# Evaluating the Validity of Digital Financial Inclusion Frameworks in Explaining Bank Stability Across Countries

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**المستخلص**

تقيّم هذه الدراسة صلاحية نظريات الشمول المالي في تفسير استقرار البنوك مع تركيز خاص على الشمول المالي الرقمي. ل١٢٧ دولة رُصِدت في أعوام ٢٠١٤ و٢٠١٧ و٢٠٢١. يُقاس استقرار البنوك بنسبة القروض المتعثرة(NPLs) ، بينما شملت المتغيرات المستقلة: المشاركة الرقمية العامة، المستخدمون غير النشطين/غير الراضين، مشاركة الفئات الضعيفة، والناتج المحلي الإجمالي، الائتمان للقطاع الخاص، ونسبة التعليم الاساسي كمقاييس لنظريات المستفيدين للشمول المالي. تُشير النتائج بشكل متسق إلى أن زيادة الشمول المالي الرقمي — المقاس بحصة البالغين الذين أجروا أو تلقوا مدفوعات رقمية — ترتبط بانخفاض نسبة القروض المتعثرة (تحسُّن الاستقرار)، بينما ترتبط زيادة حصة الحسابات غير النشطة بارتفاع نسبة القروض المتعثرة. كما أن الناتج المحلي الإجمالي ومعدل إتمام التعليم الأساسي ساهم في خفض نسبة القروض المتعثرة؛ أما تأثير الائتمان للقطاع الخاص فكان ضعيفا ويعتمد على النموذج. المتغيرات الدالية الإقليمية وفئات الدخل كانت غير ذات دلالة

إحصائية. تؤكد النتائج صحة الفرضيات الرئيسية لنظريات المستفيدين في سياق رقمي وتبرز أن جودة الشمول المالي لها أثر جوهري على استقرار البنوك. تشمل الدلالات السياسية تشجيع الاستخدام الرقمي النشط، وتعزيز الثقافة المالية والرقمية، ومواءمة الأطر التنظيمية وإدارة المخاطر مع الانتشار السريع للتقنيات المالية للحفاظ على استقرار القطاع المصرفي.

**الكلمات المفتاحية:** الشمول المالي، الشمول المالي الرقمي، الاستقرار المصرفي، الاستقرار المالي، القروض المتعثرة.

## Abstract

This study evaluates the validity of financial inclusion theories in explaining bank stability with an explicit focus on digital financial inclusion (DFI). Using panel data for 127 countries observed in 2014, 2017 and 2021, a fixed-effects panel regression was applied. Bank stability is proxied by non-performing loans (NPLs), while the independent variables included: digital public participation, dissatisfied user, vulnerable groups participation and macro-financial controls (GDP, credit to private sector, education) as proxies for the beneficiary theories of FI. Results consistently show that greater DFI—measured by the share of adults who made or received digital payments—is associated with lower NPLs (improved stability), while a higher share of inactive accounts is associated with higher NPLs. System-level drivers (GDP and primary-education completion) also reduce NPLs; credit-to-private-sector effects are weaker and model-dependent. Regional and income-

group dummies are generally insignificant. Findings validate key propositions of beneficiary theories in a digital context and highlight that the quality of inclusion matters for bank soundness. Policy implications include promoting active digital usage, strengthening financial and digital literacy, and aligning regulation and risk management with rapid fintech adoption to sustain banking stability.

**Key words**: Financial Inclusion (FI), Digital Financial Inclusion (DFI), Bank Stability, Financial Stability, Non-performing Loans (NPL).

## 1- Introduction

According to the World Bank, financial inclusion (FI) is about providing financial services to individuals and businesses in an easy and cost-effective manner. After being a part of the Sustainable Development Goals (SDGs), governments started addressing the issue with special importance for its social and economic benefits (World Bank, 2025). The importance of the concept of (FI) comes from is its substantial effect on different aspects of country related issues, economically and socially. Fi was found to have a substantial effect in increasing savings, reducing income inequality and poverty, increasing employment, improving education and encouraging new firm creation (Ahamed $ Mallick, 2019). The significance of financial inclusion extends beyond mere access to financial services; it is

fundamentally about enabling individuals and communities to improve their economic well-being and contribute to broader economic growth (Hassouba, 2022). FI promotes economic growth through enabling individuals to start businesses depending on funds from other people's savings. It also allows people to save their money safely through gaining trust in the formal system and thus promoting financial stability, which will in turn reduce potential risk a bank might face (Almaleeh, 2020).

Additionally, technology has transformed every aspect of the financial from the type, ato ccessibility and efficiency of financial services. This leads to the concept of Fintech, the integration between finance and technology, as an important dimension of FI that aims at attracting the excluded part of the community into the formal financial system in different countries (Kim et al., 2018). Also, easy accessibility to financial services through such technology has promoted FI greatly through closing the geographic gap that would discourage some from being included in the formal financial system (Chatterjee & Anand, 2017).

On the other hand, the global financial crisis has shed the light on the importance of financial stability and addressing associated risks. As banks are considered the main provider for financial services, their stability encompasses the whole financial system stability (Morgan & Pontines, 2014). This raises the

question of whether FI and bank stability are related, and if digitalizing financial services would affect that relationship.

To be able to righteously address the relationship, the theories of FI will be the starting point as an incorporation between practice and literature to have validation according to a solid base facilitating future predictions and courses of action.

