (Supply-side)</b>					
Number of ATMs per 1,000 km <sup>2</sup>	45	41.8193	68.4982	0.84	224.63
Number of ATMs per 100,000 adults	45	23.3741	18.1523	4.26	54.28
Number of mobile money outlets per 1,000km <sup>2</sup>	45	400.31	444.937	12	1681
Number of mobile money outlets per 100,000 adults	45	861.05	1324.928	2	4592
<b>DFI Components (Demand-side)</b>					
Mobile & internet banking transactions per 1000 adults	45	3021314.6	3211642.96	0	9622243
Mobile & internet banking transactions (per commercial banks)	45	5347.104	9652.5208	57.95	44161.81
Value of mobile & internet banking transactions (% of GDP)	45	110.6924	270.6637	0.31	1081.6
Active mobile money accounts per 1,000 adults	45	369.28	301.421	0	1138
Mobile money transactions dealing with financial services per 1000 adult	45	27915.61	32571.471	60	146383
Value of mobile money transactions dealing with financial services (%of GDP)	45	19.03	29.062	0	144
<b>Bank-specific variables</b>					
Bank size (LSIZE)	555	13.894	1.1692	10.2435	16.7029
Capital Adequacy (LCAP)	555	2.3517	0.4842	-2.2160	3.805
Asset quality (LAQ)	555	3.8425	0.4801	1.6353	4.3983
Liquidity (LLIQ)	555	3.0053	0.7595	0.5000	4.5359
<b>Macroeconomics Variables</b>					
Real GDP growth rate (RGDPG)	555	2.4789	4.5396	15.7650	6.7773
Inflation (INF)	555	5.6812	4.1446	-2.5952	17.8697

#### 4.2 Results and Analysis

The analysis from Table 3, derived from equation models 2-4, confirms the significant influence of DFI on bank profitability. The dynamic nature of bank profitability is substantiated by the significance of the lagged dependent variable in all models, which justifies the use of a dynamic panel estimator over a traditional one. Supporting the findings, the robustness of the regression models is evidenced by successful diagnostic tests including the Hansen test for instrument validity, and the Arellano-Bond tests for autocorrelation, which indicate no second-order serial correlation and affirm the model's specification. The absence of instrument proliferation further validates the approach, ensuring that the results are both reliable and indicative of true underlying patterns.

The coefficients of the main variables, pertaining to the overall DFI index and its sub-indices, consistently indicate a significant positive effect on the ROA. The main findings from the regression analyses confirm that the overall DFI index (DFIA) is positively correlated with ROA, statistically significant at the 1% level. This indicates that a 1% increase in the DFI index is associated with a 1.96% rise in bank profitability. This relationship underscores the pivotal role that a comprehensive framework of DFI plays in expanding banks' market reach and diversifying their customer base, thereby enhancing revenue opportunities (Demirgüç-Kunt et al., 2018).

In terms of the sub-indices, the Supply-side DFI (DFIS) displays a significant positive effect on profitability at the 5% level, emphasizing the benefits of improved financial infrastructure and greater availability of services. This suggests that enhancements in DFS can reduce operational costs and boost service efficiency, thereby elevating bank profitability (Allen et al., 2016). On the other hand, the Demand-side DFI (DFID) exhibits an even stronger positive impact on profitability, significant at the 1% level. This finding highlights the critical role of consumer engagement with DFS, which enhances transaction volumes, customer retention, and balance maintenance—all key drivers of profitability (Ozili, 2018).

The analysis also considers broader banking metrics and economic factors. While bank size shows a positive, albeit insignificant, effect on profitability, metrics like capital adequacy and asset quality demonstrate significant positive impacts. Moreover, economic indicators such as real GDP growth positively correlate with ROA, suggesting that banks tend to perform better in economically thriving environments. Conversely, the effect of inflation on profitability is found to be statistically insignificant.

In conclusion, the detailed examination of DFI's role in enhancing bank profitability reveals that not only is DFI a supportive factor, but it also serves as a central element in driving profitability within banks in developing countries. These insights suggest that embracing comprehensive DFI strategies, which integrate both the supply of and demand for digital financial services, could significantly benefit bank performance. This underscores the need for policies and strategic initiatives that promote an inclusive digital finance ecosystem, enhancing both access to and the quality of financial services in developing regions. This strategic shift towards DFI is poised to deliver substantial returns on profitability for banks engaged in these markets.

