POMS
PERIODICALS OF MANAGEMENT STUDIES

Periodicals of Management Studies
pISSN 2790-8747, eISSN 2790-8755
Volume. 5, Issue 4, 2025

Impact of FinTech Innovation on the Financial Sector's Stability

Sana Riaz
Lecturer, Shaheed Zulfikar Ali Bhutto Institute of Science and Technology
SZABIST University, Gharo Campus Pakistan
sana.riaz@ghr.szabist.edu.pk

Osman Rashdi
Programme Director, Denning Business School
osmanrashdi@gmail.com

Muhammad Asad Ali
Assistant Professor, Faculty of Management Sciences
Shaheed Zulfikar Ali Bhutto Institute of Science and Technology Karachi, Pakistan
dr.asad@szabist.edu.pk

Received: September 2025 **Accepted: November 2025** **Published: December 2025**

Abstract

Financial technology has rapidly influenced financial services by using digital banking, blockchain, and other innovative areas, which ask about its effect on financial stability. This research looks at how using digital banking for financial transactions influences the stability of the banking industry in emerging markets, after taking other key economic trends into account. A panel of 16 countries taking data from 2011–2023 is studied using two separate fixed-effects driscroll and Kraay regressions taking the non-performing loan (NPL) ratio and bank Z-score as indicators of stability as dependent variables. The study finds insignificant impact of Fintech on both proxies of financial stability. Bringing more operations into digital banking (shown by an increase in mobile money transactions) was not linked to a noticeable reduction in risk. On the other hand, traditional elements confirmed the results e.g., When trade is more open and credit is not expanding too fast in the private sector, this is associated with stabilized banks and low NPLs, but excess domestic credit linked to the private sector brings about higher NPLs and indicates risk for banks. The evidence points out that whether FinTech helps or hinders stability varies country to country and also depends on the situation.

Keywords: FinTech innovation, Digital banking, Mobile money transactions, Banking sector risk, Financial sector resilience, Technology-driven finance.

INTRODUCTION

Financial technology (FinTech) is described as technologically innovative financial services that generate new business approaches and user interfaces and functional processes and end products affecting financial sectors and their institutions (Zhao, Li, Yu, Chen, & Lee, 2021). Daud et al. (2021) and Vučinić (2020) claim that in the last ten years the fast evolution of financial services took place because of innovations in FinTech such as digital banking platforms, blockchain networks, cloud computing, big data analytics, and artificial intelligence. The technological advancements seek to enhance financial operations by combining information technology with finance thus enabling cost reduction and service delivery to underserved communities (Yang, 2022). The adoption of digital banking as a banking services delivery method through web and mobile application interfaces has substantially increased the number of people accessing fast

financial services that are convenient to use. The distributed ledger systems known as blockchain have allowed users to access financial products such as cryptocurrencies and smart contracts without needing conventional intermediaries. Many experts have observed the swift growth of Bitcoin alongside blockchain-based assets since 2022 while acknowledging their dual benefits and unknown aspects (Yang 2022). Modern financial technologies create a critical problem regarding their influence on financial industry stability. FinTech technology serves as a foundation for financial service expansion while increasing unbanked client base which advances system stability by introducing service variety (Vučinić, 2020). Research findings indicate that banking system financial stability reduces as the adoption of FinTech grows because banks gain enhanced operating transparency alongside better efficiency and market diversification (Daud et al., 2021). Innovative financial services create competition challenges for established businesses while also compromising banking profitability through excessive risks that result from limited regulatory response (Nguyen & Dang, 2022; Vučinić, 2020). The integration of FinTech innovations into traditional banking operations has been observed competing against traditional banks through peer-to-peer lending services and digital payment providers leading banks to take riskier steps to preserve their profit margins (Nguyen & Dang, 2022). The widespread use of cryptocurrencies and quick deposits to central bank digital currencies may simultaneously remove banks from transactions and decrease banking sector financial stability by reducing liquidity (Sadiq et al. 2023). The academic and industry communities currently face a disagreement about whether FinTech presents risks or opportunities regarding financial stability. A study taking data from 63 countries indicates that higher FinTech adoption rates create positive relationships with stable financial conditions which are measured by banks' Z-scores. The authors explained how FinTech strategies increased business diversification together with information clarity that generated stability benefits which outweighed associated risks (Daud et al., 2021). Another study conducted in developing countries about digital financial services demonstrates that digital inclusion yields stability outcomes. Digital financial inclusion across the ASEAN region at its full development level decreases banking default risks which leads to better banking stability levels (Banna & Alam, 2021). Bank Z-scores indicating lower insolvency risk and NPL ratios showing reduction appeared as digital inclusion indexes rose in Sub-Saharan Africa which demonstrates that financiers running digital inclusion programs achieve stronger stability. The findings show that FinTech promotes bank stability through enhancing efficiency alongside increased access to services which supports the hypothesis that "financial systems with highly inclusive digital financial services tend to enhance bank stability" (Chinoda & Kapingura, 2023). Multiple empirical studies demonstrate the existence of potential negative effects of FinTech on financial stability which becomes noticeable under specific conditions. The fast pace of FinTech development in Vietnam led to financial instability because banks with greater exposure to FinTech operations showed lower Z-scores indicating higher insolvency risk according to Nguyen and Dang (2022). According to Nguyen and Dang (2022), bank destabilization occurred primarily because of weak market discipline which was successfully managed by high levels of transparency and depositor surveillance.

Previous studies suffer from the problem of using generalized composite indices of FinTech with financial inclusion because it prevents researchers from analyzing distinct innovation effects such as digital banking versus blockchain. The analysis combines multiple FinTech technologies into generic development indexes by Daud et al. (2021) and inclusion measures that prevent researchers from discerning which innovations produce stability outcomes. A recent study shows that FinTech supported financial inclusion while avoiding destabilization throughout the pandemic (De Sant'Anna & Figueiredo, 2024), yet this crisis period has only recently come under examination due to digital banking usage soaring at that time. The research lacks consistency with respect to its geographic scope since specific research uses local or regional samples instead of global approaches (Nguyen & Dang, 2022; Chinoda & Kapingura, 2023). A complete evaluation needs to analyze these innovative developments in multiple countries by considering variables such as economic situation together with financial system development.

The study examines FinTech innovation effects on financial stability using digital banking adoption and blockchain adoption as primary independent elements. These prominent components of FinTech receive individual investigation to generate more specific findings regarding their independent influence on standard stability metrics of the financial sector. This research brings importance to existing knowledge gaps through the utilization of a newly constructed panel dataset for 2011 to 2023. Furthermore, it takes into account vital economic variables during analysis. This study's findings will allow financial organizations and regulatory bodies to decide if they should implement digital banking with blockchain technologies because these initiatives will strengthen financial stability or create new system weaknesses.