This paper is organized as follows: the second part includes the study literature review discussing the importance and other aspects of FI, Fintech as an integral part of recent studies, banks and their role in the financial system and its stability and the linkage between the two concepts, FI and financial stability. The third part encompasses the methodology and data specification and research variables and statistics. Then the results and discussion come as the fourth part along with conclusions and recommendations.

## 2- Literature Review

One of the primary reasons why financial inclusion is important is its role in reducing poverty and enforcing equality bridging the gap between the rich and the poor through empowering those individuals by giving them the needed tools to be able to manage and maintain their finances, save in a risk-free way and be provided prospect investment opportunities (Mishra

et al., 2024). Through seeking social equality, financial inclusion enforces the participation of all segments of the society like women, rural population, low-income and other marginalized parties to have equal access to financial services. For example, initiatives targeting women has achieved great success in providing them with the appropriate tools to start businesses, manage finances and have investment plans (World Bank, 2025).

Aside from social achievements, financial inclusion has offered a lot economically. As highlighted by the World Economic Forum that financial inclusion would encourage innovation and economic growth (World Economic Forum, 2024). When members of the society are financially included, sufficient funds will be provided to encourage productive investments, this is turn would generate job opportunities and enhance economic activities. MCMEs employ more than 50% of the adult population and through financial support, productivity would be enhanced, risk reduced, innovation encouraged and allow economic growth (World Bank, 20205).

## 2-2 Financial inclusion achievements and challenges:

National Financial Inclusion Strategies have been adopted by more than 60 nations since 2010 as a complement to the sustainable development goals to bring all stakeholders from regulators to policy makers to businesses and governments in all

aspects; agriculture, environment and education to promote FI. Since then, 35% of adult population in low-income countries opened their first financial account as a procedure required by the government to be able to receive their government payments (World Bank, 2025). Another leap towards implementing FI worldwide was when The World Bank collaborated with the G20 to ensure all individuals and businesses have access to affordable and effective financial services to achieve sustainable economic growth.

Despite the progress, significant challenges remain like inactive users, who became inactive due to reasons like lack of trust, high cost and geographical limitations (Ozili, 2020). Financial illiteracy has also affected the ability to fully benefit from FI. Without the appropriate financial education, especially with the digital side of gaining more importance, users will eventually become inactive hindering the benefits of FI socially and economically (Mishra et al., 2024).

Addressing previous challenges requires collaborative efforts from governments, financial institutions and international organizations. Given the facts, regulators and policy makers must address the financial risk issues for smooth implementation and full benefit of FI as an ongoing development process (Thompson, 2023). As was stated in the recent World Bank Global Financial Inclusion and Financial Consumer Protection Survey (2022); a

country must have regulations and supervision over financial users, providers and market conduct.

## 2-3 Financial Inclusion theories:

The gap between practice and literature concerning FI increased the interest of academics to understand and better explain the phenomenon to be able to benefit from its benefits to the fullest (Ozili, 2020). Policy makers and practitioners focus on how to achieve financial inclusion, while academics are more concerned with the relationship between financial inclusion and poverty, income inequality and its overall effect on the economy (Morgan & Pontines, 2014). Theories were then introduced to provide harmony between the two directions by (Ozili, 2020), who clustered them into three categories, Beneficiary, Delivery and Funding theories. The two later theories will be excluded due to insufficient data. Beneficiary theories explains who should benefit from the financial services and divided into 4 subcategories as follows:

- *Public good theory*: states that financial services should be for everyone with no restrictions to specific groups.
- *Dissatisfaction theory*: states that financial services should be targeted to individuals who were in the formal system but are no longer for their dissatisfaction.

- *Vulnerable group theory*: states that financial services should be targeted to vulnerable groups in a society such as poor people, young people, women and the elderly.
- *Systems theory*: states that achieving financial inclusion will be achieved through existing systems (economic, financial and social).

## 2-4 Digital Financial Inclusion (DFS)

Technological advancements have played a vital role in promoting and enhancing FI by overcoming traditional system barriers like lack of physical infrastructure, geographical constraints and high cost through providing them with utmost convenience and low-cost (CFA institute, 2023). That is when the concept of Financial Technology (Fintech) was introduced considering technology as dominating all aspects of life. Fintech advancements are transforming the financial sector at an unprecedent pace, introducing new players, products, and technologies (World Economic Forum, 2024). Fintech innovations have significantly transformed the financial services industry by making financial products and services more accessible, efficient, and user-friendly (Stripe, 2024). It helped promote FI by reaching the financially excluded population (Kampani, 2024). According to one study, the relation between fintech variables and economic growth is found to be positive while the relation with traditional financial inclusion shows a

negative one. At the same time, it shows a positive relation between digital payment usage and ATM density indicating fintech would enhance the performance of traditional systems (Azmeh & Al-Raeei, 2024). Reduced risk of theft in traditional financial services, more economic empowerment and development, eliminating geographical barriers and increasing the speed of transactions, better productivity of MSMEs through easier access to financial services and improving individual resilience through inclusion in the financial system, are all positive outcomes from applying fintech in financial services (Feyen et al., 2023).

Fintech offers numerous benefits like financial inclusion, efficiency, and innovation, but also pose potential risk to bank stability. For example, technology is evolving way faster than existing rules and regulations leading to an era of vagueness and an unknown phase that is hard to predict or cope with (Cevik, 2023). One of the potential risks is concerned with cyber security threats that could harm consumer confidence and financial systems (Ibrahim, 2025). Technology related issues might also impose great risk on the process like glitches and disruption in the system that might cause the loss of data or security breach (World Bank, 2025).

