



**THE IMPACT OF DIGITAL FINANCIAL INCLUSION ON BANKING SECTOR
STABILITY: EVIDENCE FROM DEVELOPING COUNTRIES**

J M R Fernando

K Disanayaka

SLJBF 07.01.03: pp. 51-66

ISSN 2345-9271 (Print)

ISSN 2961-5348 (Online)

DOI: <http://doi.org/10.4038/sljbf.v7i1.53>

Abstract

The research explores the transformative impact of Digital Financial Inclusion on banking sector stability in developing countries, where advanced technologies reshape financial services. With a focus on FinTech, E-wallets, and digital transactions, the study addresses a critical gap in the existing literature by examining the impact of digital Financial Inclusion indicators, such as ATMs and mobile money accounts, on developing countries banking stability. This study contributes valuable knowledge to policymakers and financial professionals in a rapidly evolving digital era. Employing data from 36 developing nations and covering the period of 2011 to 2017, the research establishes a link between digital Financial Inclusion and enhanced banking stability. Z-score is used to measure financial stability, and ATMs and mobile money accounts are used to measure digital financial inclusion, covering the outreach and usage metrics. Macroeconomic variables like gross domestic product and inflation are included to capture broader economic influences on banking stability. A panel regression was used to analyse the data. The study found that digital Financial Inclusion proxies significantly impact the banking sector's stability. The attention for enhancing digital financial services in improving and maintaining the banking sector stability is reconfirmed from this study based on a larger data set of developing countries.

Keywords: Banking Sector Stability, Digital Financial Inclusion, Developing Countries, Mobile Money Account

J M R Fernando

(Corresponding Author)

Department of Finance, University of Kelaniya, Sri Lanka

K Disanayaka

Department of Finance, University of Kelaniya, Sri Lanka

Email: ruwani@kln.ac.lk

Tel: +94 71 4491 024

 <https://orcid.org/0000-0002-1345-4699>

Email: kavindubhanuka126@gmail.com



1. INTRODUCTION

Digital Financial Inclusion (DFI) closely aligns with the concept of financial inclusion, representing the evolutionary stage where the integration of cutting-edge technologies comes into play. This facet of financial inclusion has obtained significant attention on the global stage, as evidenced by extensive discussions in recent years (Ozili, 2018). Digital financial inclusion is the process of providing underserved and unbanked populations with access to financial services through the use of digital technologies, including mobile banking, digital payment platforms, and online financial services (Hannig & Jansen, 2010).

Presently, inventive digital financial services accessible through mobile phones and comparable devices have been introduced in a minimum of 80 nations. (GSMA, 2014). As per the Global Findex index, by 2017, only 18.83 percent of individuals had access to bank accounts via mobile phones in developing countries. However, the index in 2021 reports that due to the impact of COVID-19, about 40 percent of adults in developing economies had used digital payment modes such as mobile banking and card payments and one-third of adults in developing economies made their first direct utility bill payment from an account after the pandemic began. However, digital financial inclusion still needs significant attention due to the gap that exists in global financial inclusion (Pazarbasioglu et al., 2020). Moreover, as per the Global Findex database, the adults who owns a credit cards is around 8 percent in low income economies compared to 43 percent of high income economies, the percentage of adults owns debit cards are 25 percent and 75 percents in low-income and high-income economies, respectively, and adults who use a mobile phone or the internet to make payments, buy things, or to send or receive money using a financial institution is about 34 percent and 70 percent in low-income and high-income economies respectively. Thus, these data imply that there is a considerable gap between DFI in developed and developing economies. However, most developing countries are now improving digital financial services to achieve global financial advancement (Demirgüç-Kunt et al., 2017) over the recent past. Thus, the objective of this study is to examine the effects of DFI on the stability of the banking sector in developing countries given the importance of achieving financial stability due to the rapid technological changes. Furthermore, Pazarbasioglu et al., (2020) reported that a significant portion, 65 percent, of adults in the poorest developing nations still do not have access to a traditional bank account, with merely 20 percent utilizing formal financial institutions for savings. However, considering the importance and the target of achieving SDGs by 2030, many countries have initiated digital financial services around the world, for example, in Sub-Saharan Africa (Chinoda & Kapingura, 2023). Moreover, financial institutions can provide convenient and accessible financial services to those with limited access to traditional banking services by using digital platforms to overcome geographical constraints and reduce the cost of transactions (Hannig & Jansen, 2010). On the other hand, broader digital financial inclusion supports banks in achieving stability (Demirgüç-Kunt et al., 2018; Ahamed & Mallick, 2019). The rationale for conducting the current study rests on the premise that a more extensive embrace of digital financial services holds the potential to act as a catalyst for positive transformations within the financial landscape, ultimately

influencing the path of the banking sector in developing countries. In the context of the banking sector, the impact of digital financial inclusion is significant. DFI enables financial institutions to expand their reach and provide convenient and accessible financial services to underserved populations. By leveraging digital platforms, such as mobile banking, digital payment platforms, and online financial services, banks can overcome geographical constraints and reduce transaction costs, thus enhancing financial access and efficiency.