Table 3. Regression Coefficients and Parameters from a Two-step System GMM Analysis with Windmeijer Corrected for Standard Errors

<i>Variable</i>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>
<b>L.ROA</b>	0.3424*** (0.0943)	0.2533** (0.0991)	0.3492*** (0.0953)
<b>DFIA</b>	0.0196*** (0.0054)		
<b>DFIS</b>		0.0062** (0.0029)	
<b>DFID</b>			0.0303*** (0.0087)
<b>LSIZE</b>	0.0012 (0.0008)	0.0014* (0.0009)	0.0010 (0.0007)
<b>LCAP</b>	0.0051* (0.0027)	0.0073*** (0.0026)	0.0049* (0.0027)
<b>LAQ</b>	0.0001 (0.0023)	-0.0019 (0.0029)	0.0006 (0.0022)
<b>LLIQ</b>	0.0026** (0.0012)	0.0027* (0.0015)	0.0022* (0.0011)
<b>RGDPG</b>	0.0003*** (0.0000)	0.0002** (0.0001)	0.0003*** (0.0001)
<b>INF</b>	0.0000 (0.0003)	0.0005* (0.0003)	0.0001 (0.0003)
<b>Constant</b>	-0.0341** (0.0162)	-0.0342* (0.0190)	-0.0319** (0.0156)
<b>Arellano-Bond AR(1)</b>	-2.92**	-2.94**	-2.90***
<b>Arellano-Bond AR(2)</b>	1.35	1.27	1.35
<b>Hansen Test</b>	4.56	3.25	4.65

Note(s): Number of instruments = 8, Number of observations = 555, LROA = Lagged of Return on Assets, DFIA = Overall DFI index, DFIS = DFI index (supply-side), DFID = DFI index (demand-side), LSIZE = Log of bank size, LCAP = Log of Capital Adequacy, LAQ = Log of Asset Quality, LLIQ = Log of Liquidity, RGDPG = Real GDP Growth, INF = Inflation. \*, \*\*, \*\*\* denote statistical significance at the 10%, 5% and 1% levels, respectively. Windmeijer Corrected Standard Error is in parentheses.



### 4.3 Disaggregated Analysis by DFI Index

The study further explores the relationship between DFI and bank profitability by examining specific components of the DFI composite index. The disaggregated analysis from Table 6 and 7 provides insights into the impact of specific supply-side and demand-side components of DFI on bank profitability, respectively. These components include ATM availability, mobile money services, and mobile and internet banking, identified as critical determinants of bank profitability in developing countries due to their potential to reach underbanked populations. To conduct this detailed analysis, the main equation (Equation 1) is re-estimated for each of the 10 DFI indicators separately.

The supply-side analysis reveals mixed impacts on bank profitability. The density of ATMs per 1,000 km<sup>2</sup> negatively affects ROA, indicating inefficiencies in less populated areas due to lower usage that does not justify the high maintenance costs (Kumar et al., 2022). Conversely, the ATM density per 100,000 adults shows no significant effect on profitability, suggesting a neutral impact when adjusted for population size. Meanwhile, a significant positive impact on ROA from mobile money agents per 100,000 adults highlights the role of mobile money services in enhancing financial accessibility and stimulating transactions in underserved areas (Muthiora, 2015). However, a high density per km<sup>2</sup> may slightly reduce profitability, potentially indicating market saturation (Donovan, 2012).

Table 4. Two-step System GMM Regression Coefficients and Parameters (DFI components from the supply-side) with Windmeijer Corrected for Standard Errors

Variable	M1	M2	M3	M4
L.ROA	0.2079** (0.0963)	0.2206** (0.1005)	0.3334*** (0.0912)	0.1704 (0.1075)
ATM_KM	-0.101*** (0.0030)			
ATM_AD		-0.0024 (0.0029)		
MMAO_AD			0.0118*** (0.0040)	
MMAO_KM				-0.0066* (0.0038)
LSIZE	0.0026*** (0.0010)	0.0016* (0.0009)	0.0013 (0.0008)	0.0020** (0.0009)
LCAP	0.0077*** (0.0026)	0.0080*** (0.0027)	0.0055* (0.0029)	0.0083*** (0.0026)
LAQ	-0.0024 (0.0027)	-0.0021 (0.0029)	0.0002 (0.0024)	-0.0018 (0.0028)
LLIQ	0.0023* (0.0014)	0.0025 (0.0015)	0.0024** (0.0012)	0.0012 (0.0015)
RGDPG	0.0002*** (0.0001)	0.0002** (0.0001)	0.0002*** (0.0001)	0.0003*** (0.0001)
INF	0.0005* (0.0002)	0.0006* (0.0003)	0.0002 (0.0003)	0.0008*** (0.0003)
Constant	-0.0420* (0.0188)	-0.0323* (0.0196)	-0.0345** (0.0156)	-0.0367* (0.0191)
Arellano-Bond AR(1)	-2.92**	-2.89**	-2.88***	-2.93***
Arellano-Bond AR(2)	1.26	1.25	1.36	1.25
Hansen Test	2.16	2.87	4.33	2.18