## 2-5 Financial Stability and the role of banking system

Financial stability is key to economic progress because a stable financial system allows an economy to allocate resources effectively, reduce financial risk and absorb financial shocks (Shahriar et al., 2023). According to the European Central Bank, financial stability is the ability of the system to face shocks. A stable economy will have the ability to control prices from sudden fluctuations, keeping employment levels in its normal rate and allocating resources efficiently and effectively (World Bank, 2025). Financial stability is associated with three conditions, which are: being able to hand resources from savers to investors efficiently and effectively; accurate assessment, pricing and management of financial risk; ability to withstand economic shocks easily (Morgan & Pontines, 2014).

The banking sector play the role of intermediation between savers and borrowers in a financial system and that is why its stability reflects on the financial system stability. If banks fail to fulfill their purpose, the economy would be vulnerable to shocks which would in turn affect the banking sector too (Sifrain, 2021). Ensuring the stability of banks is essential for the overall health of the economy, as banks play a pivotal role in financial intermediation and credit allocation (Central Bank of Egypt, 2022). The stability of banks is influenced by various factors,

including capital adequacy, management efficiency, earnings stability, and liquidity (Tran et al., 2022).

## 2-6 Non-performing loans (NPL) to assess bank stability

Non-performing loans are the proportion of a depositor's loan portfolio that is impaired or at risk of default (World Bank,2025). In other words, NPLs are loans that are past due by 90 days or more with some considered bad debts and are unlikely to be paid with no collateral. NPLs are calculated by the ratio of non-performing loans to total gross loans. A high NPL ratio indicates a higher probability of default from the borrower while a low ratio indicates low credit risk to the bank (ECB, 2020). High NPLs would ruin the intermediary function of financial institutions and harm the economy as a whole through affecting trade like what happened during the financial crisis which originated from some distressed borrowers to the world banking system failure. An act of a few months would take years of reform (Shahriar et al., 2023). In the sub-Saharan Africa, NPLs have increased from 6.5% to 12.72% from 2014 to 2020, harming the balance sheet and affecting the banks' ability to provide loans and perform their intermediation role. Bank performance would then be limited and its profitability as well (Chinoda & Kapingura, 2023).

The European Central Bank has set standards that help reduce the risk of NPLs; making the appropriate check before lending, monitor the process of repaying to predict who might default and deal with it early, communicate with distressed borrowers on how to reschedule their loans and ensure proper collateral to reduce loss.

## 2-7 Digital Financial Inclusion and its impact on Bank Stability

The low-cost nature of Fintech and its efficiency in providing financial services can greatly enhance financial inclusion in a way traditional banks cannot. This would also help achieve sustainable development goals and enhance the financial system and economy (Kishor et al., 2024). Banks in the Sub-Saharan African countries have adopted digital solutions for financial services as it helps achieve financial improvements and stability for the whole financial sector. Attracting more depositors would reduce bank costs and risks of funding (Ahamed & Mallick, 2019).

The sub-Saharan African countries were studied to examine the effect of DFI on bank stability represented in bank z-score and NPLs. The results found that DFI positively affects z-score and negatively affects NPLs indicating better stability (Chinoda & Kapingura, 2023).. When Egyptian banks were

studied, a positive relationship was found between Fintech and the rate of return of bank assets and thus better bank performance (Salman, 2021). Financial and digital literacy, access to infrastructure and quality of institutions were found to be key drivers for digital financial inclusion, which expedites economic growth according to a study of developing countries (Khera et al., 2021). This supports the study on Asian emerging countries that concluded the positive effect of DFI on bank stability (Alam & Banna, 2021). This positive relation sometimes might be hindered due to other factors like market risk which was found to moderate that positive influence on financial stability (Risman et al., 2021). DFI also enhances economic development for middle- and high-income countries improving the whole financial sector (Ananzeh et al., 2025). On a larger scale, it was found that DFI enhances banking sector performance in different countries around the world (Murharsito &Muharam, 2022). Another study for the underserved regions found that Fintech has significantly improved financial inclusion which was previously found to enhance bank stability as well (Kampani, 2024).

On the other hand, some studies found different results. A study on the effect of DFI and bank stability of Egyptian banks was found to have a significant relationship but contradicting as well. Some DFI indicators had a positive effect and others had a negative one. According to the study

two reasons might cause such confusing results, the economic conditions of the country and the early stages of implementing such technologies (Ganna et al., 2024). Another study found a positive relation between DFI and bank stability for conventional banks but a negative relation for Islamic banks, which might be due to Shariah compliance. It was also found that financial literacy improves the positive effect in conventional banks but increases the gap in Islamic banks (Banna, 2025). Other contradicting results were found by (Vuong et al., 2024) where DFI was found to weaken bank stability in low developed ones, while enhance it in high developed ones. One study in Ethiopia found that DFI negatively affects financial stability. This might be because of the incompatible development of regulations and risk management processes to align with the rapid progress in Fintech or the resistance of traditional financial bodies for such change (Hordofa, 2024).