Several empirical studies have examined the relationship between financial inclusion (FI) and bank stability (Li et al., 2020; Neaime & Gaysset, 2018; Ahamed & Mallick, 2019). Despite the widespread acknowledgement of the significance of DFI, a critical observation emerges from the current literature. The issue has been tested in several regions, such as Sub-African region (Chinoda & Kapingura, 2023), European region (Danisman & Tarazi, 2020), and Asian region (Banna & Alam, 2021). Banna and Alam (2021) examined the effect of DFI on the banking sector stability of ASEAN countries during the post-Covid period by taking seven emerging Asian Countries. Ozili (2018) stressed the importance and challenges of the DFI, and Banna, Hassan and Alam (2020) examined the effect of digital financial inclusion on Islamic banking stability and sustainable economic growth. There are a few studies which have examined the DFI status in emerging and developing countries (for example, Khera et al., 2021); and the nexus between DFI and economic growth (for example, Ahmad, et al., 2021), however, no studies have been conducted to examine the effect of DFI on the banking sector stability based on the developing countries, and thus, the implications of the extant literature cannot be generalized to the developing country context as they possess several different institutional characteristics.

The current study focuses on the effect of DFI on the banking sector stability, particularly in developing countries. Thus, it has extended the scope by selecting developing countries on the basis of financial and technical assistance received from the World Bank to enhance the DFI. Thus, the study provides a much wider scope and view of the impact of DFI on banking sector stability. The current study provides a significant contribution to the banking sector of developing nations as they are in the process of using modern technology to offer financial services. As these countries increasingly adopt digital financial services such as FinTech and E-wallets, the study seeks to comprehend the impact of this shift on the stability of their banking systems.

This study recognizes DFI as a game-changer and emphasizes its capacity to address the changing needs of consumers in an era dominated by digital technologies. This suggests that DFI is not just a passing trend but a deliberate and strategic response to the expectations of a contemporary and technology knowledgeable population. And this seeks to offer tangible insights for policymakers and professionals in the financial sector. Through the application of empirical analysis, the study not only arrives at conclusions but also extends policy recommendations grounded in the identified findings. Section 2 reviews the extant literature on digital financial inclusion and banking sector stability. Section 3 explains the methodology, section 4 presents the analysis and discussions, and section 5 concludes the paper.

2. REVIEW OF LITERATURE

2.1. Theoretical Background

Digital Financial Inclusion refers to financial services conducted remotely in a cashless environment through various electronic devices (Klapper, 2017). Digital technologies should be utilized to broaden access to financial services for underserved populations, especially in developing economies. Thus, several theories help explain and guide efforts in this area. Financial inclusion theory highlights that access to financial services is essential for economic development and poverty alleviation, and digital technologies can significantly reduce barriers to financial inclusion, such as high transaction costs and lack of physical infrastructure (Kling et al., 2022). The technology acceptance model suggests that perceived usefulness and ease of use determine users' acceptance and usage of technology. Thus, financial services providers can focus on designing user-friendly and beneficial digital financial products to enhance acceptance among potential users thereby achieving financial system stability.

2.2. Digital Financial Inclusion

Digital financial inclusion is the process of providing underserved and unbanked populations with access to financial services through the use of digital technologies, including mobile banking, digital payment platforms, and online financial services (Hannig & Jansen, 2010). The adoption of digital financial inclusion has gained increasing recognition for its potential impact on financial inclusion and inclusive economic growth. Manyika et al. (2016) reveal that digital finance has the capacity to provide financial access to 1.6 billion people in emerging economies, with a particular emphasis on empowering women. They further project that widespread adoption and usage of digital finance could lead to a 6% increase in the GDP of emerging economies by 2025, amounting to USD 3.7 trillion. To put this into perspective, this economic growth is equivalent to the size of Germany's economy. The report also suggests that the implementation of digital finance has the potential to generate 95 million new jobs across various sectors worldwide.

