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The effect of financial technology on commercial banks' stability in Sub-Sahara Africa

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Abstract

The swift progression of digital technology is revolutionizing the financial domain and significantly influencing the stability of commercial banks through their pursuit of operational efficiency, reach, service delivery, and increased client attention, enhanced by increased consumer convenience, satisfaction, and loyalty. A complex change indeed as it is often associated with complications related to cyber-attacks which result in among other factors; data breaches, theft of sensitive customer information, and systems disruptions. This explains why the study is designed to investigate the effect of financial technology on commercial banks' stability in Sub-Sahara Africa. Panel data from 2010 to 2022 was collected for 22 commercial banking sectors from the World Bank Global Financial Development Database 2022 and Financial Access Survey 2022. A composite index was formed to capture financial technology and the banking Z-score was used to capture commercial bank's stability, all driven by data availability. The estimation technique used was the Panel-Corrected Standard Errors (PCSE). The results showed a positive and significant effect of financial technology on commercial banks' stability at 1%. To improve their stability, commercial banks should invest more in ATMs, credit and debit card infrastructures, and mobile and internet applications, and policymakers should also encourage the development of financial technology (fintech) companies by creating 4G mobile networks, and rural electrifications, to guarantee equitable network and power supply.

Keywords: ATMs, Commercial banks, Commercial banks stability, Credit card, Debit card, Financial technology, Internet and mobile banking

1. Introduction

The world is witnessing exceptional levels of digitalization or innovations in financial technology (fintech), which are transforming financial systems in both developed and developing countries. This has led to efficiency in financial services delivery which is crucial for the competitiveness and financial advancement of banks and their stability, (Wysokińska, 2021). Globally, the evolution of fintech has taken place through three and a half eras: fintech 1.0 (1886-1967), fintech 2.0 (1967-2008), fintech 3.0 (2008-Current for developed countries), and fintech 3.5 (2008-current within developing countries). This has been seen as a blessing as well as a curse to the existence of commercial banks. In fintech 1.0, infrastructure was built to support globalized financial services, such as the first transatlantic cable (1866) and Fedwire (1918). In fintech 2.0, the first ATM was installed by the Barclays Bank in 1967, as well as the advent of computer systems that enhanced the digitalisation of financial services. In fintech 3.0 and 3.5, the financial services market for developed countries saw new providers like bitcoin and other cryptocurrencies, digital wallets, and small ticket loans, while emerging markets have been opened to the spread of these innovations, (Buckley et al., 2016).

2. Background of the study

Commercial banks' stability evolving across time and space, has been a captivating story of adaptation, marked by periods of boom and bust, that were often disrupted by significant regulatory shifts and technological advancements. In the pre-20th century, commercial banks were largely unregulated and the sector characterized by frequent bank failures due to speculation, poor lending practices, and economic shocks, that often resulted in disruptions in currencies despite the

initiation of the Gold Standard to ensure stability. Bank runs characterized by depositors rushing for their savings resulting in widespread bank failures and economic instability, were the order of the day (Friedman & Schwartz, 1963).

In the early 20th century, the financial sector experienced significant changes, with the creation of central banks like the Federal Reserve Bank of America and the establishment of deposit insurance schemes (Kindleberger, 1978). The financial crisis of the 1930s led to the creation of the Federal Deposit Insurance Corporation (FDIC) and the Securities and Exchange Commission (SEC) in the US, and regulatory reforms were established to restore the financial system's resilience (Temin, 1989). After World War II, European countries focused on economic development, but little attention was given to financial innovations and regulation. The formation of the European Union (EU) led to greater financial integration but also highlighted the need for harmonised regulatory frameworks (European Commission, 2023). The introduction of the Euro in 1999 further facilitated financial integration but also presented challenges in managing currency fluctuations and potential imbalances (Mourre & Remillard, 2018).

The Asian financial sector post World War II was relatively underdeveloped, with limited competition and weak regulatory frameworks (Aoki, 2000). The late 20th century saw increased globalisation of financial markets and the emergence of new financial instruments and technologies, presenting new challenges for banks (Allen & Gale, 2000). The 2008 global financial crisis however, further highlighted the need for stronger regulatory frameworks and the Basel Accords, which aimed to strengthen bank capital requirements, liquidity, and risk management practices (Basel Committee on Banking Supervision, 2010).

Hence, commercial banks' stability is not only enhanced by fintech, but stricter capital requirements in terms of leverage and liquidity ratios are measures requiring banks to hold a certain amount of highly liquid assets to cover short-term funding needs, and cover their assets and liabilities, as implemented by the Basel Committee on Banking Supervision of the Basel III, to enhance commercial banks stability (Basel Committee on Banking Supervision, 2010). Countercyclical capital buffers to save up more capital during periods of economic expansion (Financial Stability Board, 2010), conduct stress tests, and strengthen bank supervision are methods of bank regulators and the FSB to identify vulnerabilities and improve risk management practices, governance, and internal controls. Stricter bank regulations and the resolutions of deposit insurance and early intervention measures are also implemented to reduce systemic risk (Financial Stability Board, 2023). Lastly, the cooperation of FSB and IMF is aimed at promoting global financial stability. In this light, the FSB coordinates efforts, monitors systemic risks, and recommends policies to enhance stability while the IMF provides technical assistance and financial support to countries facing financial crises through bank supervision and regulation (International Monetary Fund, 2023).