## 3- Research Hypotheses:

According to the literature review and the previous studies, the following research hypotheses were developed:

**Hypothesis 1**: "Public Good Beneficiary theory of FI has a significant positive effect on bank stability"

**Hypothesis 2**: "Dissatisfaction Beneficiary theory of financial inclusion has a significant negative effect on bank stability"

**Hypothesis 3**: "Vulnerable Group – females Beneficiary theory of financial inclusion has a significant positive effect on bank stability"

**Hypothesis 4**: "Vulnerable Group – poor Beneficiary theory of financial inclusion has a significant positive effect on bank stability"

**Hypothesis 5**: "Systems – economic Beneficiary theory of financial inclusion has a significant positive effect on bank stability"

**Hypothesis 6**: "Systems – financial Beneficiary theory of financial inclusion has a significant positive effect on bank stability"

**Hypothesis 7**: "Systems – social Beneficiary theory of financial inclusion has a significant positive effect on bank stability"

## Methodology and statistics:
## 4-1 Dataset and variables

Panel cross sectional time series data for 143 countries were gathered from the World Bank, 16 of which were ruled out due to insufficient data. Digital financial inclusion of 127 countries for 2014, 2017 and 2021 as data regarding financial inclusion is gathered every 3 years except for the COVID year, which was postponed to 2021. The study variables are as follows:

1. The Dependent variables: Bank stability (non-performing loans)
2. The Independent variables:

- Public good theory (X1): Made or received digital payment
- Dissatisfaction theory (X2): Has an inactive account (% age 15+)
- Vulnerable group theory (X3 and X4):
  - Made or received digital payment-female (X3)
  - Made or received digital payment-poor (X4)
- Systems theory:
  - Economic (X5): GDP
  - Financial (X6): credit to the private sector by banks % of GDP
  - Social (X7): primary education completion rate

3. Control variables:

- Country income group: low, lower middle, upper middle, high

- Region: Europe & central Asia, east Asia & pacific, Latin America & Caribbean, east and north Africa, south Asia, sub-Saharan Africa, north America

The reason for choosing the NPLs was because it was widely used in previous studies to interpret the soundness of the financial system and data were available for assessment. FI proxies were chosen to grasp the digital aspect. The 2 vulnerable groups, females and poor, were chosen according to the definition of the United Nations and the availability of data.

**4-2 Model estimation**

The general estimating equation of the nonlinear model takes the form of Least Squares Dummy Variables (LSDV) that follows.

$$\mathbf{y}_{tk}^{3} = \alpha_k + \sum_{i=1}^{k} \beta_{ik} \mathbf{x}_{itk} + \lambda_k + \upsilon_{tk}$$

Where t = 1, …., n

k = number of firms in each group.

$\mathbf{y}_{tk}$ = bank z-score, bank NPLs

$\mathbf{X}_{itk}$ = different digital financial inclusion measures for each financial inclusion theory

$\lambda_k$ = Random error term due to the individual effect.

$\upsilon_{tk}$ = Random error.

## 4-3 Statistics

**Table (1): Pearson correlation matrix (NPL)**

| | NPL | X1 | X2 | X3 | X4 | X5 | X6 | X7 |
|---|---|---|---|---|---|---|---|---|
| NPL | 1.000 | | | | | | | |
| X1 | - 0.440*** | 1.000 | | | | | | |
| X2 | 0.557*** | - 0.452*** | 1.000 | | | | | |
| X3 | - 0.450*** | 0.993*** | - 0.448*** | 1.000 | | | | |
| X4 | -0.649*** | 0.987*** | - 0.499*** | 0.984*** | 1.000 | | | |
| X5 | -0.521*** | -0.148*** | 0.075 | -0.146*** | -0.139*** | 1.000 | | |
| X6 | -0.446*** | 0.495*** | -0.088** | 0.482*** | 0.490*** | -0.139*** | 1.000 | |
| X7 | -0.424*** | 0.109** | -0.056 | 0.113** | 0.114** | -0.050 | 0.111** | 1.000 |

Significance: *** p < 0.01, ** p < 0.05, * p < 0.10

Pearson correlation matrix has revealed a significant negative relationship between the dependent variable NPL and the independent variables X1, X3, X4, X5, X6 and X7, while having a positive relationship with X2. It also detected multicollinearity between the independent variables X1, X3 and X4. As a result, 3 models will be created each including one of the correlated variables as follows:

**Model A**: dependent variable Y with independent variables X1, X2, X5, X6 and X7

**Model B**: dependent variable Y with independent variables X2, X3, X5, X6 and X7

**Model C**: dependent variable Y with independent variables X2, X4, X5, X6 and X7

## Table 2: Variance of Inflation (VIF) analysis

| Variable | Model A | Model B | Model C |
|---|---|---|---|
| NPL | 1.0906 | 1.0758 | 1.0758 |
| X1 | 3.5546 | NA | NA |
| X2 | 1.4654 | 1.4961 | 1.5379 |
| X3 | NA | 2.6461 | NA |
| X4 | NA | NA | 2.6989 |
| X5 | 1.1090 | 1.0983 | 1.0983 |
| X6 | 1.7973 | 1.7416 | 1.7453 |
| X7 | 1.0693 | 1.0511 | 1.0504 |

As evident in table 2, after separating the correlated independent, the VIF results were all below 5 indicating no serious multicollinearity (Witten et al., 2021).