Siddik and Kabiraj (2020) demonstrate that the influence of digital finance on financial inclusion (FI) is substantial. They argue that the effective implementation of digital financial inclusion (DFI) has the potential to stimulate sustainable economic growth by eliminating poverty. According to Gomber, Koch and Siering (2017), Digital Financial Services (DFS) encompass cutting-edge financial products, finance-related software, and effective methods of interacting and communicating with customers facilitated by FinTech and other service providers in the financial sector, including prominent entities like BigTech firms. Many countries, including over 80 nations, are embracing digital financial services through mobile phones to bring welfare benefits to their populations (Pénicaud & Katakam, 2019).

Financial innovation, particularly within the banking industry, plays a crucial role in enhancing efficiency and improving services for both banks and the overall financial system (Frame & White, 2004). Banks, among various businesses, are genuinely

interested in innovation to serve their customers better and improve efficiency (Alalwan et al., 2017). ATMs have emerged as a highly accepted innovation that performs vital functions such as deposits, withdrawals, printing mini statements, and bill settlements. Their adoption has reduced operational costs for bank branches (Akhisar et al., 2015). Mobile banking, another strategic change in retail banking, enables customers to access their bank accounts through mobile devices for financial and non-financial transactions (Shaikh & Karjaluo, 2015). Internet banking, facilitated through internet portals, provides customers with a range of banking services, from bill payments to investments (Pikkarainen et al., 2004). Debit cards, linked to checking accounts, offer customers the ability to engage in banking transactions both online and offline (Frame & White, 2004). The attributes of debit cards, including acceptance, security, portability, time costs, and payment features, resemble those of credit cards (Zinman, 2008).

Digital financial inclusion, particularly in the form of electronic banking, has become increasingly important for providing customers, partners, and employees with secure access to information. However, ensuring the security of electronic banking systems remains a challenge. While software and hardware vendors claim to build secure products, it is crucial for e-banking institutions to have assurance regarding the security of these products (Freixas & Rochet, 1998). Independent security evaluations based on internationally established criteria can provide the necessary assurance of vendors' security claims.

The development of new payment methods, such as smart cards and software-based products for online payments, known as electronic money (e-money), has been facilitated by advancements in information technologies (Frame & White, 2004). However, the degree of adoption of these revolutionary e-money systems in the future remains a subject of debate. In the meantime, mixed products and emerging experiences of pure digital cash are being introduced to coexist with traditional payment mechanisms. Theoretical banking literature, as suggested by Bhattacharya and Thakor (1993), highlights the essential role of banks and financial intermediaries in allocating capital within the economy. Financial intermediation theory, focusing on information asymmetries, explains how banks operate in the presence of asymmetric information (Freixas & Rochet, 1998). Asymmetric information leads to adverse selection and moral hazard problems. Adverse selection occurs before a transaction and relates to the lack of information about lenders' characteristics, while moral hazard occurs after a transaction and involves incentives for lenders to behave opportunistically (Freixas & Rochet, 1998).

2.3. Financial Inclusion, Digital Financial Inclusion, and Banking sector stability

The connection between DFI and banking sector stability is limited in the literature and required further investigation. The empirical studies in the area of financial inclusion has focused on the nexus between financial inclusion and; economic growth (for example, Sarma & Pais, 2011), financial stability (for example, Hannig & Jansen, 2010), country-specific practices of financial inclusion (for example, Mitton, 2008), and the role of financial technology (for example, Ozili, 2018). The development of electronic devices then expands the boundary of financial inclusion to digital

financial inclusion. Thus, the scholars have focused on digital financial inclusion by connecting with areas such as, DFI and sustainability (for example, Uzoma et al., 2020), DFI and bank profitability (for example, Ozili (2018), DFI and financial growth (for example, Beck et al., 2014). Further, many studies on the level of DFI in developing countries (for example, Li et al., 2020). Naumenkova et al., 2019) and developed countries (for example, Huang et al., 2021) perspectives.

García and José (2016) highlight the parallel relationship between Financial Inclusion (FI) and financial stability, with financial stability serving as an indicator of banking stability. Beck, Senbet, and Simbanegavi (2014) emphasize that FI should be viewed as a crucial driver of financial growth and stability in the banking sector. Ozili (2018) suggests that the proper application of DFI can increase bank profitability, contributing to financial growth and stability. They highlight the importance of inclusive finance in promoting the stability of financial institutions. Moufakkir and Mohammed (2020) highlight the strong nexus between financial inclusion and DFI, with DFI filling the gaps of traditional financial inclusion through the implementation of technological innovation. They argue that DFI strengthens its functions, contributing to enhanced banking sector performance. These theoretical perspectives shed light on the interplay between FI, DFI, and banking stability.