However, the adoption of fintech has had varying transformative proportions on commercial bank stability between the Northern African countries and SSA due to economic uncertainties and regulatory complexities (World Bank, 2021). Countries like Tunisia and Algeria have implemented measures to strengthen banking regulations and enhance stability post-crisis, and other regulatory authorities have proactively shaped frameworks to support fintech innovations while ensuring commercial banks' stability. Collaborations among organizations like the Arab Monetary Fund and national regulators have fostered the development of tailored financial solutions. Southern African countries have been experiencing significant advancements in financial technology, and the pursuit of commercial banks stability, but commercial banks stability varies across African countries, with challenges stemming from currency volatility and regulatory gaps (African Development Bank, 2020).

Though Sub-Saharan Africa (SSA) has made significant strides in fintech adoption, the commercial banking sector still remains small and is relatively underdeveloped as compared to other regions of the world. It boasts the lowest bank account penetration globally, with only 44% of its adults having bank accounts in financial institutions (World Bank, 2022). Europe has 94% and North America has a 96% penetration rate. Also, the commercial banks' asset size of approximately USD 1.5 billion is significantly smaller compared to that of developed economies with USD 100 billion in North America and USD 50 billion in Europe (IMF, 2021). The share of banking assets in relation to GDP is largely below 30% in most SSA countries remaining far below what is observed in other parts of the globe such as Germany with 83.4% and 216.3% in America for 2021.

Additionally, commercial banks in SSA have a higher ratio of non-performing loans (NPLs), indicative of higher credit risk and potential instability, attributable to economic vulnerabilities, weak regulatory frameworks, and limited access to credit information. (African Development Bank, 2019). The Bank for International Settlements (2021) stipulates that the global average NPL ratio for banks was 3.3%; with developed economies like the US and Europe generally having lower ratios of between 1-2% while emerging markets like those of SSA having higher NPL ratios of 5-10% and more, (African Development Bank, 2019). More so, liquidity ratios that measure the ability of banks to meet their short-term obligations are relatively lower in SSA compared to other regions, an indication of a higher risk of liquidity stress in periods of economic downturns or market volatility. That said, lending to the private sector has not consistently accounted for more than 25% of GDP, indicating a lack of funding for the economy and breaches in the financial stability of the commercial banks (World Bank Group, 2024).

Furthermore, while return on assets (ROA) figures vary between countries and institutions, the industry average for the entire region stands at 1.5% lower than the global 1.8%, (Financial Stability Board, 2022). Finally, there is a high dominance of mobile money adoption with over 1 billion active mobile money accounts, which though demonstrates financial inclusion, shows a reliance on alternative financial services providers rather than traditional banks, (GSMA, 2021). Based on these issues and despite the surge in fintech adoption, together with the financial reforms on commercial banks stability centered on regulatory frameworks, risk management practices, and capital adequacy standards, with the development of the Basel Committee on Banking Supervision introducing stricter capital requirements, liquidity

standards, leverage ratios, and mandating stress testing for banks, and other efforts of the FSB and IMF to guarantee banks stability in SSA, a lot remains to be examined in the context of how these innovations enhance the resilience of the commercial banking sector. This explains why this research piece targets investigations on the effect of financial technology on commercial banks' stability in Sub-Saharan Africa. The diverging opinions of stakeholders justify the need for further research on these two concepts.

3. Literature review

Fintech is a blend of finance and technology, delivering financial services through innovative tools like mobile banking, insurance, and investment apps. For the purpose of this study, it is basically digitalisation which is any form of digital innovation that can enhance the rendering of fast, cheap, and reliable financial services. These services stem from payments, settlements, savings or cheque deposits and withdrawals, to transfers, compared to the former traditional way of rendering financial services. Digitalization is captured through ATMs, mobile banking, internet banking, and credit and debit card adoption. Automated Teller Machines (ATMs) are electronic telecommunication devices that enable customers of a financial institution to perform financial transactions such as cash withdrawals, deposits, funds transfers, balance inquiries, or account information inquiries, at any time and without the need for direct interaction with bank staff (Merriam-Webster Dictionary, 2017). Some ATMs are simple cash dispensers, while others allow a variety of transactions such as check deposits, balance transfers, and bill payments. Hence, captured through the number of ATMs per 1000 adults (Al-Smadi, 2023).

Mobile and or internet banking is the conduct of banking transactions like the checking of account balances, electronic bill payments, and P2P payments remotely through mobile or banking applications. This study measures fintech through mobile and internet banking transactions per 1000 adults. Credit cards are financial instruments issued by banks or credit unions for transactions, debt, and consumer benefits (Bennett & Wojno, 2024). They come with fees, grace periods, and credit limits. Major cards include Visa, MasterCard, Discover, and American Express. Debit cards allow secure online payments from checking accounts, unlike credit cards that borrow from a creditor's line of credit. They can also be used to withdraw cash at ATMs. Debit cards offer easier access to savings and help monitor bank account balances, building trust in financial institutions (Chakravorti, 2003). Credit and debit cards are captured in this study by the number of credit cards per 1000 adults, and the number of debit cards per 1000 adults respectively (Iwedi & Wachuku, 2023; Kolli & Amarouche, 2023).