The research examines the FinTech innovation variables and economic and financial context variables as they relate to financial sector stability through these specific questions. The study investigates predicted relationships originating from previous academic work through questions which analyze how economic strength fosters stability along evaluating the effects of FinTech adoption on stability.

LITERATURE REVIEW

FinTech Innovation and Financial Sector Stability: Theoretical Perspectives

Financial stability indicates how well the financial system composed of banks markets and institutions performs aftershocks and continue to operate and aid the economy. Financial innovation possesses theoretical capabilities to affect stability either favorably or unfavorably. Financial innovation creates positive stability effects because it improves distribution of risks while producing operational and accessibility benefits. The traditional financial framework links new financial products paired with advanced technologies to improved risk distribution along with efficient capital allocation which produces stabilized systems (Daud et al., 2021). Financial sector diversification generated by innovative practices allows banks to diminish their vulnerability to specific market segments thus stabilizing their annual income. The application of AI and big data analytics solutions from FinTech innovation improves credit risk predictions which leads to decreased loan losses and enhances bank financial stability (Zhao, Li, Yu, Chen, & Lee, 2021). Hope for stable deposits through technological financial services (for example mobile banking) will simultaneously reduce informal credit activities creating bigger deposit bases that enhance banking sector stability as Beck et al. (2013), Banna & Alam (2021) and others have proposed.

The negative element of financial innovation consists of increased complexity together with reduced transparency which might result in elevated systemic risk (Daud et al, 2021). New product regulations often have voids which enable market entry and unknown network effects emerge such as the complex derivatives discovered to be destabilizing elements in the 2008 financial collapse. Rapid financial innovation occurs regardless of proper monitoring which results in credit explosions through risky loan platforms or instruments that give credit to higher risk communities. Studies such as Arcand et al. (2015) and other demonstrate financial deepening's negative impact on economic stability at high levels while creating asset bubbles. Fast credit expansion becomes more likely through peer-to-peer lending and algorithmic lending methods which existing regulators lack full understanding of it.

Theory shows that FinTech innovation exists in a contradiction between its advantages and disadvantages rather than providing straightforward predictions. The "strong social and economic potential" of FinTech depends on regulatory progress because an uncoordinated regulatory environment could make technological advancements in financial services unstable according to recent reviews. Policymakers have accepted this financial reconciliation because the Bali Fintech Agenda developed by the IMF and World Bank states explicitly how to achieve sustainable FinTech opportunities along with necessary risk protection. The existing policy consensus demands updated regulations and international cooperation between entities because FinTech innovations must not exceed necessary security measures (Vučinić, 2020).

Empirical Evidence on FinTech, Digital Inclusion, and Stability

Empirical research attempts to answer whether FinTech causes more financial stability than instability throughout the economy. The lack of empirical research on FinTech stability assessment persisted because data about FinTech developments remained scarce according to Daud et al. (2022). According to them, the absence of data on FinTech development hinders researchers from studying the impact of FinTech on financial stability. A shift is observable in academic research as multiple studies adopt new datasets alongside indices to do their work. The text-mining analysis

by Daud et al. (2022) has resulted in a new FinTech Index which provides technological news analysis about AI, blockchain, cloud and data technologies across 63 nations. They employed System GMM estimations for dynamic panels during 2006–2017 which established FinTech innovation produces a beneficial influence on financial stability. The baseline regression of their study showed the FinTech Index bringing positive results at the 1% level which reveals that countries with stronger FinTech development display improved bank Z-scores reflecting less bank default probability.

The research on digital financial inclusion involving research on FinTech core aspects demonstrates that stability increases do occur. Around 213 banks operating within four ASEAN nations reveal that higher Digital Financial Inclusion (DFI) indexes lead to elevated bank stability as measured by Z-scores and reduced NPL ratios (Banna & Alam, 2021). According to them, Digital Financial Inclusion (DFI) allows banks in ASEAN countries to enhance their stability during the COVID-19 pandemic. Banks make stronger through digital inclusion since more depositors join and borrowers participate which distributes financial risks across different channels while increasing stability during cash flow and credit crisis.

Similarly, Chinoda and Kapingura (2023) build a new digital inclusion index through their application of two-step GMM framework to study Sub-Saharan Africa. According to their analysis digital financial inclusion has a positive effect on bank stability where an increase of 1% in their index resulted in 0.161 raise of Z-score and substantial NPL reduction. The study demonstrates that formal inclusion through digital channels decreases the general credit risks and enhances stability. Enhancing inclusion levels provides banks greater profitability and improves their income diversity resulting in increased soundness.

Control Factors: Macroeconomic Environment and Financial Development

The assessment of both FinTech stability and FinTech needs quantitative adjustments for systematic financial and economic influences. Economic growth exists in a strong relationship with stability. A rising GDP with increased incomes creates healthier bank conditions by reducing non-performing loans while boosting service demand to make banks more stable. A research study by Ijaz et al. (2020) shows bank stability functions as a major growth factor among 38 European countries but economic downturns lead to bank fragility. The authors documented bank stability indicators declining during recession periods because macroeconomic conditions affect financial instability. The relationship between GDP per capita (or GDP growth) and financial stability shows a positive association according to existing cross-country research findings. A constant macroeconomic system enables both consumers to pay off their debts and banks to run successfully which directly affects positive Z-scores alongside reduced credit default frequencies.

Traditional economic theory judges low and stable rates of inflation as beneficial for financial stability because they maintain asset market values and debtor loans performable. Although the literature highlighted the domination of low inflation over financial stability through price stabilization before 2008 most scholars had no concern about institutional fragility because price stability had apparently handled itself. The global financial crisis proved wrong this perspective since the downturn happened during a time of minimal inflation. According to Fouejieu (2017) emerging market countries following inflation-targeting strategies did not show superior financial stability versus other countries whereas their targeting central banks demonstrated equal or more financial vulnerabilities. During the crisis authorities discovered that inflation-targeting monetary policy alone neglects developing financial weaknesses and price stability fails to assure stability in the financial system. Very high rates of inflation reduce banks' capital bases through devaluation of real values leading to situations where banking crises can occur. Most empirical evaluations show that excess inflation produces negative stability correlations because macroeconomic failures and underlying banking sector problems arise together. Developing countries normally face banking system instability at times when inflation rates rise sharply or another form of

macroeconomic instability occurs. The stability of a system requires moderate inflation combined with macroprudential policies that reinforce monetary policies