Several empirical studies have examined the relationship between financial inclusion (FI) and bank stability, highlighting the positive influence of FI on financial sustainability. Li, Wu, and Xiao (2020), in their study of 31 Asian countries from 2004 to 2016, found that FI has a significant positive impact on financial stability. Neaime and Gaysset (2018) demonstrate a close association between FI and bank stability in MENA countries. Ahamed and Mallick (2019) also observe a significant impact of FI on bank stability. These studies provide empirical evidence of the positive relationship between FI and bank stability. A recent study (Banna & Alam, 2021) examined the impact of digital financial inclusion on banking sector stability in Southeast Asian countries and focused particularly on the post-Covid period. Covering both the supply and demand side of DFI, Banna and Alam (2021) used the data relating to a number of mobile money agent outlets, mobile money accounts and mobile and internet banking transactions for the demand side and number of mobile money accounts per 1,000 adults, Number of mobile and internet banking transaction (during reference year) per 1,000 adults and Value of mobile and internet banking transaction have been taken for the supply side. Their findings suggest that DFI increases the stability of the banking sector of ASEAN countries. Compared to the extant literature, the current study focuses on the stability of the DFI and banking sector, particularly from developing countries' perspectives. Although significant attention has been given to promoting digital financial inclusion in several parts of the world, developing countries still lack certain areas of development. For example, financial inclusion is not similar in all countries, where developed countries tend to have a high level of satisfactory financial inclusion. Most of the developing countries fall under the category of low income, and they remain unbanked (Banna and Alam (2021), and they lack the infrastructure facilities to reach the target level of DFI (eg. high-speed internet connection). Moreover, the institutional quality of the developing countries is far below that of the developed countries. Thus, the role of the

governments of these developing countries is massive in promoting ICT platforms to achieve higher levels of DFI. Thus, given the above facts, this study warrants a new perspective on the DFI on the banking sector stability of developing countries.

2.4. Hypotheses Development

Based on the extant literature, a significant impact of financial inclusion on banking sector stability is established. Banna (2020) considered the number of active mobile money agents, the number of active mobile money accounts, and mobile money transactions per 1,000 adults to be the proxies of the DFI. He found a positive and significant association of these variables with bank stability. Banna and Alam (2021) used the same variable and developed an index to examine the effect of DFI on banking sector stability on the basis of DFI access and usage covering the period of post-Covid era. They found that both the access and usage of DFI positively influence the banking sector stability and could reduce the default risk and upturn financial mobility.

Thus, most of the extant literature confirmed DFI's significant and positive effect on banking stability (for example, Banna and Alam, 2021), indicating that digitalized financial services such as debit cards, credit cards, and mobile banking enhance the convenience of banking transactions. Thus, it assumes that due to convenience, people tend to increase their savings, thereby increasing their banking stability. However, there are negative aspects of DFI due to card hacking, card jamming and privacy insecurity. By considering both positive and negative effects, the current study assumes the positive impact of DFI outperforms the negative impact. Thus, the hypotheses of the study are;

H1: The number of ATMs per 1,000 km² has a significant effect on the banking sector stability.

H2: The number of ATMs per 100,000 adults has a significant effect on banking sector stability.

H3: The number of mobile money accounts per 1,000 adults has a significant effect on banking sector stability.

H4: The number of mobile money transactions has a significant effect on banking sector stability.

3. RESEARCH METHODOLOGY

3.1. Population, Sample and Data

The population of this study is based on developing countries that obtained financial and technical assistance from the World Bank Group to promote DFI over the period of 2011-2017. Thus, it includes 36 countries, and the relevant data were drawn from reputable sources such as the Financial Access Survey of the International Monetary Fund, the Global Financial Development Database, and the World Development

inquiry. The normality test helps to determine how likely it is for a random variable underlying the data set to be normally distributed.

Table 1: Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max	Skew.	Kurt.
Bank z-score (BZ)	231	2.671	.488	1.611	3.33	-.739	2.695
Number of ATMs per 1,000 km ² (DFI1)	252	12.495	16.27	.122	52.881	1.34	3.524
Number of ATMs per 100,000 adults (DFI2)	252	15.872	16.453	.721	54.731	1.15	3.126
Number of active mobile money accounts per 1000 adults (DFI3)	252	271.337	324.223	-1.063	1088.987	1.34	3.663
Number of Mobile Money transactions per 1000 adults (DFI4)	196	101.347	152.187	-22.959	518.729	1.673	4.637
Annual GDP Growth (GDP)	252	4.428	3.132	-4.851	14.047	-.049	4.349
Annual Inflation (INF)	244	5.651	3.993	.223	15.49	.858	3.208

4.2. Correlation analysis

Table 2 shows the correlations among the study variables. Accordingly, the banking sector stability (Z-score) with the Number of ATMs per 1,000 km² and Number of ATMs per 100,000 adults show a positive and moderate correlation, suggesting that increases in ATMs per 1000 Km² increase the banking sector stability due to the convenience and the availability of the facility. The correlation between Bank z-score, Number of active mobile money accounts per 1000 adults and Number of Mobile Money transactions per 1000 adults shows a negative moderate correlation, suggesting an inverse relationship between mobile money accounts and mobile money transactions and banking sector stability.