A commercial bank is a financial institution or an intermediary that carries out all financial operations related to the deposit and withdrawal of money, loan provision for investment, risk management, and other such activities for profit motives. Commercial bank stability is a state in which the financial intermediation process of individual banks runs smoothly and there is trust in the performance of these financial institutions, (Bank Negara Malaysia, 2023), as they are sound, stable, and profitable (Onuonga, 2014). Commercial bank's stability is crucial for the financial system, as they help allocate funds and manage financial risks.

Commercial banks' stability can be assessed using composite indices like Altman's Z-score, CAMELS rating, and the Commercial Bank Stability Index, but this study uses the Bank level Z-Score, as also found in the works of (Stankevičienė & Kabulova, 2022; Ratnawati, 2020). Z-score compares the buffer of a country's banking system (capitalization and returns) with the volatility of those returns and is estimated as $(ROA + (\text{equity}/\text{assets})) \div \text{sd}(ROA)$; where $\text{sd}(ROA)$ is the standard deviation of ROA. The ROA, equity, and assets are country-level aggregate figures calculated from underlying bank-by-bank unconsolidated data from Bank scope. A higher value of Z score means lower levels of risk to commercial banks, thus higher levels of commercial banks stability (Liu, 2023).

This study is built on the disruptive innovation theory (DIT) and value chain theory (VCT). The Clayton Christensen (1997) DIT suggests that new technologies emerge in niche markets, often displacing established competitors. While the Michael Porter 1985 VCT outlines how a company generates value by linking primary and secondary activities, in this case digitalisation being the secondary activity that adds value to commercial banks operations. So, commercial banks can examine how they might provide value for their clients, ascertain the benefits and drawbacks of each value chain activity in order to lower costs and raise customer satisfaction, and enhance the effectiveness and efficiency of their lending and payment operations by investing in digital technology.

From the empirical perspective, Baker and others (2023) studied the impact of financial technology on the financial stability of commercial banks registered in the Amman Stock Exchange and Abu Dhabi Securities Exchange using financial information and data from 2012 to 2020 and the multiple linear regression analysis. Their study found that FinTech enhances net profitability and overall deposits, suggesting that banks should implement comprehensive strategies for sustainable development. Similarly, Kolli and Amarouche (2023) examined the impact of financial technology on financial stability in 19 MENA countries from 2004-2020, using the panel vector autoregression models (Panel VAR) for analysis. They found no significant relationship between financial stability and financial technology. Also, Nguyen and Dang (2022) reveal that fintech development negatively impacts financial stability in Vietnam's commercial banks using data gathered from 2010 to 2020, though market discipline can mitigate this effect, it is stronger when financial stability is low and weaker when banks have higher state ownership.

Daud's study (2022) found that fintech through artificial intelligence, cloud technology, and data technology, enhances financial stability in 63 countries from data gathered within the period 2006 to 2017, and bank concentration playing a crucial role. Financial institutions should embrace fintech for enabling ecosystems. Safiullah and Paramati's 2022 study found that as fintech companies grow, bank financial soundness increases, supporting the influence of fintech businesses on bank financial stability in Malaysia, regardless of model configurations or fintech. Stankevičienė and Kabulova (2022)

studied the impact of financial technology on financial institution stability using data from 37 countries. They found that fintech can reduce or increase financial market vulnerability, impact financial institutions through profitability, and have no effect on institution vulnerability. However, these metrics overlook the complexity of fintech and its impact on financial institutions and the industry. Wanalo, Mande and Ngâ (2020) found that financial technology improvements, such as agency banking and automated teller machines, improved Kenyan commercial banks' performance, while credit risk had a small negative effect. They recommend adopting the Central Bank's risk identification guidelines.

Musabegovic and others (2019) also found a positive correlation between per capita GDP and smartphone usage for payment processing, financial activities, utilities, and income, using World Bank data from 150 countries, and found significant positive effects of new technologies and cell phones. Haabazoka's 2019 study on 19 Zambian commercial banks found that technological innovations in Internet Banking, Mobile Banking, and Automated Teller Machines improved their financial performance. Mobile banking transactions had a stronger impact than Internet banking, while automated teller machine transactions also positively impacted the banks' performance. The 2018 Kemboi study employed multiple regressions to analyse the relationship between financial technology and the financial performance of 43 Kenyan banks from 2013 to 2016 and found that mobile, online, and agency banking positively impacted financial performance. To enhance operational efficiency, the study recommended banks invest in financial technology, encourage client adoption, and allocate resources towards technical infrastructure development.

The researcher identified gaps in previous studies as most of the studies relied on the use of the panel regression techniques of analysis such as panel VAR (Kolli & Amarouche, 2023), dynamic panel or system GMM (Al-Smadi, *et al.*, 2023; Daud *et al.*, 2022; Safiullah & Paramati, 2022), to name a few, while this researcher used the PCSE estimation technique, as the data availability meant that the period of study (number of years which is 13) was less than the number of cross-sectional units or the selected countries in this case 22, as well as, the ability of PCSE technique to produce efficient results. The gap is based on the reviewed works. Also, the majority of the research captured financial technology using an index created by a fintech company (FINC), comprising all-new fintech businesses founded within the period, and fintech transaction (FINT), composed of all the value of fintech transactions within the period like in the work of Nguyen and Dang (2022) in Vietnam. However, inadequate information about financial businesses and activities in SSA explains why the researcher captures financial technology using an index formed from various innovations in financial services, such as ATMs, Credit and debit cards, and mobile banking or internet banking to evaluate how they affect the financial stability of commercial banks in SSA.