The stability levels of an economy depend on trade openness together with financial openness which represent structural elements. The process of export diversification enables open economies to reach stronger growth outcomes while maintaining stability because trade creates positive long-term effects on financial sector development (Kim et al., 2010). Financial openness through trade allows the market to face exterior market issues such as global economic waves and foreign imports that impact native companies. The mixed evidence related to trade openness shows that research by Kim et al. (2010) proves trade openness leads to financial development in the long run yet demonstrates negative short-run implications during early stages of economic development. Economic stability tends to rise through financial advancement which stems from positive openness effects yet becomes briefly unstable during early openness periods. The Chinese financial sector expanded meaningfully from increased trade and enhanced financial openness throughout the past two decades (Zhang et al., 2015) while registration and other regulatory improvements maintained stability as the industry grew. A study indicated that financial outcome effects from openness depend on income levels and inflation frameworks rendering trade-stability relations either supportive or non-supportive or detrimental across different circumstances (Kim, Lin, & Suen, 2010) (Kim, Lin, & Suen, 2010). We did not come across direct research that links trade openness to financial stability yet we expect this relation to be positive since trade openness generates growth which stabilizes financial systems. The measurement of financial development evaluates how deep financial institutions and markets operate while providing access and effective service to users (private credit/GDP or similar indices). The existence of various funding sources coupled with risk management tools in well-developed financial systems helps to improve stability through shock resistance. The research conducted by Singh and Jha (2023) proves financial stability working together with financial development results in poverty reduction because both variables contribute synergistically to economic success (Singh & Jha, 2023; Singh & Jha, 2023). The research indicates that stable financial environments experience minimal poverty reduction from further development yet unstable financial conditions display higher poverty declines from developmental investments (Singh & Jha, 2023; Singh & Jha, 2023). The observations from this poverty-stricken environment highlight that financial growth normally benefits stability until a saturation point is reached. The financial sector of advanced economies presents strong regulatory controls that deliver stability yet excessive growth of the financial sector beyond GDP (credit booms) nurtures financial instability. The existing literature predicts that the Financial Development Index relates positively to stability because both deep banking structures and well-developed institutions tend to enhance banking system resilience (Daud, Ahmad, Khalid, & Azman-Saini, 2021). Higher private credit-to-GDP rates which serve as financial depth indicators tend to reduce bank risk in world economies after controlling for all other factors unless the credit expansion reaches extreme levels.

All research on FinTech effects should rely on these regulating variables because wealthier nations with low inflation rates and advanced financial markets demonstrate greater stability. The examined studies employ GDP per capita and private credit/GDP as control variables that remain significant in the analyses. Daud et al. (2022) demonstrated through their analysis that GDP per capita had a positive link to stability because it was "highly significant" in their specifications. Proof from their study indicated negative findings when they included the private credit/GDP ratio (excessive credit issuance contributes to higher credit risks). Research findings about the impact of banking sector characteristics show mixed effects between concentration and competition dynamics on financial sector stability (Chinoda & Kapingura, 2023). Excessive competition can bring down margins and stability while competitive forces may support financial stability. Various empirical research findings display changes between contexts and times because of different conditions.

Research Gaps and Justification for This Study

Previous research combined innovations into broad group indices that include the FinTech index and the inclusion index. This approach provides useful results but limits researchers in ascertaining which distinct technology adoption patterns (digital banking against blockchain) cause specific effects. A quantitative panel analysis of financial stability effects from digital banking adoption metrics versus blockchain adoption metrics has not been conducted by any known study thus far. Digital Banking adoption and Blockchain technology adoption serve as distinct separate variables in our research while we incorporate specific proxy metrics suitable for each category. The studies in literature such as one by Nguyen and Dang (2022) stop at financial data from mid-2010s until 2020 at the maximum. The extended research period to 2023 allows us to examine how digital banking stability was impacted by the rapid digitalization that emerged during pandemic restrictions in addition to testing various fintech businesses. The study presents existing findings pertinent to present-day decision-making by executives at various levels of government. Our study encompasses worldwide panel data allowing researchers to verify the reliability of past regional research (ASEAN, SSA, MENA) across a broader scope. The analysis permits investigation into moderation effects which evaluate whether Financial Development Index levels influence how digital banking impacts stability alongside Elgharib's (2024) MENA finding. Such refined details can be analyzed through the rich database availability.
The review shows all researchers agree that FinTech effects depend on official policies as well as institutional frameworks being benign or harmful. The stability advantages of FinTech refer to markets with strong regulation and transparent systems along with healthy competition (e.g. global sample, ASEAN, etc.), yet unregulated or weakly governed environments can generate stability risks (e.g. Vietnam's case). The control variables and fixed effects incorporated into our study work to remove some elements of contextual variation which reveals the basic patterns.

Hypothesis Development

Drawing on the theoretical expectations and empirical evidence reviewed, we propose the following hypotheses regarding the relationships between our variables and financial stability:

H_1 (Digital Banking Adoption): *Greater adoption of digital banking services has a positive impact on financial stability.*

Justification: The literature on inclusion (Banna & Alam, 2021; Chinoda & Kapingura, 2023) demonstrates that higher digital banking adoption leads to expanded financial inclusion bringing more deposits which improves bank Z-scores. The stability level in countries directly correlates with their digital banking penetration rates when other conditions remain equal.

H_2 (GDP per Capita): *Higher GDP per capita is associated with higher financial stability.*

Justification: The literature demonstrates this relationship because wealthier nations possess stronger institutions together with ample resources which stabilize their banking system (Ijaz et al., 2020). The coefficient should be positively sloped because higher GDP per capita levels indicate sounder banks with lower failure risks.

H3 (Inflation): *Higher inflation is associated with lower financial stability.*

Justification: Altered economic stability levels revealed through high inflation rates lead to decreased bank capital value and damaged loan portfolios. Statistical research shows that times of

steady or low inflation demonstrate historically decreased frequency of banking crises yet cannot guarantee this outcome (Fouejieu, 2017). The research suggests that higher inflation rates will correspond to decreased Z-scores plus reduced stability conditions thus establishing a negative connection.

H4 (Trade Openness): *Greater trade openness is associated with higher financial stability.*

Justification: Open economies obtain more stable financial institutions because they receive money from various sources while experiencing market competition that promotes institution quality. According to Kim, Lin, and Suen (2010) open trade systems stimulate enduring economic development that supports stability. Our research suggests a positive relation where trade-to-GDP ratios above 50% should lead to financial sector stability (excluding short-term market fluctuations at the dataset level).