**Table 3: Statistical tests results**

| Test | Model A | Model B | Model C |
|---|---|---|---|
| Cross-sections | 127 | 127 | 127 |
| Observations | 254 | 254 | 254 |
| Hausman p-value | 0.0000 | 0.0000 | 0.0000 |
| Pesaran CD | 1.557, p = 0.3203 | 19.557, p = 0.0000 | 20.567, p = 0.0000 |
| Breusch-Godfrey | F=2.083, p=0.1498 | F=3.189, p=0.0749 | F=0.0677, p= 0.7948 |
| Heteroskedasticity | White | ARCH | ARCH |
| Heteroskedasticity | F=1.252, p=0.0688 | F=3.544, p= 0.0605 | F=3.267, p= 0.0715 |
| Ramsey RESET (specification) | F(0.693) = 1.364, p = 0.4058 | F(0.478) = 1.360, p = 0.4897 | F(1.396) = 1.364, p = 0.2382 |

Hausman test results were highly significant with a p-value less than 0.05. Consequently, the null hypothesis was rejected applying the fixed effects for all 3 models.

Pesaran CD was chosen to assess cross section dependence as it is suitable for the dataset of a large N and small T. For Model A the results were insignificant indicating no evidence of to reject the null hypothesis of weak cross-sectional dependence,

while in Models B and C the results are significant indicating evidence of cross section dependence. That is why the focus will be on Model A while tackling Model B and C.

The Breusch-Godfrey Serial Correlation LM test was insignificant failing to reject the null hypothesis showing no sign of serial correlation in residual for all models.

The heteroskedasticity test insignificance show no evidence to reject the null hypothesis showing the existence of homoscedasticity for all models.

The Ramsey Specification Error Test (RESET) insignificance results in accepting the null hypothesis indicating that the regression equations are correctly specified.

**Table 4: Panel Least Squares statistic results**

| Statistic | Model A | Model B | Model C |
|---|---|---|---|
| R-squared | 0.590265 | 0.590238 | 0.590252 |
| Adjusted $R^2$ | 0.562603 | 0.564413 | 0.564428 |
| Prob | 0.000000 | 0.000000 | 0.000000 |

Table 4 show that the 3 models are similar in fit with $R^2$ almost 0.59, indicating that 59% of the change in the dependent variable is explained by the explanatory variables with level of confidence less than 0.01.

**Table 5: Panel Least Squares regression results**

| Model | Model A | | Model B | | Model C | |
|---|---|---|---|---|---|---|
| Variable | Coeffi | Prob. | Coeffi | Prob. | Coeffi | Prob. |
| NPL | 0.57833 | 0.0000 | 0.57835 | 0.0000 | 0.57877 | 0.0000 |
| X1 | -0.04044 | 0.0001 | — | — | — | — |
| X2 | 0.11687 | 0.0000 | 0.11453 | 0.0015 | 0.11986 | 0.0115 |
| X3 | — | — | -0.00198 | 0.0410 | — | — |
| X4 | — | — | — | — | -0.00176 | 0.0041 |
| X5 | -0.08009 | 0.0088 | -0.07948 | 0.0001 | -0.07992 | 0.0084 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **X6** | **-0.06013** | **0.0221** | **-7.21E-0** | **0.9905** | **-0.00018** | **0.9758** |
| **X7** | **-0.04840** | **0.0008** | **-0.04799** | **0.0465** | **-0.04798** | **0.0007** |
| **ECA** | **0.79127** | **0.5986** | **0.78584** | **0.6004** | **0.78819** | **0.5991** |
| **EAP** | **0.27922** | **0.8565** | **0.26174** | **0.8648** | **0.26798** | **0.8615** |
| **LAC** | **-0.02880** | **0.9852** | **-0.03708** | **0.9810** | **-0.01710** | **0.9912** |
| **ENA** | **0.77055** | **0.6247** | **0.75855** | **0.6310** | **0.77578** | **0.6207** |
| **SA** | **1.04785** | **0.5348** | **1.01860** | **0.5462** | **1.03968** | **0.5344** |
| **SSA** | **1.97361** | **0.2096** | **1.92711** | **0.2114** | **1.94157** | **0.2064** |
| **NA** | **1.89182** | **0.2712** | **1.86582** | **0.4301** | **1.85943** | **0.4359** |
| **Low income** | **-0.10890** | **0.9027** | — | — | **1.46735** | **0.5467** |
| **Lower middle** | **0.61631** | **0.3436** | **0.66747** | **0.1128** | **0.68719** | **0.1034** |
| **Upper middle** | **0.34145** | **0.4499** | **0.37244** | **0.3043** | **0.37764** | **0.2995** |
| **High Income** | **0.53301** | **0.2396** | **4.54104** | **0.2316** | — | — |

According to table 5, all 3 models are similar in the autoregressive coefficient (~0.58) implying strong persistence. X2 was positively significant for all models, while X5 and X7 were negatively significant. X5 varied in the negative significance level for Model A and Models B and C at confidence level 95% and 90% respectively. X6 appeared to be negatively significant for Model A and insignificant for Models B and C. The region and income dummies were insignificant across all models. X1, X3 and X4 were negatively significant in their model specification.

## 4- Results and discussion

The results of the regression analysis have proven a significant relationship between bank stability represented in non-performing loans and the study explanatory variables representing the fintech aspect of the financial inclusion theories supporting the findings of (Salma, 2021; Muharsito & Muharam, 2022; Fernando & Disanayaka, 2024).