4. Research method

4.1. Scope and area of the study

This study centers on financial technology and commercial banks' stability in Sub-Saharan Africa. Sub-Saharan Africa is made up of 48 countries as classified by the UN Development Programme and 50 states according to Gray and Zellers (2018), but the study is based on some 22 selected countries; Angola, Botswana, Cameroon, Cape Verde, Chad, Congo (Democratic Republic), The Gambia, Ghana, Guinea, Kenya, Lesotho, Madagascar, Mauritania, Mauritius, Mozambique, Namibia, Rwanda, Seychelles, South Sudan, Uganda, Zambia and Zimbabwe, a dissection of all the sub-regional blocks of the entirety of the SSA Region, and based on the data available for the different banking sectors and not individual banks for the period 2010-2022, which characterize the digital era.

Countries like Angola, Botswana, and Cape Verde have diverse geography, well-developed banking sectors, and diverse industries. Chad, the 21st largest country, has a diverse economy with oil, gas, agriculture, and livestock industries. The Democratic Republic of the Congo faces corruption and bureaucracy. Gabon, the smallest African country, has a \$2 billion GDP. Ghana faces high inflation and a large informal economy. Kenya has a well-developed banking sector but faces high crime rates and a large informal economy. Fintech is growing rapidly in Kenya, while Lesotho and Madagascar have underdeveloped banking sectors with limited large banks. South Sudan, Uganda, and Zambia's banking sector is dominated by banks like Bank of South Sudan, Nile Commercial Bank, and Equity Bank South Sudan. However, challenges like corruption and bureaucracy persist, and fintech is rapidly growing, promoting digital financial services (World Bank, 2023).

4.2. Research design

To investigate the effect of financial technology on commercial banks' stability in Sub-Sahara Africa, a quantitative research design of the ex-post facto and causal research designs, with a descriptive deductive approach used, with interpretation being the appropriate epistemological stance due to the developing nature of financial technology. The quantitative rather than qualitative study appeared to be the preferred choice since all of the drivers for fintech and commercial banks' stability were proxies to operationalize the hypothesized relationship and of ex-post facto study or after-the-fact research given that the investigation was conducted after the data had been recorded without interference from the researcher.

4.3. Nature and sources of data

This research used secondary panel data from 22 selected SSA banking systems covering the period 2010-2022, obtained from the World Bank's financial access survey and global financial development database. A normalization and aggregation method was used to form a financial technology index for ATM adoption based on the number of ATMs per 1000 adults, Mobile cellular subscriptions given by the number of mobile and internet banking transactions (during the

reference year) per 1,000 adults, number of credit cards per 1000 adults, number of debit cards per 1000 adults, while the Altman's Bank level Z-Score for commercial banks stability as it compares a country's banking system's buffer and its volatility, as used in works including (Al-Smadi, 2023; Kolli & Amarouche, 2023; Iwedi & Wachuku, 2023; Kouladoum, Wirajing & Nchofoung, 2022).

4.4. Model specification

The empirical model employed in this work was inspired by a host of authors and literature on the relationship between fintech and commercial banks stability or financial stability in general across different sections of the world (Al-Smadi, Kolli & Amarouche, 2023; Nguyen & Dang, 2022; Safiullah & Paramati, 2022; Stankevičienė & Kabulova, 2022). The following model was used for this empirical research:

$$Z Score_{it} = \alpha + \lambda_i FTI_{it} + \rho_i X_{it} + \zeta_{it}$$

Where λ_i and ρ_i are vectors of the unknown coefficients for the financial technology index (FTI) and the control variables respectively. The control variables are both the banking-specific characteristics and macroeconomic factors that can influence the stability of the commercial banking sector aside from those of fintech captured in this study. The banking characteristics are bank credit to bank deposits (%) (BCBD) and liquid assets to deposits and short-term funding (%) (LQAD) while the macroeconomic factors are inflation level through consumer prices (annual %), foreign capital flows through foreign direct investments (FDI) as percentage of GDP and remittance (REM) as also employed in (Al-Smadi, 2023; Khan *et al.*, 2021) all driven by data availability.

α is the constant term, and ζ is the stochastic error term and it represents i for the 22 commercial banking sectors at time t for the 13 years.

5. Data analysis

Newey & West in 1987 developed standard errors compatible with heteroskedasticity and autocorrelation, including panel variations. Parks provided a generic least squares known as the feasible generalised least squares (FGLS)-based approach that was popularized by Doran & Kmenta in 1986. However, it is often unworkable with micro econometric panels due to time dimension falling below the cross-sectional dimension and yielding excessively low standard error estimates. Beck & Katz then proposed the panel-corrected standard errors (PCSEs) coefficient in OLS estimations to mitigate these drawbacks, (Bailey & Katz, 2011). This quantitative research, therefore, uses inferential statistics to analyse the effects of financial technology on commercial banks' stability based on the Prais-Winsten regression, PCSEs since considering that the 13-year duration (time dimension) covered in this study is far lower than the cross-sectional dimension of 22 commercial banking sectors of SSA.