H5 (Financial Development): *A higher Financial Development Index is associated with higher financial stability.*

Justification: Stability in countries emerges from deep financial markets together with strong institutions which enable risk-sharing alongside regulatory tools. Previous studies indicate these variables tend to reinforce one another (Singh & Jha, 2023). A positive link exists when a country maintains robust financial development through multiple sectors (banking and financial markets) its banking stability increases due to lower bank fragility.

METHODOLOGY

Panel data from 2011 to 2023 are used in this study to perform quantitative analysis of the results. Choosing this panel analysis allows us to identify how changes in time and countries influence the use of FinTech, removing any unobserved country specific effects. Researchers can make accurate estimates of causal effects when they use a panel dataset and ways to account for variation and bias among their regressors. Not every country has data available throughout the entire 2011–2023 period which means the data is unbalanced among countries. Research was done wherever complete and reliable information could be found since 2011. The research of current FinTech in the years 2011–2023 began when digital banking, blockchain and other advanced technologies began and goes on to explore the latest FinTech growth seen in 2023. By choosing this time, observations are recent, while at the same time enough points have been measured to allow meaningful comparisons because most FinTech indicators were created after 2011. Since the bank stability indicators had continuous data during the period from 2006 to 2017, the report by Daud et al. (2022) used this window for their study. Each included country has to have both stability data and FinTech measures starting from the year 2011 for the analysis. Data will be drawn from reputable secondary sources as follows:

Financial Stability (Dependent Variable):

We will mainly rely on the banking sector Z-score to check the financial sector's stability. Banks are at higher risk of becoming insolvent if their Z-score is low and this score is formed by profitability, leverage and return volatility. To get the Z-score, take the ROA to Assets ratio, divide that by Assets and Equity divided by Assets and then multiply the result by the standard deviation. Higher Z-score values help banks become more stable since this means they can handle greater losses (Nguyen and Dang 2022). We gather country-level Z-scores from GFDD for the "Bank Z-score (country-level)" variable. The process of producing these scores, according to Ijaz et al. (2020), combines the individual Z-scores for each bank which are then weighted to represent the

total stability of the banking sector. They make it possible to compare analysis from one country to another in a uniform way.

Digital Banking Adoption (Independent Variable):

The study employs Value of mobile money transaction (VMMT) as the primary variable to record digital banking adoption in the region. The number shows how much was transacted via mobile money platforms across all economic activities in a certain country and period of time. It works as a solid sign of how digital money is being used and the number of people using mobile services for money management. Many reports in FinTech and inclusion have turned to Value of Mobile Money Transactions to judge how much individuals interact with digital finance (Demirgüç-Kunt et al., 2022; IMF, 2024).

Even though experts suggest using Principal Component Analysis (PCA) to form composite indices like the DFI Index using many usage and access measures (Banna & Alam, 2021), getting all the same data every year and for many countries is often difficult. Thus, this research chooses a single high-coverage factor called VMMT which is provided yearly in the FAS by the IMF and covers many people.

The VMMT proxy follows the basic idea of digital banking adoption since it tracks the value exchanged in digital channels by underbanked people in developing countries. Besides, using mobile money services for remittances, bills and daily purchases shows how much digital finance is part of life in these countries. This measure can be presented as USD or as a percentage of GDP, mainly depending on how easy it is to compare countries with similar data. When a year value is not provided, the missing data will be filled in either through linear interpolation or nearest-neighbor imputation to make the panel dataset smooth.

Control Variables:

GDP Per Capita: The data comes from the World Bank World Development Indicators (WDI) and it is measured in constant international dollars (PPP) and constant US dollars. GDP per capita in the logarithm development (Ln GDP per capita) format is used in the regression analysis. This method is the most reliable when you want to compare how much money can be spent in different countries. A rise in values should show major meaningful increases in stability.

Inflation: Inflation data is taken from WDI and describes yearly changes in the consumer price index (CPI). By including inflation rate as a factor, the model detects macroeconomic instability and produces as expected, negative results.

Trade Openness: The World Development Indicators give data on the total (Exports + Imports) value as a percentage of each country's GDP. The ratio of (Exports + Imports) to GDP reported by standard trade openness measurement is given as a percentage. Every year, this type of information comes out in official releases. The hypothesis will be tested by this experiment.

Financial Development: Financial development is represented in the study as Domestic Credit to the Private Sector (% of GDP). This measure records how much money members of the private sector receive from financial institutions by way of loans, security purchases and trade credits. Many studies rely on the financial development index because it can be used globally and over time (Beck et al., 2000; World Bank, 2024). Even though composite indices such as the IMF's Financial Development Index include several aspects of financial systems (Sahay et al., 2015; Svirydzenka, 2016), they cannot be used for all countries and years because of incomplete data.

Prior authors have recommended using amount of domestic credit to the private sector as a reliable control variable for analyzing financial development in studies about finance stability and the economy in general (Khan et al., 2001; Levine, 2005). WDI and GFDD provided by the World Bank give the data which supports uniformity of the analysis.

Table 1 represents a list of variables and their measurements with the sources noted in the same way as Nguyen & Dang (2022) did when defining the variables. This assures that all measurements are easily understood.

Table 1: List of Variables used

Variable Type	Variable Name	Definition / Proxy	Expected Relationship	Source
Dependent	Financial Stability	Bank Z-score = (ROA + Equity/Assets) / σROA. Higher Z-score → Lower insolvency risk	–	GFDD (World Bank)
Independent	Digital Banking Adoption	Value of Mobile Money Transactions (VMMT) – Total mobile money transactions per year or as % of GDP	Positive	IMF Financial Access Survey (FAS)
Control	GDP per Capita (Ln GDP)	Natural log of GDP per capita in PPP constant USD	Positive	World Bank (WDI)
Control	Inflation	Annual % change in Consumer Price Index (CPI); may also use high-inflation dummy	Negative	World Bank (WDI)
Control	Trade Openness	(Exports + Imports) / GDP, as a %	Positive (long-run)	World Bank (WDI)
Control	Financial Development	Domestic Credit to Private Sector (% of GDP)	Positive (unless excessive credit)	World Bank (WDI), GFDD

Econometric Model and Estimation Techniques

To analyze the impact of FinTech innovation on financial stability, we will estimate regression models of the general form:

$$Stability_{i,t} = \alpha + \beta_1(lvmmt_{i,t}) + \beta_2(GDPpc_{i,t}) + \beta_4(Infl_{i,t}) + \beta_5(tr_{op_{i,t}}) + \beta_6(dcps_{i,t}) + \mu_i + \lambda_t + \varepsilon_{i,t} \dots (i)$$