Table 2: Correlation analysis

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) BZ	1.000						
(2) DFI1	0.300	1.000					
(3) DFI2	0.305	0.624	1.000				
(4) DFI3	-0.239	-0.100	-0.039	1.000			
(5) DFI4	-0.227	-0.033	0.064	0.751	1.000		
(6) GDPGR	-0.087	0.058	-0.143	-0.079	-0.040	1.000	
(7) INF	-0.007	-0.202	-0.328	0.113	-0.029	0.050	1.000

Note: Table 3 presents the correlations among BZ= Natural Logarithms of Bank Z score; DFI1= Number of ATMs per 1,000 km²; DFI2= Number of ATMs per 100,000 adults; DFI3=, Number of active mobile money accounts per 1000 adults; DFI4= Number of Mobile Money transactions per 1000 adults; GDPGR= Annual GDP Growth; INF=Annual Inflation

Table 3 presents the results of the Variance inflation factor in measuring the multicollinearity issue. Accordingly, no multicollinearity is found among the independent variables, as the VIF values are less than 10.

Table 3: VIF test results

Variable	VIF	1/VIF
DFI1	4.02	0.249026
DFI2	3.97	0.251917
DFI3	1.90	0.526990
DFI4	1.74	0.575845
GDPGR	1.17	0.851385
INFL	1.07	0.934887

Note: Table 4 presents variance inflation factor results for DFI1=Number of ATMs per 1,000 km²; DFI2= Number of ATMs per 100,000 adults; DFI3= Number of active mobile money accounts per 1000 adults; DFI4= Number of Mobile Money transactions per 1000 adults; GDPGR= Annual GDP Growth; INFL, Annual Inflation.

4.3. Regression Analysis

The regression analysis conducted in this study aims to explain the empirical impact of DFI on the stability of the banking sector. Table 4 provides regression estimates of the equation (1) coefficients, highlighting the impact on the dependent variable when an independent variable undergoes a one-percentage-point change, also shedding light on their standard errors and statistical significance. The model estimation was done using different models: panel fixed effect (Model 1), panel random effect (Model 2), pooled regression (Model 3) and panel with cluster option (Model 4).

As per Table 4, the coefficient for the Number of ATMs per 1,000 km² (DFI1) is estimated at -0.007 with a standard error of 0.004. The t-value is -1.85 with a p-value of 0.066, indicating that the variable is statistically significant at 10% significance level. Similarly, the Number of ATMs per 100,000 adults (DFI2) shows a coefficient of 0.005, a t-value of 0.71, and a p-value of 0.481, suggesting a lack of statistical significance. The number of active mobile money accounts per 1000 adults (DFI3) exhibits a significant association with a coefficient of 0.0002, a t-value of 2.34, and a p-value of 0.021. The number of Mobile Money transactions per 1000 adults (DFI4) has a coefficient of -0.0002 with a p-value of 0.205, indicating a non-significant impact on banking sector stability. Moving to the control variables, GDP growth also lacks statistical significance with a coefficient of 0.005, t-values of 1.60 and p-values of 0.112. However, inflation shows statistical significance with a coefficient of 0.009, t-values of 2.44, and p-values of 0.016. The constant term has a coefficient of 2.561, indicating the expected value of bank stability.

The fixed effect results provide insights into the hypotheses examining the impact of various factors on the natural logarithm of the Bank Z score. The hypothesis suggesting a significant impact from the number of ATMs per 1,000 km² (DFI1) on the Bank Z score (H1) is supported, as the coefficient is negative and statistically significant at the 10% level (p-value = 0.066). However, this result is not consistent

with the initial expectation and is quite like most previous studies by Banna and Alam (2021). And the hypothesis regarding the impact of the number of ATMs per 100,000 adults (DFI2) on the Bank Z score (H2) is not substantiated, with a positive coefficient but a non-significant p-value (0.481).