Independent variables X1 (made or received digital payment) representing the public good theory, X5 (GDP) representing the economic aspect of the systems theory, X6 (credit to the private sector by banks) representing the financial aspect of the systems theory and X7 (primary education completion rate) representing the social aspect of the systems theory all have negative coefficients, while X2 (has an inactive account) representing the dissatisfaction theory has a positive coefficient. This proves that higher digital FI would enhance bank soundness (Boulenfad & Hacini, 2021; Chinoda & Kapingura, 2023; Risman et al., 2021). On the other hand, more dissatisfied users would cause it to deteriorate leaving the banking sector with more risk like (Tshuma et al., 2023), who suggested creating more trust in the financial industry helps achieve DFI and bank stability. According to the World Bank, dissatisfaction may occur for reasons ranging from distrust in the system to financial illiteracy to geographical restrictions. As for the level of GDP or credit to private sector or the level of primary education completion rate all have positive coefficients proving better macroeconomic focus, encouraging private investments through enhancing financial intermediation and increasing the level of education all play a significant role in achieving bank stability and reducing risk, which supports the findings of (Kher et al.,2021; Barik & Pradhan, 2021) about the role of GDP in financial enhancement and (Tshuma et al., 2023;

Banna, 2025), who stated that financial literacy strengthens the positive relation between DFI and bank stability.

The difference in model 2 is that X1 was removed and replaced by X3 due to detected correlation. X3, made or received digital payment-female, represents the vulnerable group theory. The negative coefficient indicates that increasing the participation of women in the financial system would help the banking system achieve inclusion and thus lowering the risk factor as (Yang & Ali, 2024) concluded. Model 3 represents another vulnerable group, which is the poor as X4, made or received digital payment-poor. The negative coefficient also highlights how excluded poor people in the society would benefit the financial system through being digitally included (Cihak et al., 2016).

The results contradict with other studies, for example (Vuong et al., 2024) found that DFI in low financially developed countries damages stability. (Hordofa, 2024) also studied Ethiopia to find the same results. Some of the reasons that might have caused different results are using different proxies for DFI, different targeted group samples and different timelines (Anton & Nucu, 2024; Cihak et al., 2016). Other reasons might be due to the different economic systems or being at an early stage of implementing such technologies (Ganna et al., 2024). (Hordofa, 2024) suggests that incompatible regulations and risk

management with technological advancements or the resistance of the traditional systems might be the cause.

In conclusion, all models studied were able to validate the financial inclusion theories and give the practical area some academic ground that will enable it to be appropriately studied and conclusions driven. The study also highlights the importance of technology and its role in achieving FI. The study recommends that regulators and policy makers should take advantage of the technological break throughs to (1) reach the inactive and vulnerable groups; (2) invest in digital financial literacy and building trust; (3) align regulation and risk assessment for adopted technologies; (4) encourage and facilitate innovation.

## 5- Limitation and future area of research:

The study examined the effect of digital financial inclusion on bank stability to validate the financial inclusion theories. The financial inclusion data provided by the World bank are limited to 4 years which are 2011, 2014, 2017 and 2021 with a lot of missing data especially for the year 2011 forcing the researcher to omit that year and some countries as well. The study depended on only 3 years. Also, the study can be done using a wide variety of proxies to measure each variable that could not all be included in the study.

## References

1. World Bank (2025) 'Financial Inclusion'. Available at: https://www.worldbank.org/en/topic/financialinclusion/overview#:~:text=Financial%20inclusion%20is%20a%20catalyst,supports%20entrepreneurship%20and%20business%20growth (Accessed: 20 August 2025).
2. Ahamed, M. and Mallick, S. (2019) 'Is financial inclusion good for bank stability? International evidence', *Journal of Economic Behavior & Organization,* 157, pp. 403–427.
3. Hassouba, A. (2025) 'Financial inclusion in Egypt: the road ahead', *Review of Economics and Political Science,* 10(2), pp.90–111.
4. Almaleeh, N. (2020) 'Financial Inclusion in Egypt: Does It Affect Banks' Profitability and Liquidity?', *International Finance and Banking*, 7(1), pp. 73-91.
5. Kim, D., Yu, J. and Hassan, M. (2018) 'Financial inclusion and economic growth in OIC countries', *Research in International Business and Finance*, 43, pp.1-14.
6. Chatterjee, A. and Anand, N. (2017) 'Financial Inclusion, Information and Communication Technology Diffusion and Economic Growth: A Panel Data Analysis', Annual Conference on Contemporary Issues in Development Economics. Available at: https://www.researchgate.net/publication/323218542_Financial_Inclusion_Information_and_Communication_Technology_Diffusion_and_Economic_Growth_A_Panel_Data_Analysis (Accessed: 22 August 2025).
7. Morgan, P. and Pontines, V. (2014) Financial Stability and Financial Inclusion. ADBI Working Paper 488. Available at: http://www.adbi.org/working-paper/2014/07/07/6353.financial.stability.inclusion/ (Accessed: 22 August 2025).
8. Mishra, D., Kandpal, V., Agarwal, N. and Srivastava, B. (2024) 'Financial Inclusion and Its Ripple Effects on Socio-Economic

Development: A Comprehensive Review', *Journal of Risk and Financial Management,* 17(3), pp.1–20.