Note(s): Number of instruments = 8, Number of observations = 555, LROA = Lagged of Return on Assets, ATM\_KM = Number of ATMs per 1,000 km<sup>2</sup>, ATM\_AD = Number of ATMs per 100,000 adults, MMAO\_AD = Mobile money agent outlets: active per 100,000 adults, MMAO\_KM = Mobile money agent outlets: active per 1,000 km<sup>2</sup>, LSIZE = Log of bank size, LCAP = Log of Capital Adequacy, LAQ = Log of Asset Quality, LLIQ = Log of Liquidity, RGDPG = Real GDP Growth, INF = Inflation. \*, \*\*, \*\*\* denote statistical significance at the 10%, 5% and 1% levels, respectively. Windmeijer Corrected Standard Error is in parentheses.

On the demand side, the results underscore the importance of digital transactions. Mobile and internet banking transactions at commercial banks significantly boost ROA, reflecting efficiency gains and increased fee income from higher transaction volumes. However, the overall value of these transactions as a percentage of GDP has a slight negative impact, likely due to the initial costs of setup and security that outweigh short-term benefits (Demirgüç-Kunt et al., 2018). Meanwhile, the number of active mobile money accounts and transaction volume per 1,000 adults significantly enhance ROA, demonstrating the vital role of mobile money in increasing engagement and financial inclusion, thus boosting profitability through transaction fees and customer retention (Jack & Suri, 2011). Additionally, the value of mobile money transactions as a percentage of GDP shows a robust positive impact, suggesting significant benefits from integrating mobile money into the financial ecosystem (Dupas et al., 2012).

Both analyses of supply and demand components of DFI consistently show positive effects from larger bank size and capital adequacy, reinforcing the notion that well-capitalized banks are more profitable. Favorable economic conditions, indicated by real GDP growth and stable inflation rates, also consistently favor bank profitability, aligning with theories that banks thrive in growing economies (Levine, 2005).

The detailed examination reveals that while traditional infrastructure like ATMs may not significantly boost ROA, digital platforms, particularly mobile money services and internet banking, play critical roles in augmenting bank profitability in developing countries. This underscores the need for a strategic shift towards investing in digital financial services, not only to enhance financial inclusion but also to substantially improve bank profitability.

Table 5. Two-step System GMM Regression Coefficients and Parameters (DFI components from the demand-side) with Windmeijer Corrected for Standard Errors

<i>Variable</i>	<i>M5</i>	<i>M6</i>	<i>M7</i>	<i>M8</i>	<i>M9</i>	<i>M10</i>
<b>L.ROA</b>	0.2636*** (0.0986)	0.2112** (0.1003)	0.2294** (0.0977)	0.2713*** (0.0914)	0.3524*** (0.0937)	0.3469*** (0.1027)
<b>MIBT_CB</b>	0.1513** (0.0679)					
<b>MIBT_AD</b>		0.0112 (0.0140)				
<b>VMIBT</b>			-0.0055* (0.0021)			
<b>MMA_AD</b>				0.0101*** (0.0027)		
<b>MMT_AD</b>					0.0213*** (0.0065)	
<b>VMMT</b>						0.0147*** (0.0046)
<b>LSIZE</b>	0.0012 (0.0008)	0.0016* (0.0009)	0.0018* (0.0009)	0.0017** (0.0008)	0.0010 (0.0007)	0.0009 (0.0008)
<b>LCAP</b>	0.0074*** (0.0026)	0.0081*** (0.0027)	0.0079*** (0.0027)	0.0063*** (0.0024)	0.0049* (0.0027)	0.0049* (0.0029)
<b>LAQ</b>	-0.0015 (0.0027)	-0.0022 (0.0029)	-0.0026 (0.0029)	-0.0012 (0.0024)	0.0006 (0.0022)	0.0009 (0.0023)
<b>LLIQ</b>	0.0022 (0.0014)	0.0022 (0.0015)	0.0026* (0.0015)	0.0022* (0.0012)	0.0023** (0.0011)	0.0024* (0.0012)
<b>RGDPG</b>	0.0003*** (0.0001)	0.0003*** (0.0001)	0.0002** (0.0001)	0.0003*** (0.0001)	0.0003*** (0.0001)	0.0003*** (0.0001)
<b>INF</b>	0.0006** (0.0003)	0.0007*** (0.0003)	0.0005** (0.0003)	0.0004 (0.0002)	0.0002 (0.0003)	0.0001 (0.0003)
<b>CONSTANT</b>	-0.0301 (0.0188)	-0.0335* (0.0196)	-0.0340* (0.0197)	-0.0383** (0.0166)	-0.0312** (0.0157)	-0.0294* (0.0167)
<b>Arellano-Bond AR(1)</b>	-2.95***	-2.88***	-2.90***	-2.89***	-2.89***	-2.86***
<b>Arellano-Bond AR(2)</b>	1.31	1.25	1.25	1.24	1.33	1.41
<b>Hansen Test</b>	3.48	2.78	2.97	2.19	4.42	6.24