Conversely, the hypothesis involving the number of mobile money accounts per 1,000 adults (DFI3) (H3) is supported, as the positive coefficient is statistically significant at the 5% level (p-value = 0.021). This result is consistent with the initial expectation and with the previous study by Banna and Alam (2021). However, the hypothesis pertaining to the number of mobile money transactions per 1,000 adults (DFI4) (H4) is not supported, as the negative coefficient lacks statistical significance (p-value = 0.205). In summary, only the variable representing the number of mobile money accounts per 1,000 adults exhibits a significant positive impact on the Bank Z score, while the other variables do not demonstrate statistically significant effects. However, note that Banna and Alam's study utilized only four emerging Southeast Asia countries compared to 36 developing countries on which the current study focused.

As per model 1, the R-squared value of 0.124 suggests that the model explains approximately 12.4% of the variability in BZ, and the F-test p-value of 0.000 indicates that the overall model is statistically significant. The Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) provide measures of model fit, with lower values indicating better fit. In this case, the AIC is -293.314, and the BIC is -271.488.

Table 4: Model Estimation

Bank Z-Score	Model 1	Model 2	Model 3	Model 4
DFI1	-.007* (.004)	-.005 (.004)	.007**(0.003)	-.007*(.004)
DFI2	.005 (.007)	.007 (.006)	.007* (0.004)	.005 (.008)
DFI3	.0002** (.00013)	.0001** (.0008)	-.0001 (.0002)	.0002 (.0001)
DFI4	-.0002 (.0005)	-0.0002 (0.00021)	-.0005 (0.0005)	-.0002 (.0003)
GDPGR	.005 (.003)	.004 (0.0033)	-.01(0.116)	.005(.004)
INFL	.009** (.004)	.009*** (0.003)	.015*(0.009)	.009*(.004)
Constant	2.561*** (.063)	2.517*** (0.116)	2.51*** (0.0977)	2.561*** (.068)
R-squared	0.124	0.117	0.179	0.124
F-test	3.231***	17.008***	5.877***	4.56***
Akaike crit. (AIC)	-293.314		215.282	

Note: This table presents the results of the panel fixed effect model (Model 1), panel random effect (Model 2), Pooled regression (Model 3) and Panel with cluster (Model 4). Where; BZ,=Natural Logarithms of Bank Z score; DFI1= Number of ATMs per 1,000 km²; DFI2= Number of ATMs per 100,000 adults; DFI3= Number of active mobile money accounts per 1000 adults; DFI4=Number of Mobile Money transactions per 1000 adults; GDPGR=Annual GDP Growth; INFL, Annual Inflation. The table reports the coefficients and the standard errors (in parentheses), and*** p<.01, ** p<.05, * p<.1 indicates the significant levels of 1%, 5% and 10% respectively.

The results given in Table 4 for model 2 report the Number of active mobile money accounts per 1000 adult's variable as the only significant variable proxied for DFIs with a r-squared value of 0.117. The number of ATMs per 1,000 km² and the number of ATMs per 100,000 adults are significant under model 3 with an r-squared value of 0.179. Under model 4, the Number of ATMs per 1,000 km² is the only significant variable proxied for DFI with a 0.124 r-squared value. Control variables are significant under each model. Overall, the results suggest that DFI significantly affects the banking sector stability.

5. CONCLUSION

In the realm of contemporary finance, the symbiotic relationship between digital financial inclusion (DFI) and the stability of the banking sector has become a focal point of scholarly exploration. Throughout this research, various significant analyses were conducted to explore the relationship between Digital Financial Inclusion on Banking Sector Stability in Developing Countries over the period from 2011 to 2017. The study employed a fixed panel data model to assess the impact of digital financial inclusion on banking sector stability.

To operationalize study objectives, proxies were employed as analytical tools. The number of ATMs, serving as a traditional financial infrastructure component, was compared against the growing landscape of mobile money accounts and transactions, representative of cutting-edge digital financial services. These proxies aimed to capture the essence of digital financial inclusion and its potential impact on the stability of the banking sector.

One of the noteworthy revelations was the significant positive impact of the number of mobile money accounts per 1,000 adults on the natural logarithm of the Bank Z score. This result highlights the transformative potential of mobile money services in bolstering the stability of banks. The positive correlation suggests that as the prevalence of mobile money accounts increases, so does the stability of the banking sector. This finding aligns with the global trend where mobile money has emerged as a powerful force in financial inclusion, particularly in regions with limited access to traditional banking services. The convenience, accessibility, and versatility of mobile money services seem to have a positive influence on the overall stability of the banking sector.