9. World Economic Forum (2024) 'Why financial inclusion is the key to a thriving digital economy', World Economic Forum, 24 July 2024. Available at: https://www.weforum.org/stories/2024/07/why-financial-inclusion-is-the-key-to-a-thriving-digital-economy/ (Accessed: 22 August 2025).
10. Ozili, K. (2020) 'Theories of financial inclusion' (SSRN: https://ssrn.com/abstract=3526548).
11. CFA Institute (2023) 'How fintech is driving financial inclusion', CFA Institute Annual Report 2023. Available at: https://www.cfainstitute.org/sites/default/files/-/media/documents/corporate record/CFA_Annual_Report_2023_FINAL_03-06-23.pdf (Accessed: 22 August 2025).
12. Thompson, V. (2023) 'Financial Inclusion & Financial Literacy: Why Collaborative Efforts for Solving Social Inequality is an Economic and Climate Imperative'. Available at: https://www.linkedin.com/pulse/financial-inclusion-literacy-why-collaborative-efforts-thompson-bnxme (Accessed: 22 August 2025).
13. Stripe (2024) 'What is fintech? A guide to financial technology'. Available at: https://stripe.com/resources/more/what-is-fintech-a-guide-to-financial-technology (Accessed: 22 August 2025).
14. Kampani, R. (2024) 'The role of fintech in enhancing financial inclusion', *IOSR Journal of Economics and Finance*, 15(6), pp.47–49.
15. Azmeh, Ch. and Al-Raeei, M. (2024) 'Exploring the dual relationship between fintech and financial inclusion in developing countries and their impact on economic growth: Supplement or Substitute?, *PLOS One*, 19(12).

16. Feyen, E., Natarajan, H., and Saal, M. (2023) 'Fintech and the Future of Finance: Market and Policy Implications' . World Bank Group. Available at: https://documents1.worldbank.org/curated/en/099450005162250110/pdf/P17300600228b70070914b0b5edf26e2f9f.pdf (Accessed: 22 August 2025).
17. Cevik, S. (2023) 'The Dark Side of the Moon? Fintech and Financial Stability', IMF Working Papper 253. Available at: https://www.google.com/search?q=IMF+working+paper+23%2F253&rlz=1C5CHFA_enEG830EG830&oq=IMF+working+paper+23%2F253&gs_lcrp=EgZjaHJvbWUyBggAEEUYOTIHCAEQIRigATIHCAIQIRigATIHCAMQIRiPAtIBCjE4ODY2ajBqMTWoAgiwAgHxBXDtOIVMVvhL8QVw7TiFTFb4Sw&sourceid=chrome&ie=UTF-8 (Accessed: 22 August 2025).
18. Ibrahim, A. (2025) 'CYBERSECURITY THREATS IN THE FINANCIAL SECTOR: TRENDS AND MITIGATION STRATEGIES', The Seybold REPORT, 20(5).
19. Shahriar, A., Mehzabin, S., Ahmed, Z., Dongul, E., and Azad, M. (2023) 'Bank stability, performance and efficiency: an experience from West Asian countries', *Ranchi journal of management studies, 2*(1), pp. 31-47.
20. Sifrain, R. (2021) 'Determinants of Banking Stability: Evidence from Haiti's Banking System', *Journal of Financial Risk Management*, 10(1), pp.80-99.
21. Central Bank of Egypt (2022) 'FINANCIAL STABILITY REPORT 2022'. Available at: https://www.cbe.org.eg/-/media/project/cbe/page-content/rich-text/financial-stability/english/financial-stability-report-2022.pdf (Accessed: 22 August 2025)

22. Tran, S., Nguyen, D., Nguyen, L. (2022) 'Concentration, capital, and bank stability in emerging and developing countries', *Barsa Istanbul Review, 22*(6), pp. 1251-1259.
23. Chinoda, T. and Kapingura, F. (2023) 'The impact of Digital Financial Inclusion and Bank Competition on Bank Stability in Sub-Saharan Africa', *Economies*, 11(15).
24. Kishor, K., Bansal, S. and Kumar, R. (2024) 'The Role of Fintech in Promoting Financial Inclusion to Achieve Sustainable Development: An Integrated Bibliometric Analysis and Systematic Literature Review', *Journal of the Knowledge Economy*, 16(1), pp.5664-5692.
25. Salman, E. (2021) 'The Impact of FinTech on Financial Performnace and Client's Satisfaction: Evidence from Egyptian banking sector', *Scientific Journal of Research and Business Studies*, 35(4), pp. 47-69.
26. Khera, P., NG, S., Ogawa, S. and Sahay R. (2021) 'Is Digital Financial Inclusion Unlocking Growth?', IMF Working paper, Monetary and Capital Markets Department. Available at: https://www.imf.org/en/Publications/WP/Issues/2021/06/11/Is-Digital-Financial-Inclusion-Unlocking-Growth-460738.
27. Banna, H. and Alam, Md. (2021) 'Is digital financial inclusion good for bank stability and sustainable economic development? Evidence from emerging Asia', ADBI Working paper, Asian Development Bank Institute, Tokyo. Available at: https://www.adb.org/publications/digital-financial-inclusion-good-bank-stability-sustainable-economic-development-asia (Accessed: 22 August 2025).
28. Risman, A., Mulyana, B., Silvatika, B.A. and Sulaeman, A.S. (2021) 'The effect of digital finance on financial stability', *Management Science Letters*, 11, pp. 1980-1984.