Where:
Stability=financial stability measured by Zscore and NPL
vmmt = Value of mobile money transaction
gdppc=GDP per Capita
infl = Inflation
tr op=Trade Openness
dcps=Domestic Credit to Private Sector
Here, i and t are used to represent countries and years and the country effects are shown by μ_i while λ_t takes care of time effects wherever needed for the global shock. The stability assessment will depend on using log of Z-score

Panel FE as the main regression will be used since it handles elements that stay the same throughout time (including the legal environment and culture) when looking at stability. Our variables related to GDP per capita and financial development show a correlation with aspects that differ across countries, so Hausman test should support fixed-effects models as better choices. This analysis allows us to study the effects digital banking has on country-specific financial stability instead of focusing on how it affects countries as a whole group.
Using robust standard errors can make the results more stable, handle differences in variances and account for country-level errors that may happen at the same time. As a result, we can infer things correctly.
The study will mainly cover worldwide data, except when a few extreme cases and small financial systems create unclear results. It is important for us to include advanced and emerging economies along with developing countries, as Fintech affects the whole world. We will interpolate the missing information for a few years on variables, particularly the FinTech index and make sure there is no bias introduced while using dummy indicators when necessary. Even though the setup is uneven, both GMM and FE can help to deal with the problem.

Econometric Method Justification

When there are fixed factors that affect stability, the best way to look at digital banking influence is through fixed-effects linear regression. Because of the regression model, proper assessment of coefficients (β1 and β2) is made possible. The adoption of FinTech and stability in a country may both be influenced by an outside shock which can alter the estimates of FE models.
The presence of multicollinearity among control variables was explored using VIFs, especially for GDP per capita and financial development which seemed to show a strong degree of statistical correlation. In instances when multicollinearity was an issue, the researcher considered using different approaches such as not including or blending related controls. To test for stationarity, Levin, Lin and Chu's (LLC) and Im, Pesaran and Shin's (IPS) panel unit root tests were used since T = 14. It was found that inflation and trade as a share of GDP did not change much and may have shown constant but predictable changes within the range observed. For any variable suspected of having a unit root, either the data was differenced or percentage changes used in the analysis. Overall, the time span was regarded as not too long for most variables to remain stationary while being analyzed.

Panel Regression Specification Checks

We used four panel regression models to make sure our findings were reliable. First, the base model used is Pooled OLS, then the Fixed Effects model takes over, after that the Random Effects model is applied and finally, a Fixed Effects model with Driscoll-Kraay standard errors is introduced to tackle cross-sectional and serial dependence. In this analysis, the Pooled OLS model acts as a base and the FE and RE models take into account differences between countries that cannot be observed.
Based on the results of the Hausman test, the Fixed Effects model was considered preferable since it showed that there is correlation between the regressors and other unobserved effects for each nation. For the final model, Driscoll-Kraay standard errors were applied to handle potential heteroskedasticity, autocorrelation and cross-sectional dependence, since these problems are usual in macro-panel data.
Grouping models in this way adds to the results' trustworthiness by verifying the findings in various ways. FE and Discrol help us to focus on the effects of various factors on financial stability within countries, factoring in diverse structures among countries.

DATA ANALYSIS & RESULTS

This part summarizes the outcomes of a panel data analysis on data from 208 observations representing 16 countries over 13 years. Analysis using POLS, FE, RE and Driscoll-Kraay models is done to study how the four variables: NPL, bank Z-score, lvmmt, lgdpp, infl, tr_op and dcps relate. Diagnosis is verified with tests to confirm that the model is reliable and well-founded.
Out of the 16 countries included in the study, four are from Africa, seven from East Asia and four from Europe and Central Asia. The sample is mostly from Sub-Saharan Africa which accounts for 62.5% and involves 10 out of 16 countries. The list shows that South Asia puts in 3 countries (18.75%), East Asia and Pacific add 2 countries (12.5%) and Europe and Central Asia offer 1 country (6.25%). This shows that development and emerging economies, mainly the Sub-Saharan and South Asian areas, are being purposefully chosen because green growth and digital financial changes in these regions are growing in significance. The fact that there are many different regions adds to the analysis by covering different frameworks, environment and stages of financial development.

Table 2: Tabulation of region name

Region	Freq.	Percent
East Asia and Pacific	2	12.50
Europe and Central Asia	1	6.25
South Asia	3	18.75
Sub-Saharan Africa	10	62.50
Total	16	100.00

Most of the countries sampled are lower-middle-income with 9 of the 16 countries falling into that category. There are 3 low-income countries which are found in Sub-Saharan Africa. Among those countries, 3 are deemed upper-middle-income and one is classified as high-income. An important point is that all the countries in South Asia are lower-middle-income nations, but Sub-Saharan Africa includes lower, lower-middle and upper-middle-income countries. With income differences and regional variety, the analysis can cover many socio-economic and policy factors that lead to green growth in countries of different stages of development.

Descriptive Analysis

There is a lot of variation found in the characteristics of the variables. Calculated as the mean, NPL amounted to 7.133% and its standard deviation was 4.189, going from a minimum of 0.935% to a maximum of 21.591%. The average bank Z-score is 14.92 and its standard deviation is 5.827, while the range goes from 4.37 to 26.935. This data for mobile transactions (lvmmt) has a mean of 12.635 and a range between 1.869 and 19.942, proving the popularity of using mobile financial services. The average lgdp per capita is 7.599 and its standard deviation is 0.87. Inflation in India shows an average of 6.673% and a standard deviation of 5.12, but there is much more variation in trade openness which has a mean of 68.08 and in domestic credit to the private sector which is 29.326.

Table 3: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
infl	208	6.673	5.12	-.391	38.107
tr op	208	68.08	38.358	24.702	185.271
dcps	208	29.326	16.066	9.964	72.768
zscore	208	14.92	5.827	4.37	26.935
npl	208	7.133	4.189	.935	21.591
lgdp	208	24.887	1.823	21.443	28.903
lgdpp	208	7.599	.87	6.099	10.005
lvmmt	208	12.635	3.739	1.869	19.942

Stationarity Tests

We conducted stationarity tests for the panel data models using both the IPS and LLC tests. As per the results, every variable; lgdp, infl, tr_op, dcps, zscore, npl, lgdpp and lvmmt is stationary at level (I(0)) with p-values usually below 0.05 in both tests for lag 0 and lag 1, except lgdp and lgdpp which are stationary at lag 1 in the LLC (augmented unit root) test. It points out that the variables can be used in a panel data way without having to differ them first.