Importantly, a negative impact from the Number of ATMs per 1,000 km² (DFI1) on the Bank Z-score level is also accepted at a minimum significant level. This scenario prompts an exploration of several potential contributing factors to this less significant yet negative impact. The uneven spatial distribution of ATMs, variations in the quality of digital financial inclusion implementation, and local consumer behaviour favouring traditional banking services are conceivable influences on this outcome.

Financial institutions, on the other hand, need to recalibrate their strategies, recognizing the evolving landscape where digital services play a pivotal role. The non-significant effects observed for ATMs signal the need for a strategic reevaluation of the role and distribution of traditional banking infrastructure. Furthermore, the

study contributes to the ongoing dialogue on the global stage about the significance of digital financial inclusion in achieving broader economic development goals. It underscores the role of digital financial services not only in fostering financial access but also in fortifying the very foundations of the banking sector. This study implies that the necessity of having mass awareness on the digital financial services throughout the country and providing them the hand on experience at the branch level to promote these facilities. The study's findings also warrant exploration of policy implications and regulatory best practices, offering guidance to policymakers in creating an enabling environment for digital financial services.

The study's reliance on a limited set of proxies, namely the number of ATMs, mobile money accounts, and transactions, is indicative of the challenges posed by data unavailability. The inability to incorporate the most current data may limit the study's relevance and applicability to the present financial environment. However, future research endeavors in this domain should strive for more comprehensive datasets, encompassing a broader array of DFI indicators and accounting for the latest developments, to provide a more robust understanding of the evolving dynamics between digital financial inclusion and banking sector stability. Incorporating qualitative research methods, such as interviews and surveys, can delve into user experiences, perceptions, and challenges associated with digital financial services. By embracing these recommendations, future research endeavors can contribute to a more comprehensive and dynamic understanding of the interplay between digital financial inclusion and the stability of the banking sector.

REFERENCES

- Ahamed, M. M., and Mallick, S. K. (2019). Is Financial Inclusion Good For Bank Stability? International evidence. *Journal of Economic Behavior and Organization*, 157(C), 403–427.
- Ahmad, M., Majeed, A., Khan, M. A., Sohaib, M., & Shehzad, K. (2021). Digital Financial Inclusion and Economic Growth: Provincial Data Analysis of China. *China Economic Journal*, 14(3), 291-310.
- Akhisar, I., Tunay, K. B., & Tunay, N. (2015). The Effects of Innovations on Bank Performance: The Case of Electronic Banking Services. *Social and Behavioral Sciences*, 369–375.
- Alalwan, A. A., Dwivedi, Y. K., & Rana, N. P. (2017). Factors Influencing Adoption of Mobile Banking by Jordanian Bank Customers: Extending UTAUT2 with Trust. *International Journal of Information Management*, pp. 99-110
- Banna, H., Hassan, M. K., & Alam, M. R. (2020). Digital Financial Inclusion, Islamic Banking Stability and Sustainable Economic Growth. *Islamic perspective for sustainable financial system*, 131-152.

- 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.
- Bede Uzoma, A., Omankhanlen, A. E., Obindah, G., Arewa, A., & Okoye, L. U. (2020). Digital Finance as a Mechanism for Extending the Boundaries of Financial Inclusion in Sub-Saharan Africa: A General Methods of Moments Approach. *Cogent Arts & Humanities*, 7(1), 1788293.
- Beck, T., Senbet, L., and Simbanegavi, W. (2014). Financial Inclusion and Innovation in Africa: An overview. *Journal of African Economies*, 24(suppl_1), i3–i11.
- Bhattacharya, S., & Thakor, A. (1993). Contemporary Banking Theory. *Journal of Financial Intermediation*, 3, 2-50.
- CGAP. (2015). What is Digital Financial Inclusion and Why Does it matter? Retrieved from <http://www.cgap.org/blog/what-digital-financial-inclusion-and-why-does-it-matter>.
- Chinoda, T., & Kapingura, F. M. (2023). The Impact of Digital Financial Inclusion and Bank Competition on Bank Stability in sub-Saharan Africa. *Economies*, 11(1), 15.
- Danisman, G. O., & Tarazi, A. (2020). Financial Inclusion and Bank Stability: Evidence from Europe. *The European Journal of Finance*, 26(18), 1842-1855.
- Demirgüç-Kunt, A., Klapper, L., Singer, D., Ansar, S., & Hess, J. (2020). The Global Findex Database 2017: Measuring Financial Inclusion and Opportunities to Expand Access to and use of Financial Services. *The World Bank Economic Review*, 34(Supplement_1), S2-S8.
- Frame, W. S., & White, L. J. (2004). Empirical Studies of Financial Innovation: Lots of talk, Little Action? *Journal of Economics Literature*. 42(1), 116-144.
- Freixas, X., & Rochet, J. C. (1998). *Microeconomics of Banking*. MIT Press.
- García, M. J. R., and José, M. (2016). Can financial inclusion and financial stability go hand in hand. *Economic Issues*, 21(2), 81–103.
- Gomber, P., Koch, J.-A., and Siering, M. (2017). Digital Finance and FinTech: Current Research and Future Research Directions. *Journal of Business Economics*, 87(5), 537–580.
- GSMA. (2014) State of the Industry Report on Mobile Financial Services for the Unbanked.