29. Ananzeh, I., Khalaf, L. and Khalawi, d. (2025) 'The role of Fintech and financial inclusion in the economic development of countries: A comparative analysis', *Banks and Bank Systems*, 20(1), pp. 248-258.
30. Muharsito, M. and Muharam, H. (2022) 'The effect of digital financial inclusion on bank efficiency', Proceedings of the 2nd International Conference on Research and Development, Indonesia, pp. 1-6. Available at: https://www.researchgate.net/publication/370032007_The_Effect_of_Digital_Financial_Inclusion_on_Bank_Efficiency (Accessed: 22 August 2025).
31. Ganna, M., Shokr, A. and El-Danaf, M. (2024) 'Digital Financial Inclusion and the Banking Sector's Stability during Economic Turbulence: Evidence from Egypt', *Journal of Modern Business Research*, 10(17), pp. 295-317.
32. Banna, H. (2025) 'Digital Financial Inclusion And Bank Stability In a Dual Banking System: Does Financial literacy Matter?, *Journal of Islamic Monetary Economics and Finance*, 11(1), pp. 63-90.
33. Vuong, G., Barky, W. and Nguyen M. (2024) 'Stabilizing the national banking system through digital financial inclusion, creative innovations, and green finance in low-financially developed economies', *Journal of Open Innovation: Technology, Market and Complexity*, 11.
34. Hordofa, D. (2024) 'Impact of digital transformation on financial stability in emerging markets: evidence from Ethiopia', *Discover Sustainability*, 5(309).
35. James, G., Witten, D., Hastie, T. and Tibshirani, R. (2021) 'An Introduction to Statistical Learning: with Applications in R. Springer'. Springer Texts in Statistics. New York. Available at: https://link.springer.com/book/10.1007/978-1-0716-1418-1.
36. Fernando, J. and Disanayaka, K. (2024) 'The Impact of Digital Financial Inclusion on Banking Sector Stability: Evidence from Developing Countries', *Sri Lankan Journal of Banking and Finance*, 7(1), pp. 52-66.

37. Boulenfad, A. and Hacini, I., (2021) 'The relationship between financial inclusion and financial stability – Empirical evidence from the North African countries', *Journal of Financial Accounting and Managerial Studies,* 8(1), pp. 734-751.
38. Tshuma, P., Tshuma, N., Mpofu, S. and Sando, E. (2023) 'An Analysis of the Impact of Digital Financial Inclusion on Financial Stability' *International Journal of Research and Innovation in Social Science,* 7(4), pp. 994-1006.
39. Barik, R. and Pradhan A. (2021) 'Does financial inclusion affect financial stability: Evidence from BRICS nations?', *The Journal of Developing Areas,* 55(1), pp. 341-356.
40. Čihák, M., Mare, D. and Melecky, M. (2016) 'The Nexus of Financial Inclusion and Financial Stability', Policy Research Working Paper, World Bank Group.
41. Yang, J. and Ali, MD. (2024) 'Digital Financial Inclusion and Bank Stability: Insights from Bangladesh'. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4826903.
42. Anton, S., Nucu, A. (2024) 'The impact of digital finance and financial inclusion on banking stability: International evidence', *OECONOMIA COPERNICANA,* 15(2), pp.563-593.
43.
44. Kulshrestha, S. (2023) 'The role of financial technology in enhancing financial literacy and inclusion among low-income households in India', *International Journal of Research in Marketing Management and Sales,* 5(1), pp. 25-30.
45. Harsono, I. and Suprapti, I. (2024) 'The Role of Fintech in Transforming Traditional Financial Services', *Accounting Studies and Tax Journal,* 1(1), pp. 81-91.

46. Awwad, Bahaa (2025) 'Climate Finance and Sustainability: A Story Told Through the Journal of Cleaner Production', *EuroMid Journal of Business and Tech-Innovation*, 4(2), pp. 31-47.
47. Al-Afifi, Ahmed (2025) 'The Impact of Using Artificial Intelligence Applications on Reducing the Default Risk in SMSEs', EuroMid Journal of Business and Tech-Innovation, 4(2), pp. 19-30.
48. Li, X., Tripe, D., Malone, C. and Smith, D. (2020) 'Measuring systemic risk contribution: The leave-one-out z-score method', *Finance Research Letters*, 36.
49. Stewart, R., Chowdhury, M. and Arjoon, V. (2021) 'Bank stability and economic growth: trade-offs or opportunities?', *Empirical Economics*, 61(2), pp.827-853.
50. Chiaramonte, L., Croci, E. and Poli, F. (2015) 'Should we trust Z-score? Evidence from the European Banking Industry', *Global Finance Journal*, 28, pp.111-131.
51. Farid, R. (2020) 'The effect of financial inclusion on Banks' credit risk: perspective from MENA region', Master's Thesis, the American University in Cairo.
52. Jungo, J., Madaleno, M. and Botelho, A. (2022) 'The Effect of Financial Inclusion and Competitiveness on Financial Stability: Why Financial Regulation Matters in Developing Countries?', Journal of Risk and Financial Management, 15(122).
53. Antwi, F., Kong, Y. and Gyimah, N., (2024) 'Financial inclusion, competition and financial stability: New evidence from developing economies', *Heliyon*, 10.
54. Matsebula, V. and Sheefeni, J. (2022) 'An Analysis of the Relationship Between Financial Inclusion and Financial Stability in South Africa', *Global Journal of Economics and Business*, 12(5), pp. 637-648.

55. Rwechungura, K., Kaleshu, J. and Ndiege, B. (2021) ‘Banking inclusion and the stability of commercial banks in Tanzania', *Journal of Co-operative and Business Studies,* 5(1).
56. Oljira, D., Muhammed, Sh. And Ravi, J. (2024) ‘The Effect of Digital Financial Inclusion on Banking Sectors Stability in Ethiopia’, *Journal of Tianjin University Science and Technology,* 57(12), pp. 201-216.
57. Olusegun, T., Evbuomwan, O. and Belonwo, C. (2021)’ Does Financial Inclusion Promote Financial Stability in Nigeria?’, Economic and Financial Review, 59(1), pp. 77-99.