Note(s): Number of instruments = 8, Number of observations = 555, LROA = Lagged of Return on Assets, MIBT\_CB = Number of mobile & internet banking transactions (during reference yr, commercial banks), MIBT\_AD = Number of mobile and internet banking transactions (during reference yr) per 1,000 adults, VMIBT = Value of mobile and internet banking transactions (during reference yr) (% of GDP), MMA\_AD = Number of active mobile money accounts per 1,000 adults, MMT\_AD = Number of mobile money transactions (during the reference year) per 1,000 adults, VMMT = Value of mobile money transactions (during the reference year) (% of GDP), LSIZE = Log of bank size, LCAP = Log of Capital Adequacy, LAQ = Log of Asset Quality, LLIQ = Log of Liquidity, RGDPG = Real GDP Growth, INF = Inflation. \*\*\*,\*\* denote statistical significance at the 10%, 5% and 1% levels, respectively. Windmeijer Corrected Standard Error is in parentheses.

## 5. Conclusion

This study scrutinizes the impact of DFI on bank profitability across nine countries from 2016 to 2020, affirming that DFI notably enhances profitability. The analysis underlines the crucial role of both supply and demand aspects of DFI in broadening market access, enhancing service efficiency, and elevating customer engagement—factors that collectively contribute to higher profitability in banks within developing nations. The robustness of these findings suggests the imperative for these countries to expand DFI implementation across banking institutions, leveraging features like convenience, affordability, and accessibility, underpinned by robust policies and regulations.

It is recommended that policymakers develop comprehensive DFI strategies to bolster digital financial infrastructure and widen consumer access to digital services. This should include regulatory support for digital banking

innovations, incentives for banks to diversify digital offerings, and efforts to boost digital literacy among consumers. Furthermore, policies should ensure consumer protection and data privacy to maintain trust in digital services. Continuous evaluation of these policies will optimize the benefits of DFI on bank performance. Addressing challenges related to data security and privacy is crucial in the era of financial digitization.

Despite some data limitations, these insights lay a foundation for future research in different regions or through different lenses, such as the effects of COVID-19, varying bank sizes, or stages of country development. Future studies might also consider the quality of digital services to refine the DFI index further and examine the long-term impacts of DFI on broader economic outcomes, thereby providing a fuller picture of its benefits.

### Author Contribution

Author 1: conceptualization, writing original draft, data curation, formal analysis, investigation, methodology.