- Hannig, A., & Jansen, S. (2010). Financial Inclusion and Financial Stability: Current Policy Issues. World Bank Policy Research Working Paper, No. 5255.
- Huang, R., Kale, S., Paramati, S. R., & Taghizadeh-Hesary, F. (2021). The Nexus between Financial Inclusion and Economic Development: Comparison of Old and New EU member countries. *Economic Analysis and Policy*, 69, 1-15.
- Khera, P., Ng, S., Ogawa, S., & Sahay, R. (2022). Measuring Digital Financial Inclusion in Emerging Market and Developing Economies: A new index. *Asian Economic Policy Review*, 17(2), 213-230.
- Klapper, L., Singer, D., & Ansar, S. (2018). The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution. World Bank Publications.
- Kling, G., Pesqué-Cela, V., Tian, L., & Luo, D. (2022). A Theory of Financial Inclusion and Income Inequality. *The European Journal of Finance*, 28(1), 137-157.
- Liu, Y., Luan, L., Wu, W., Zhang, Z., & Hsu, Y. (2021). Can digital financial inclusion promote China's economic growth?. *International Review of Financial Analysis*, 78, 101889.
- Li, J., Wu, Y., and Xiao, J. J. (2020). The Impact of Digital Finance on Household Consumption: Evidence from China. *Economic Modelling*, 86(March 2020), 317–326.
- Manyika, J., Lund, S., Singer, M., White, O., and Berry, C. (2016). Digital Finance for all: Powering Inclusive Growth in Emerging Economies. McKinsey Global Institute.
- Mitton, L. (2008). Financial Inclusion in the UK: Review of Policy and Practice. York: Joseph Rowntree Foundation. Retrieved from <https://kar.kent.ac.uk/78253/>
- Moufakkir, M., and Mohammed, Q. (2020). The Nexus between FinTech Adoption and Financial Inclusion. In *Impact of Financial Technology (FinTech) on Islamic Finance and Financial Stability* (pp. 193–209): IGI Global.
- Naumenkova, S., Mishchenko, S., & Dorofeiev, D. (2019). Digital Financial Inclusion: Evidence from Ukraine. *Investment Management & Financial Innovations*, 16(3), 194.
- Neaime, S., and Gaysset, I. (2018). Financial Inclusion and Stability in MENA: Evidence from Poverty and Inequality. *Finance Research Letters*, 24, 230–237.

- Ozili, P. K. (2018). Impact of Digital Finance on Financial Inclusion and Stability. *Borsa Istanbul Review*, 18(4), 329–340.
- Pénicaud, C., and Katakam, A. (2019). State of the Industry 2013: Mobile Financial Services for the Unbanked. *Gates Open Res*, 3, 1–65.
- Pazarbasioglu, C., Mora, A. G., Uttamchandani, M., Natarajan, H., Feyen, E., & Saal, M. (2020). Digital Financial Services. World Bank, 54. <https://pubdocs.worldbank.org/en/230281588169110691/Digital-Financial-Services.pdf>
- Pikkarainen, T., Pikkarainen, K., Karjaluoto, H., & Pahnla, S. (2004). Consumer Acceptance of Online Banking: An Extension of the Technology Acceptance Model. *Internet Research*, 14(2), 224–235.
- Sarma, M., Pais, J. (2011). Financial inclusion and development. *Journal of International Development*. 23 (5), 613–628. <https://doi.org/10.1002/jid.1698>
- Shaikh, A., & Karjaluoto, H. (2015). Mobile Banking Adoption: A Literature Review. *Telematics and Informatics*, 32 (1)
- Siddik, M. N. A., and Kabiraj, S. (2020). Digital Finance for Financial Inclusion and Inclusive Growth in Digital Transformation in Business and Society (pp. 155–168): Springer
- Zinman, J. (2008). Debit or Credit? *Journal of Banking and Finance*, 33(2), 358–366.