6. Findings and discussion

6.1. Descriptive statistics

Table 1: Descriptive Statistics

Variable		Mean	Std. dev.	Min	Max	Observations
Z Score	Overall	14.3857	6.454958	3.67	27.95	N = 286
	Between		6.229158	5.900769	24.70615	n = 22
	Within		2.120816	5.144161	21.2557	T = 13
FTI	Overall	0.136618	0.211868	0	1	N = 286
	Between		0.204125	0.003187	0.656537	n = 22
	Within		0.070537	-0.16887	0.528283	T = 13
BCBD	overall	66.70255	25.75827	7.62	121.95	N = 286
	between		23.26135	11.96615	105.3762	n = 22
	within		12.04911	-6.07668	103.1633	T = 13
LQAD	overall	43.09692	18.69105	11.76	128.79	N = 286
	between		16.02156	18.52769	84.90692	n = 22
	within		10.17215	-14.61	86.97999	T = 13
REM	overall	4.925315	9.127804	0	75.83	N = 286
	between		7.124561	0	26.25308	n = 22
	Within		5.890218	-21.3278	54.50224	T = 13
FDI	Overall	4.688586	7.267588	-18.0218	57.83755	N = 286
	Between		5.56335	-4.8642	19.93709	n = 22
	Within		4.813539	-12.1371	44.57044	T = 13
INF	Overall	0.724869	5.561974	-47.5906	18.06588	N = 286

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	Between		2.649943	-7.24316	5.595235	n = 22
	Within		4.920268	-39.6226	18.46064	T = 13

Source: Computed by the Author, 2024

This study examines the commercial banks' stability of 22 banking sectors in the Southern African Republic (SSA) over 13 years. The commercial banks' stability measure (Z score) has a mean value of 14.3857, indicating healthy financial conditions with low risk of bankruptcy. The financial technology index (FTI) has a mean value of 0.136618, indicating low levels of financial inclusion. The percentage of bank credit to bank deposits (BCBD) has a mean value of 66.70255, indicating high financial system value. The average value of liquid assets to deposits and short-term funding (LQAD) is 43.09692, indicating a reduction in value over the study period. Remittances have a mean value of 4.925315, indicating low remittance value. The mean of foreign direct investment (FDI) is 4.688586, indicating low amounts over the years. Inflation has a mean value of 0.724869, indicating a low level of inflation.

6.2. Correlation analysis

The correlation analysis on commercial banks' stability, financial technology, and control variables is shown in Table 2 below:

Table 2: Correlation Analysis

	Z Score	FT	BCBD	LQAD	REM	FDI	INF
Z Score	1						
FTI	0.224	1					
BCBD	0.4161	0.1471	1				
LQAD	-0.2254	-0.2056	-0.6711	1			
REM	-0.0324	-0.1402	-0.3906	0.5813	1		
FDI	-0.0546	0.0672	0.05	-0.0358	-0.1272	1	
INF	0.1351	-0.052	0.27	-0.1986	-0.1175	0.1654	1

Source: Computed by the Author, 2024

Results from Table 2 above show that all the correlation coefficients along the diagonal are unitary indicating that each variable has a perfect positive correlation with itself. The table also reveals that financial technology and financial inclusion, as well as the bank credit to bank debts and inflation (control variables), are positively correlated to the financial stability (ZScore). However, the other controlled variables LQAD, REM and FDI have a weak negative correlation with financial stability. The degree of correlation amongst many of the variables is significant at either 1%, 5%, or 10%, while only a few explanatory variables are not significant.

6.3. Diagnostic test results

The following diagnostic tests were conducted to ascertain that the preconditions for the regression technique previewed were made. The tests conducted include; a test for heteroskedasticity, a test for parameter constancy (random-coefficients regression), a test for autocorrelation, a test for cross-sectional dependence, and the unit root test. The findings of these tests met all the preconditions for the use of the PCSE regression technique (Appendices 1-5).

6.4. Regression results

The following paragraphs and tables summarise the Prais–Winsten regression results based on the panel-corrected standard errors (PCSE) technique of estimation that correspond to the effect of financial technology on commercial banks' stability.

Table 3: Regression Results

Regressors	PCSE Estimates for Financial Stability (Z Score)	
	Coefficients	
Normal_FTI	0.9266522***	(0.318264)
LQAD	-0.0807616***	(0.0209421)
INF	0.0617692***	(0.0215242)
FDI	0.2058077**	(0.0894063)
REM	0.0747897*	(0.0457259)

1. The values in parentheses are the related Newey-West standard errors
2. *** (**)(*) indicates statistical significance at 1%, 5%, 10% respectively
3. The variance-covariance matrix for the PCSE model is adjusted for data clustering

Source: Computed by the Author, 2024

The Prais-Winsten regression results show a positive and significant effect of financial technology on commercial banks' stability in SSA at 1%. An increase in financial technology leads to a 0.93% increase in financial stability. However, the coefficient of liquid assets to deposits and short-term funding (LQAD) is negative and also significant at 1%. This indicates that LQAD has a negative and significant effect on commercial banks' stability. Hence, increasing LQAD by 1 unit reduces commercial banks' stability by about 0.081%. Inflation has a positive effect on commercial banks' stability, also significant at 1%. Thus, an increase in INF increases commercial banks' stability by 0.062%. Foreign direct investment (FDI) also has a positive and significant effect on commercial banks' stability in SSA, at 5%. Therefore, a unit increase in FDI increases commercial banks' stability by 0.21%. Finally, REM as well, has a positive and significant effect on commercial banks' stability in SSA, at 10% level of significance. Hence, a unit increase in REM increases commercial banks' stability by 0.075% (Appendix 6).