Author 2: review and editing, supervision, validation

Author 3: review and editing, validation, supervision

Author 4: review and editing, supervision, validation, methodology

### Financial Disclosure

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

### Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

### References

- Akhisar, I., Tunay, K. B., & Tunay, N. (2015). The effects of innovations on bank performance: The case of electronic banking services. *Procedia-Social and Behavioral Sciences*, 195, 369-375.
- Aker, J. C., Boumniel, R., McClelland, A., & Tierney, N. (2016). Payment Mechanisms and Antipoverty Programs: Evidence from a Mobile Money Cash Transfer Experiment in Niger. *Economic Development and Cultural Change*.
- Allen, F., Demirguc-Kunt, A., Klapper, L., & Martinez Peria, M. S. (2016). The foundations of financial inclusion: Understanding ownership and use of formal accounts. *Journal of Financial Intermediation*.
- Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The review of economic studies*, 58(2), 277-297.
- Athanasoglou, P.P., Brissimis, S.N. & Delis, M.D. (2008). Bank-specific, industry specific and macroeconomic determinants of bank profitability. *Journal of International Financial Markets, Institutions & Money*, 18(2), 121-136.
- Banna, H. & Alam, M.R. (2021). Impact of digital financial inclusion on ASEAN banking stability: implications for the post-Covid-19 era. *Studies in Economics and Finance*, 38(2), 504-523.
- Banna, H., Hassan, M.K. & Rashid, M. (2021). Fintech-based financial inclusion and bank risk-taking: Evidence from OIC countries. *Journal of International Finance Markets, Institutions and Money*, 75.
- Beck, T., Demirguc-Kunt, A. (2006). Small and medium-size enterprises: Access to finance as a growth constraint. *Journal of Banking & Finance*, 30(11), 2931-2943.
- Beck, T., Demirguc-Kunt, A. & Honohan, P. (2009). Access to financial services: measurement, impact, and policies. *The World Bank Research Observer*, 24(1), 119-145.
- Beck, T., Senbet, L., & Simbanegavi, W. (2014). Financial Inclusion and Innovation in Africa: An Overview. *Journal of African Economies*, 24(1), i3-i11.
- Berger, A.N., Bonime, S.D, Covitz D.M., & Hancock, D. (2000). Why are bank profits so persistent? The roles of product market competition, informational opacity, and regional/macro-economic shocks. *Journal of Banking & Finance*, 24, 1203-1235.
- Bijlsma, M., Kool, C. & Non, M. (2018). The effect of financial development on economic growth: a meta-analysis. *Applied Economics*, 50(57), 6128-6148.
- Bourke, P. (1989). Concentration and other determinants of bank profitability in Europe, North America and Australia. *Journal of Banking & Finance*, 13(1), 65-79.
- Busch, M. O., Koetter, M., Krause, T., & Tonzer, L. (2017). Broadening the G20 financial inclusion agenda to promote financial stability: The role for regional banking networks. *G20 Insights*, April, 4.
- Chronopoulos, D. K., Liu, H., McMillan, F. J., and Wilson, J. O. S. (2013). The dynamics of US bank profitability. *The European Journal of Finance*, 21(5), 426-443.
- Consultative Group to Assist the Poor (CGAP) (2016). *Fintech and the Future of Banking*. Available at <https://www.cgap.org/topics/collections/fintech-future-of-banking>
- Demirguc-Kunt, A., & Huizinga, H. (1999). Determinants of commercial bank interest margins and profitability: some international evidence. *The World Bank Economic Review*, 13(2), 379-408.