Table 4: Results of Stationarity tests

variable	Lag	IPS		LLC	
		Statistics	p-value	Statistics	p-value
lgdp	0	1.7258	0.9578	-2.2767	0.0114
	1	0.8198	0.7938	-1.9523	0.0255
infl	0	-1.334	0.091	-3.055	0.001
	1	-0.801	0.211	-1.222	0.111
tr_op	0	-2.097	0.018	-4.211	0.000
	1	-4.159	0.000	-6.386	0.000
dcps	0	-2.296	0.011	-5.127	0.000
	1	-1.415	0.079	-4.200	0.000
zscore	0	-4.914	0.000	-7.681	0.000
	1	-2.692	0.004	-4.574	0.000
npl	0	-3.315	0.000	-5.624	0.000
	1	-3.184	0.001	-5.233	0.000
lgdppc	0	0.7643	0.7776	-2.6255	0.0043
	1	0.8603	0.8052	-2.0798	0.0188
lvmmt	0	-4.3137	0.0000	-9.4859	0.0000
	1	-0.1299	0.4483	-4.5034	0.0000

Since all the variables are stationary at level, we can proceed to pooled or Fixed/Random effect models

Model Results

Two models were fit in the analysis, both using NPL as the dependent variable and another model taking the bank Z-score as the dependent variable. The Breusch-Pagan test results in p-values of 0.00, suggesting that chibar2 = 323.00 for NPL and chibar2 = 733.59 for Z-score, so the null hypothesis cannot be accepted and POLS should not be used. For this reason, FE and RE models were both estimated and the Hausman test helped identify the better model.

Non-Performing Loans (NPL) Model

Table 5 shows the findings of NPL Model. For the NPL model a chi-square statistic of 28.85 (p = 0.0000) is given by the Hausman test, showing that the fixed effects model is better than the random effects model. About 13.56% of the changes within each group can be attributed to the fixed effects model.

The fixed effects model reveals that NPL (coefficient = -0.0683) is statistically significantly decreased by trade openness which means a 1% rise in trade openness is likely to push down NPL by 0.0683 percentage points. A 1% rise in domestic credit to the private sector corresponds to an additional 0.1717% in NPLs, as shown by the study (coefficient = 0.1717, p < 0.01). The variables lvmmt, lgdpp and infl are not significant because their p-values (probability) are bigger than 0.05. To deal with the possibility of both heteroskedasticity and cross-sectional dependence, the Driscoll-Kraay standard error model was calculated. Findings endorse the importance of trade openness (coefficient = -0.0683, p = 0.011) and domestic credit (coefficient = 0.1717, p = 0.004); these coefficients did not change, but their standard errors did to account for cross-sectional dependence.

Table 5: Regression Results for Non-Performing Loans (NPL)

Variable	Pooled OLS	Fixed Effects	Random Effects	Driscoll-Kraay
Log of Mobile Money Transactions (lvmmt)	0.0710	0.0498	0.0710	0.0498
	(0.0787)	(0.0784)	(0.0787)	(0.0961)
Log of GDP per Capita (lgdpp)	-0.582	-0.844	-0.582	-0.844
	(0.687)	(0.952)	(0.687)	(0.658)
Inflation (infl)	-0.0098	-0.0009	-0.0098	-0.0009
	(0.0377)	(0.0364)	(0.0377)	(0.0291)
Trade Openness (tr_op)	-0.0358**	-0.0683***	-0.0358**	-0.0683**
	(0.0157)	(0.0203)	(0.0157)	(0.0229)
Domestic Credit to Private Sector (dcps)	0.0546	0.1717***	0.0546	0.1717***
	(0.0351)	(0.0435)	(0.0351)	(0.0478)
Constant	11.56**	12.54 (7.677)	11.56**	12.54**
	(5.109)		(5.109)	(4.280)
Observations	208	208	208	208
R-squared (within)	—	0.136	—	0.136
Number of Countries	16	16	16	16
chibar2(01)	323.00	—	28.85	—
Prob > chibar2	0.000	—	0.000	—

Note. Standard errors are in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

Bank Z-Score Model

The bank Z-score model's results are presented below in Table 6. Even though the negative chi-square value from the Hausman test (-31.81) demonstrates that the asymptotic assumptions are violated, the fixed effects model is maintained according to the NPL model outcomes and theoretical perspectives. With an R-squared value within of 0.0135, this model does not do a good job of explaining the data and none of the independent variables are statistically significant. The regression results show these coefficients: lvmmt (0.0051, p = 0.920), lgdpp (-0.2192, p = 0.721), infl (-0.0242, p = 0.304), tr_op (0.0143, p = 0.274) and dcps (0.0041, p = 0.883). The factor value of 15.5888 for the constant term shows importance (p = 0.002).

When using the Driscoll-Kraay model, there are no significant coefficients for the independent variables to challenge the main results against issues with heteroskedasticity and cross-sectional dependence.

Table 6: Regression Results for Bank Z-Score

Variable	Pooled OLS	Fixed Effects	Random Effects	Driscoll-Kraay
Log of Mobile Money Transactions (lvmmt)	0.0033	0.0051	0.0033	0.0051
	(0.0507)	(0.0504)	(0.0507)	(0.0514)
Log of GDP per Capita (lgdpp)	-0.610	-0.219	-0.610	-0.219
	(0.553)	(0.612)	(0.553)	(0.461)
Inflation (infl)	-0.0202	-0.0242	-0.0202	-0.0242
	(0.0238)	(0.0234)	(0.0238)	(0.0189)
Trade Openness (tr_op)	0.0086	0.0143	0.0086	0.0143
	(0.0122)	(0.0130)	(0.0122)	(0.0157)
Domestic Credit to Private Sector (dcps)	0.0211	0.0041	0.0211	0.0041
	(0.0266)	(0.0279)	(0.0266)	(0.0233)
Constant	18.44***	15.59***	18.44***	15.59***
	(4.490)	(4.936)	(4.490)	(4.612)
Observations	208	208	208	208
R-squared (within)	—	0.013	—	0.013
Number of Countries	16	16	16	16
chibar2(01)	733.6	—	-31.81	—
Prob > chibar2	0.000	—	1.000	—

Note: Standard errors are in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

Diagnostic Tests

Techniques were used to evaluate how dependable the models are. According to the Breusch-Pagan LM test, the NPL and Z-score models are not independent in cross-sections with both p-values being 0. Exploring cross-sectional dependence also reveals varying results, as xtcd2 shows that NPL (0.603) and Z-score (0.556) fail the CD and CD* tests which indicate weak dependence, but CDw+ (p= 0.000) proves strong dependence.