7. Implications of the study

The study evaluated the effect of financial technology on the stability of commercial banks in SSA, based on the use of ATMs, mobile and internet banking, and credit and debit cards. However, the results of a positive and significant effect of these fintech proxies on commercial banks' stability, at 1%, is an indication that an improvement on their investments by commercial banks, significantly improves their resilience by 0.93%. This result is consistent with eight of the ten studies globally reviewed on related studies such as those of Kolli and Amarouche (2023) in the MENA zone, Safiullah and Paramati (2022) on 26 Islamic and conventional banks in the Malaysian emerging market, to name a few. However, the result is inconsistent with that of Nguyen and Dang (2022) in Vietnam, and Stankevičienė and Kabulova (2022) in 37 countries, probably due to the systemic impact of fintech, which fundamentally alters competitive forces, market dynamics, financial inclusion, and consumer rights, to mention just a few.

This result is supported by the doctrine of disruptive innovations (TDI) by Clayton Christensen in 1997, which explains how new technologies initially enter the market by targeting underserved or neglected customer segments, and over time evolve and improve, eventually displacing established players of the market (Bessant et al., 2005). It can be argued that the constant advancements and user-friendliness of ATMs, mobile banking, and card payments in SSA have drawn a larger clientele, challenging conventional banking practices in the process. Due to this disruption, banks in Sub-Saharan Africa have had to innovate and adapt, which has improved their operational efficiency, reach, and service offerings, as they consistently move away from their conventional banking methods (World Bank, 2021). As a result, the region's commercial banking industry is now comparatively stable.

More so, the value chain theory proposed by Michael Porter in 1985 is consistent with the favourable and noteworthy impact of fintech on the stability of commercial banks. Key functions like transaction processing, customer support, and branch operations have been impacted by the disruption of the conventional value chain of banks in Sub-Saharan Africa (SSA) caused by the widespread use of ATMs, mobile banking, and card payments. Banks are now able to increase consumer convenience, satisfaction, and loyalty while streamlining operations and cutting expenses (McKinsey, 2017). This increased client attention and operational efficiency of the banks has made the region's financial sector more robust and long-lasting. Banks have gained more capacity to allocate their resources more effectively, improve profitability, and build stronger capital buffers, thereby enhancing their financial strength and resilience to potential losses, and stronger banking systems.

Fintech in SSA is seen as a 'pure heaven' as banks use new technologies to offer a wide range of financial services ranging from lending, payments, and investment, which accounts for the offering of financial services at a lower cost than traditional banks, improvement in the efficiency of financial services enhancing banks financial stability. However, it is still at a very low rate as shown by its mean value of 0.136618, which is quite closer to the minimum value of 0 than the maximum value of 1. Fintech though at a lower rate, has transformed the financial services industry by revolutionising the banking sector through ATMs, mobile banking, and card payments, thereby enhancing transparency, reducing contact, strengthening critical infrastructural components, realizing efficiencies in terms of faster, reliable, and reduced costs of financial services (Giancarlo, 2017), hence, enhancing customer satisfaction as contained in the Michael Porter (1985) Value Chain theory.

The widespread adoption of digital payment proxies in this study has led to a surge in transaction volumes, boosting revenue streams for banks in SSA (African Development Bank, 2020). This of course translates into higher profits, which strengthens banks' capital base and their ability to absorb losses. The increased revenue growth allows banks to invest further in expansion, innovation, and risk management strategies, hence commercial banks' resilience. Another vital factor is based on the fact that the adoption of ATMs, mobile and internet banking, and credit and debit card payments has reduced reliance on cash transactions, enhancing security and a reduction of the risk of fraud, theft, and money laundering (IFC, 2019). This digital payments shift fosters secured and transparent financial systems and allows banks to allocate resources more efficiently, improve risk management practices, and strengthen their overall resilience.

Lastly, studies have shown that customers in SSA value the convenience, accessibility, and security offered by mobile banking, ATMs, and credit payments, an initiative that has increased customer satisfaction and loyalty (Accenture, 2020). With improved customer satisfaction and loyalty, customers are more likely to remain loyal to the banks and continue using their services, contributing to a more stable banking sector. The stable banking sector translates to a more predictable revenue stream and reduces the risk of customer churn, further strengthening banks' financial resilience.

8. Contribution of the study

Financial technology has a positive and significant effect on commercial banks' stability. To this effect, commercial banks and policymakers are recommended to implement the following policies to improve their efficiency, opportunities, productivity, risk management, clients' loyalty, and a competitive edge over other financial institutions, hence strengthening their resilience. This is supported by the Porter's value chain theory (Berger & Humphrey, 1997).

Commercial banks should invest more on adopting and promoting digital financial innovation infrastructures of ATMs, mobile banking and internet banking applications, as well as, credit and debit cards infrastructures, while laying emphasis on the security of the potential users of such innovations as contained in the TRA doctrine. This has the potential to lower costs and raise customer satisfaction, enhance lending and payment operations, improve risk management/control, and probably lower their rate of losses and increase their resistance to financial shocks.