- Demirgüç-Kunt, A. & Huizinga, H. (2010). Bank activity and funding strategies: The impact on risk and returns. *Journal of Financial Economics*, 98(3), 626–650.
- Demirgüç-Kunt, A., Klapper, L., Singer, D. & Ansar, S., & Hess, J. (2018). The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution.
- DeYoung, R. (2005). The Performance of Internet-based Business Models: Evidence from the Banking Industry. *Journal of Business*, 78(3), 893-947.
- Diallo, Y., Kaho, A., & Sever, C. (2022). Financial Inclusion in Niger: Challenges and Opportunities. IMF Selected Issues Paper SIP/2023/007.
- Dietrich, A. & Wanzenried, G. (2011). Determinants of bank profitability before and during the crisis: evidence from Switzerland. *Journal of International Financial Markets, Institutions & Money*, 21(3), 307-327.
- Dong, J., Yin, L., Liu, X., Hu, M., Li, X., & Liu, L. (2020). Impact of internet finance on the performance of commercial banks in China. *International Review of Financial Analysis*, 101579.
- Donovan, K. (2012). Mobile Money for Financial Inclusion. In Information and Communications for Development 2012: Maximizing Mobile. World Bank.
- Dupas, P., Green, S., Keats, A., & Robinson, J. (2012). Challenges in Banking the Rural Poor: Evidence from Kenya's Western Province. NBER Working Paper No. 17851. Cambridge, MA: National Bureau of Economic Research. <https://www.nber.org/papers/w17851>
- El-Chaarani, H. & El-Abiad Z. (2018). The Impact of Technological Innovation on Bank Performance. *Journal of Internet Banking and Commerce*, 23(3).
- Eljelly, A. M. A. (2013). Internal and external determinants of profitability of Islamic banks in Sudan: evidence from panel data. *Afro-Asian Journal of Finance and Accounting*, 3(3), 222.
- Flamini, V., McDonald, C. A., & Schumacher, L. B. (2009). *The determinants of commercial bank profitability in Sub-Saharan Africa*. IMF Working Paper No. 09/15.
- Garcia, M.T.M., & Guerreiro, J.P.S.M. (2016). Internal and external determinants of banks' profitability: the Portuguese case. *Journal of Economic Studies*, 43(1), 90-107.
- Goddard, J., Liu, H., Molyneux, P., & Wilson, J. O. S. (2011). The persistence of bank profit. *Journal of Banking & Finance*, 35, 2881–2890.
- Hicks, D. & Niehans J. (1983). Financial innovation, multinational banking and monetary policy. *Journal of banking and Finance*, 537-551.
- Honohan, P. (2008). Cross-country variation in household access to financial services. *Journal of Banking & Finance*, 32(11), 2493–2500.
- Jack, W., & Suri, T. (2011). Mobile money: The economics of M-PESA. NBER working paper, 16721.
- Jack, W. & Suri, T. (2014). Risk Sharing and Transactions Costs: Evidence from Kenya's Mobile Money Revolution. *The American Economic Review*, 104(1), 183223.
- Jolliffe, I. (2011). Principal component analysis. In *International encyclopedia of statistical science* (pp. 1094-1096). Berlin, Heidelberg: Springer.
- Khattak, M. A, Ali, M., Azmi, W., Rizvi, S. A. R. (2023). Digital transformation, diversification and stability: What do we know about banks?. *Economic Analysis and Policy*, 78, 122-132.
- Khera, P., Ng, S., Ogawa, S., & Sahay, R. (2021). *Is Digital Financial Inclusion Unlocking Growth?* IMF Working Paper, WP/21/167
- Kumar, V., Thrikawala, S., & Acharya, S. (2022). Financial inclusion and bank profitability: Evidence from a developed market. *Global Finance Journal*, 53, 100609.
- Lee, J. Y., & Kim, D. (2013). Bank performance and its determinants in Korea. *Japan and the World Economy*, 27, 83–94.
- Levine, R. (2005). Finance and Growth: Theory and Evidence. *Handbook of Economic Growth*, 1, 865–934.
- Liu, H., & Wilson, J.O.S. (2010). The profitability of banks in Japan. *Applied Financial Economics*, 20 (24), 1851–1866.
- Mishkin, F. S., & Strahan, P. E. (1999). What will technology do to financial structure? No. w6892, National Bureau of Economic Research.
- Molyneux, P. & Thornton, J. (1992). Determinants of European bank profitability: A note. *Journal of Banking and Finance*, 16, 1173–1178.
- Muthiora, B. (2015). Enabling Mobile Money Policies in Kenya: Fostering a Digital Financial Revolution. GSMA: Mobile Money for the Unbanked.
- Ozili, P.K. (2018). Impact of digital finance on financial inclusion and stability. *Borsa Istanbul Review*, 18(4), 329-340.
- Perry, P. (1992). Do banks gain or lose from inflation?. *Journal of retail banking*, 14(2), 25-31.
- Shihadeh, F. H., Hannon, A. M. T., Guan, J., Haqul, I. & Wang, X. (2018). Does Financial Inclusion Improve the Banks' Performance? Evidence from Jordan. *Research in Finance*, 117–138.
- Silber, W. L. (1983). The Process of Financial Innovation. *The American Economic Review*, 73, 89-95.
- Smirlock, M. (1985). Evidence on the (Non) Relationship between Concentration and Profitability in Banking. *Journal of Money, Credit and Banking*, 17, 69–83.
- Williamson, O.E. (1981). The Economics of Organization: The Transaction Cost Approach. *The American Journal of Sociology*, 87(3), 548-577.

- World Bank (2015). *Press release: World bank group and a coalition of partners make commitments to accelerate universal financial access*. The World Bank, April 17.
- World Bank (2023). *Digital Progress and Trends Report*. Washington, DC: World Bank. Retrieved from <https://openknowledge.worldbank.org/server/api/core/bitstreams/95fe55e9-f110-4ba8-933f-e65572e05395/content>
- Yang, L., & Zhang, Y. (2020). Digital financial inclusion and sustainable growth of small and micro enterprises—Evidence based on China's new third board market listed companies. *Sustainability*, 12(9), 3733.
- Zins, A., & Weill, L. (2016). The Determinants of Financial Inclusion in Africa. *Review of Development Finance*, 6(1), 46-57.