According to the Modified Wald test, both models show significant bias in variances, as both χ^2 (16) results (1665.84 for NPL and 2155.45 for Z-score) are significant and the null hypothesis is undermined. The issue was solved by using Driscoll-Kraay standard errors to get strong results.

Interpretation of Findings

The NPL model shows that when countries trade more, non-performing loans fall, showing that more economic integration can make banks in these countries more stable. An advantage of more credit for private borrowers is that it may result in more loan defaults if banks lower their credit requirements. There is not much importance for mobile money transactions, GDP per capita and inflation in this case which could suggest that they are not directly related to NPLs or their impact is moderated by different variables.

Resulting from the Z-score model, there is no evidence to show that the selected variables have a major effect on bank stability. On the one hand, the wide range of data may be responsible for this; on the other hand, the model lacks the depth to cover all the variations (low R-squared) which means we may have to find more explanatory variables or consider other model types.

Hypothesis Testing Outcomes

The research looked at the following hypotheses:
H1 - Mobile money transactions (lvmmt) help decrease NPL and raise the Z-score. Lvmmt does not play a significant role in either of the models according to the findings of the analysis.
H2 - An increase in GDP per person (gdp) results in lower NPL and higher BRBNZ's overall judgement (z-score). This idea is contradicted, because lgdpp is not significant.
H3 - Inflation makes it more likely for a loan to become delinquent and decreases its Z-score. The hypothesis is not supported by the results, since infl is not significant.
H4 - When countries have more open trade, they tend to experience lower NPL and higher Z-score. This idea is partly true, because while tr_op cuts NPL, it has little effect on Z-score.
H5 - When dcps increases, the amount of NPL goes up and the Z-score decreases. This statement is somewhat true, as dcps increases non-performing loans a great deal but its impact is minimal on Z-score.
Based on the findings, the areas guiding the banking sector's performance are highlighted for each of the 16 countries and policy implications and future research suggestions are given in the following part.

DISCUSSION & CONCLUSION

Implications of Findings

In connection to this, the study shows a mixed but helpful view of the effects of digital banking on financial stability in terms of Non-Performing Loans (NPLs) and Bank Z-scores. The study reveals that if a country opens up to international trade, its banks are more likely to have fewer NPLs, thus preserving their stability with the help of diversified and increased economic activities. Kim et al. (2010) earlier found that open trade helps develop the financial system more and supports long-term stability, making our findings here consistent.
Alternatively, giving unlimited credit to the private sector leads to more NPLs, reflecting the possible rise in financial vulnerability. Which is in agreement with the warning from Arcand et al. (2015) about financial growth not being safe without strong rules.
All in all, government aid and account liquidity had the biggest direct impact on NPLs and Z-scores, while mobile money transactions did not matter much. The explanation might be that digital banking is not very well-developed or mature in these countries or that additional factors such as consumer protection, cybersecurity or clear rules aren't taken into account by the model. In the same way, inflation and GDP per capita had limited impact on stability, showing that factors such as the economy and population may not affect bank operations in the near term, particularly in developing areas with special rules.

Policy Recommendations

Through the findings of the study, we may suggest the following policies.

1. Because openness to trade reduces NPL, governments ought to simplify trade procedures, trim unnecessary measures and update the customs systems to boost the strength of the banking sector based on increased economic diversity.
2. When credit in the private sector increases, policymakers should also make sure to strengthen methods of supervision and credit review, as this will limit the possibility of major defaults.

3. Still, people working in policy should recognize that mobile money might become important even if current statistics do not prove it. Instead, they ought to work on improving rules and guidelines, safety for users, digital understanding and cybersecurity to get the most out of digital financial services.
4. Regulations should be specifically adapted to each region by following flexible risk-based strategies that match its financial environment. Using sandboxes and different licensing levels can support the innovation and management of risks for FinTech.
5. It is necessary to regularly monitor the intensity of financial development by monitoring credit-to-GDP levels. When credit in the country is expanding rapidly, authorities might use macro prudential approaches including increasing countercyclical capital buffers.

Limitations and Future Research Directions

This study is limited in some ways which affects how widely its results can be applied. Firstly, the study is about a small number of countries, with 16 cases, mainly from Sub-Saharan Africa and South Asia. Since these regions are very important, the focus on them may not fully represent what happens across the world. Secondly, Digital banking and blockchain are measured by using VMMT proxy as a symbol of their adoption. Scholars in the future might make more detailed assessments by using either composite indices (like the Digital Financial Inclusion Index) or separated indicators (like rates of both mobile banking and internet use). Thirdly, Missing blockchain adoption data across countries and for long periods prevents us from studying the second variable mentioned in the hypothesis. And finally, In theory, GDP per capita, inflation and trade openness are included as controls, yet they could not fully represent the quality of financial governance or the strength of institutions that may affect the FinTech-stability link.
Such problems should be handled by future analyses by Adding Latin American and European countries to the list of those involved in the study and Considering rules and policies as well as the effectiveness of public institutions. Including effects that interact with each other such as the combined impact of financial development and use of FinTech, and studying how the digital transformation seen during the pandemic period slowed down or changed the stability of banking.

Conclusion

The study analyzed how digital banking due to FinTech innovations has affected the financial systems of 16 emerging countries during the years 2011 to 2023. The major conclusions include allowing free trade leads to a drop in NPLs which makes it apparent that economic integration is beneficial for the stability of financial organizations, excessive lending to the private sector by banks is likely to result in a rise in NPLs, and the presence or absence of mobile money transactions, GDP per capita and inflation was not reliable to explain either NPLs or bank Z-scores in the sample assessed. All the variables tested in the Z-score model did not make a significant difference which might mean the model is lacking power or something important is missing. They partly verify the theories and reveal that the effects of FinTech on financial stability vary by the context.
This research contributes to the growing field of FinTech and financial stability studies in several ways. (i) Empirical Clarification: It disaggregates FinTech innovation into specific technologies (digital banking) rather than relying on composite indices, helping researchers better understand individual technology effects. (ii) Geographic Novelty: By focusing on under-researched regions (SSA and South Asia), the study enriches our understanding of FinTech dynamics in developing economies. (iii) Policy Relevance: The findings offer actionable insights for central banks, regulators, and international development agencies seeking to design financial systems that balance innovation with prudential oversight.

While FinTech innovations hold immense promise, their benefits on financial stability are not automatic. Effective regulation, financial education, and infrastructure development must accompany digital transformation to ensure a sustainable and stable financial future.

REFERENCES

Arif, I., & Rawat, A. (2019). Trade and financial openness and their impact on financial development. *South Asian Journal of Business Studies*. https://doi.org/10.1108/SAJBS-06-2018-0063.