Policymakers in SSA should encourage the development of fintech companies by creating enabling environments through the establishment of 4G mobile networks or reliable internet services, electrification of the rural areas, and ensuring they are reasonably priced, to enable improved access to affordable financial technologies in the form of mobile banking, ATMs.

9. Suggestions for further study

The researcher suggests the following areas for further research: research on the relationship between financial technology and the stability of banking and non-banking financial institutions in SSA. Primary research work should also be carried out to ascertain the interrelationship between financial technology, financial inclusion, and commercial banks' stability in Cameroon since secondary data availability proved to be a major hindrance. Further, research should be conducted on the effect of regulation or financial reforms on the entire financial system; the financial market, the money market in terms of the banking and non-banking financial institutions, and the stock exchange if possible. Another study on the interrelationship of financial technology, financial inclusion, and financial stability can also be conducted for the CEMAC region or on the entire continent of Africa. Studies should be conducted on the effect of credit risk management practices and asset quality on the financial stability of commercial banks in SSA.

10. Conclusion

From the statistical analysis and results of this study presented above, it can be concluded that commercial banks' stability is enhanced by investments in the digital innovative infrastructures of ATMs, credit and debit cards, internet, and mobile apps since the findings of the study showed a positive and significant relationship between financial technology and commercial banks stability. Furthermore, as the doctrines of the DIT and VCT support, the pursuit of digitalization can spur innovation and increased competition in the banking industry since institutions vying for market share are compelled to upgrade their services and innovate to draw in new clients, potentially bolstering their stability. This dynamic relationship, far from being a mere coincidence, showcases a symbolic evolution where technology empowers banks while banks in turn drive the adoption and innovation of these technologies. A positive feedback loop that enhances efficiency which streamlines core banking processes reducing operational costs and improving service delivery, translates to higher profitability reduced vulnerability to financial shocks, and increased resilience.

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References

1. Accenture. (2020). Open Banking: How to Thrive in the New Innovation Ecosystem.
2. African Development Bank. (2020). FinTech Innovations in Northern Africa.
3. Al-Smadi, M. O. (2023). Examining the relationship between digital finance and financial inclusion: Evidence from MENA countries. *Borsa Istanbul Review*, 464-472. Retrieved from <https://doi.org/10.1016/j.bir.2022.11.016>
4. Allen, F., & Gale, D. (2000). Financial Contagion. *Journal of Political Economy*, 108(1), 1-33.
5. Altman, E. I. (1968). Financial Ratios Discriminant Analysis and the Prediction of Corporate Bankruptcy. *Journal of Finance*, 23(4), 589-609.
6. Aoki, M. (2000). *Towards a Comparative Institutional Analysis*. MIT Press.
7. Bailey, D., & Katz, J. N. (2011). Implementing Panel-Corrected Standard Errors in R: The PCSE Package. *Journal of Statistical Software*, 42, 1-11.