Banna, H., & Alam, R. (2021). Impact of digital financial inclusion on ASEAN banking stability: implications for the post-Covid-19 era. *Studies in Economics and Finance*. https://doi.org/10.1108/SEF-09-2020-0388.

Beck, T., Demirgüç-Kunt, A., & Levine, R. (2000). A new database on the structure and development of the financial sector. *The World Bank Economic Review, 14*(3), 597–605. https://doi.org/10.1093/wber/14.3.597

Chinoda, T., & Kapingura, F. (2023). The Impact of Digital Financial Inclusion and Bank Competition on Bank Stability in Sub-Saharan Africa. *Economies*. https://doi.org/10.3390/economies11010015.

Daud, S. N. M., Yunus, N. H. M., & Yusof, R. M. (2022). Bank competition and financial stability in ASEAN countries: A Boone indicator approach. *Journal of Risk and Financial Management, 15*(7), 292. https://doi.org/10.3390/jrfm15070292

Daud, S., Ahmad, A., Khalid, A., & Azman-Saini, W. (2021). FINTECH AND FINANCIAL STABILITY: THREAT OR OPPORTUNITY?. *Finance Research Letters.* https://doi.org/10.1016/j.frl.2021.102667.

De Sant'Anna, D., & Figueiredo, P. (2024). Fintech innovation: Is it beneficial or detrimental to financial inclusion and financial stability? A systematic literature review and research directions. *Emerging Markets Review*. https://doi.org/10.1016/j.ememar.2024.101140.

Elgharib, W. (2024). Financial inclusion, financial development and financial stability in MENA. *Review of Accounting and Finance*. https://doi.org/10.1108/raf-05-2023-0146.

Fazio, D., Silva, T., Tabak, B., & Cajueiro, D. (2018). Inflation targeting and financial stability: Does the quality of institutions matter?. *Economic Modelling, 71*, 1-15. https://doi.org/10.1016/J.ECONMOD.2017.09.011.

Fouejieu, A. (2017). Inflation targeting and financial stability in emerging markets. *Economic Modelling, 60*, 51-70. https://doi.org/10.1016/J.ECONMOD.2016.08.020.

Ijaz, S., Hassan, A., Tarazi, A., & Fraz, A. (2020). LINKING BANK COMPETITION, FINANCIAL STABILITY, AND ECONOMIC GROWTH. *Journal of Business Economics and Management.* https://doi.org/10.3846/jbem.2020.11761.

Kenedi, K. (2024). The Nexus Between Financial Stability and Economic Growth in Southeast Asia. *Jurnal Economia.* https://doi.org/10.21831/economia.v20i3.55968.

Khan, M. S., Senhadji, A. S., & Smith, B. D. (2001). Inflation and financial depth. *IMF Staff Papers*, *48*(1), 118–129. https://doi.org/10.5089/9781451842213.001

Khattak, M., Ali, M., Azmi, W., & Rizvi, S. (2023). Digital transformation, diversification and stability: What do we know about banks?. *Economic Analysis and Policy*. https://doi.org/10.1016/j.eap.2023.03.004.

Kim, D., Lin, S., & Suen, Y. (2010). Dynamic effects of trade openness on financial development. *Economic Modelling, 27*, 254-261. https://doi.org/10.1016/J.ECONMOD.2009.09.005.

Kim, S., & Mehrotra, A. (2017). Managing price and financial stability objectives in inflation targeting economies in Asia and the Pacific. *Journal of Financial Stability, 29*, 106-116. https://doi.org/10.1016/J.JFS.2017.01.003.

Levine, R. (2005). Finance and growth: Theory and evidence. In P. Aghion & S. N. Durlauf (Eds.), *Handbook of Economic Growth* (Vol. 1, pp. 865–934). Elsevier. https://doi.org/10.1016/S1574-0684(05)01012-9

Mabeba, M. (2024). The efficacy of financial stability on economic growth: the experience of developing countries with large financial sectors. Proceedings of International Conference "Economic Security in the Context of Systemic Transformations". https://doi.org/10.53486/escst2023.13.

Nguyen, Q., & Dang, V. (2022). The Effect of FinTech Development on Financial Stability in an Emerging Market: *The Role of Market Discipline. Research in Globalization*. https://doi.org/10.1016/j.resglo.2022.100105.

Ristić, K., Živković, A., & Marjanović, N. (2019). CONTROVERSY OF ECONOMIC GROWTH AND FINANCIAL STABILITY. , *49*, 127-135.

Sadiq, M., Aysan, A., & Kayani, U. (2023). Digital Currency and Blockchain Security in Accelerating Financial Stability: A Mediating Role of Credit Supply. *Borsa Istanbul Review*. https://doi.org/10.1016/j.bir.2023.09.009.

Sahay, R., Čihák, M., N'Diaye, P. M., Barajas, A., Mitra, S., Kyobe, A., ... & Yousefi, R. (2015). Rethinking financial deepening: Stability and growth in emerging markets (IMF Staff Discussion Note No. 15/08). *International Monetary Fund*. https://doi.org/10.5089/9781513537621.006

Singh, S., & Jha, C. (2023). Are financial development and financial stability complements or substitutes in poverty reduction?. *The European Journal of Finance, 29*, 2001 - 2031. https://doi.org/10.1080/1351847X.2023.2166864.

Svirydzenka, K. (2016). Introducing a new broad-based index of financial development (IMF Working Paper No. 16/5). *International Monetary Fund*. https://doi.org/10.5089/9781513532831.001

Vučinić, M. (2020). Fintech and Financial Stability Potential Influence of FinTech on Financial Stability, Risks and Benefits. *Journal of Central Banking Theory and Practice, 9*, 43 - 66. https://doi.org/10.2478/jcbtp-2020-0013.

World Bank. (2024). World Development Indicators (WDI). Retrieved from https://databank.worldbank.org/source/world-development-indicators

Yang, R. (2022). Development and Supervision of Financial Technology Based on Blockchain. *Computational Intelligence and Neuroscience*, 2022. https://doi.org/10.1155/2022/2615153.

Zhang, C., Zhu, Y., & Lu, Z. (2015). Trade openness, financial openness, and financial development in China. *Journal of International Money and Finance, 59,* 287-309. https://doi.org/10.1016/J.JIMONFIN.2015.07.010.

Zhao, J., Li, X., Yu, C., Chen, S., & Lee, C. (2021). Riding the FinTech Innovation Wave: FinTech, Patents and Bank Performance. *Journal of International Money and Finance.* https://doi.org/10.1016/j.jimonfin.2021.102552