8. Basel Committee on Banking Supervision. (2010). Basel III: A global regulatory framework for more resilient banks and banking systems. *Basel Committee on Banking Supervision*.
9. Berger, A. N., & Humphrey, D. B. (1997). *Efficiency of Financial Institutions: International Survey and Perspectives*. New York: Oxford University Press.
10. Bessant, J., Lamming, R., Noke, H., & Phillips, W. (2005). Managing innovation beyond the steady state. *Technovation*, 25(12), 1366-1376.
11. Buckley, R., Barberis, J. N., & Arner, D. W. (2016). The Evolution of Fintech: A New Post-Crisis Paradigm? *SSRN Electronic Journal*. doi:10.2139/ssrn.2676553
12. European Commission. (2023). *The EU's Financial System*. European Commission.
13. EY. (2018). Navigating the digital transformation in banking. *EY Insights*. Retrieved from https://www.ey.com/en_gl/financial-services/navigating-the-digital-transformation-in-banking
14. Giancarlo, C. (2017, May 17). LabCFTC: Engaging Innovators in Digital Financial Markets.
15. GSMA. (2021). Mobile Money Report.
16. Gray, B., & Zellers, J. M. (2018, March 19). Africana Collections: An Illustrated Guide. *Library of Congress*.
17. Kagan, J. (2022, June 30). *Financial Technology (Fintech): Its Uses and Impact on Our Lives*. Retrieved from Investopedia: <https://www.investopedia.com/terms/f/fintech.asp>
18. Kagan, J., Khartit, K., & Bellucco-Chatham, A. (2023, December 21). What Is an ATM and How Does It Work?
19. Kindleberger, C. (1978). *Manias, Panics, and Crashes: A History of Financial Crises*. Basic Books.
20. Kolli, M., & Amarouche, K. I. (2023). The impact of financial technology on financial stability in the MENA zone. *Review of Socio-Economic Perspectives*, 8(1), 93-106.
21. McKinsey. (2018). How fintech is reshaping the financial services landscape. *McKinsey & Company*. Retrieved from <https://www.mckinsey.com/industries/financial-services/our-insights/how-fintech-is-reshaping-the-financial-services-landscape>
22. McKinsey, & Company. (2021). Digital Banking Trends Report.
23. Mourre, G., & Remillard, L. (2018). *The Euro: A History*. Polity Press.
24. Nguyen, Q. K., & Dang, V. C. (2022). The effect of FinTech development on financial stability in an emerging market: The role of market discipline. *Research in Globalization*, 5. Retrieved from <https://www.sciencedirect.com/science/article/pii/S2590051X22000260>
25. Nguyen, T. D., & Du, Q. L. (2022). The effect of financial inclusion on bank stability: Evidence from ASEAN. *Cogent Economics & Finance*, 10(1). doi:10.1080/23322039.2022.2040126.
26. O'Connell, B. (2020). History of PayPal: Timeline and Facts. *The Street*. Retrieved from <https://www.thestreet.com/technology/history-of-paypal-15062744>
27. Organisation for Economic Co-operation and Development. (2023). Income inequality Indicators. doi:10.1787/459aa7f1-en
28. PwC. (2022). Asian Fintech Trends Reports.
29. Rajan, R. G., & Zingales, L. (2019). Fintech: The New Financial Landscape. *Journal of Economic Perspectives*, 33(2), 3-20.
30. Kouladoum, J. C., Wirajing, M. A. K., & Nchofoung, T. N. (2022). Digital technologies and financial inclusion in Sub-Saharan Africa. *Telecommunications Policy*, 46(9), 102387.
31. Safiullah, M., & Paramati, S. R. (2022, August 03). The impact of FinTech firms on bank financial stability. *Electron Commer Res*. doi: 10.1007/s10660-022-09595-z
32. Stankeviciene, J., & Kabulova, J. (2022). Technological and Economic Development of Economy. 28(4), 1089–1114. doi:10.3846/tede,2022.1709.
33. Statista. (2022). Mobile Banking Trend Reports.
34. Temin, P. (1989). *The Trouble with Paper*. Harvard University Press.
35. Iwedi, M., & Wachuku, P. I. (2023). Naira Redesign and Economic Growth in Nigeria: Prospects and Challenges. *Journal of Accounting and Financial Management*, 9(1), 23-28.
36. The Payment Association. (2020, October 12). Fintech: The History and Future of Financial Technology. *Emerging Payments Ventures Limited*. Retrieved from https://thepaymentsassociation.org/filter_categories/regulation-and-compliance/
37. Tutor2u. (2023). Financial instability. Retrieved from <https://www.tutor2u.net/economics/topics/financial-instability>
38. UN Economic Commission for Africa. (2022). Regulatory Frameworks for FinTech in Africa.
39. UNDP in Africa. (2020, April 11). About Africa. *The Original*.
40. United Nations. (2010, April 20). Political Definitions of Major Regions. *The Original*.
41. United Nations Development Programme. (2023). Sustainable Development Goals. Background on the goals. *Transitioning from the MDGs to the SDGs*. Retrieved from <https://www.undp.org/sdg-accelerator/background-goals>
42. Windmill. (2023). All About Fintech: History, Development, and Future. *Windmill Editorial Team*. Retrieved from <https://www.windmill.digital/all-about-fintech-history-development-and-future/>
43. World Bank. (2015). Financial Inclusion and Fintech: Opportunities and Challenges. *World Bank*. Retrieved from <https://oeknowledge.worldbank.org/handle/1098/21035>
44. World Bank. (2017). *The Global Findex Database 2017*. Washington, DC, USA. Retrieved from <https://globalfindex.worldbank.org/>
45. World Bank. (2019). Corporate Governance Reforms in Commercial Banks: Promoting Stability and Transparency.

46. World Bank. (2020). Global Standards for Digitalisation in Financial Transactions.
 47. World Bank. (2022). *Financial Technology and Financial Inclusion in Developing Countries*. Washington, DC: World Bank.
 48. Wysokińska, Z. (2021). A Review of the Impact of the Digital Transformation on the Global and European Economy. *Comparative Economic Research*, 24, 75–92

Appendices

Appendix 1: Panel Data Heteroscedasticity Wald Test

lzsore	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
normal_FT	.1267652	.256976	0.49	0.622	-.3790849	.6326153
normal_FI	.3465375	.2271942	1.53	0.128	-.100688	.7937629
LQAD5	-.2371151	.0694621	-3.41	0.001	-.3738494	-.1003808
INF	.0109698	.0052159	2.10	0.036	.0007024	.0212373
FDI	-.0095264	.003939	-2.42	0.016	-.0172803	-.0017726
_cons	3.388436	.2609861	12.98	0.000	2.874692	3.90218
*** Panel Data Heteroscedasticity Wald Test						
Ho: Panel Homoscedasticity - Ha: Panel Heteroscedasticity						
- Wald Test:	LogE2 = X	=	68.5705	P-Value >	Chi2(1)	0.0000

Appendix 2: Test of Parameter Constancy

A Random-coefficients regression	Number of obs	=	286			
Group variable: id	Number of groups	=	22			
Time variable: years	Obs per group:					
	min	=	13			
	avg	=	13.0			
	max	=	13			
	Wald chi2(5)	=	3.09			
	Prob > chi2	=	0.6868			
lzsore	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
normal_ft	.6329528	8.921983	0.07	0.943	-16.85381	18.11972
normal_finclu	-4.26999	9.282901	-0.46	0.646	-22.46414	13.92416
lfs5	-.1268785	.100767	-1.26	0.208	-.3243782	.0706211
inf	.0037003	.006272	0.59	0.555	-.0085926	.0159933
fdi	-.0078707	.0101868	-0.77	0.440	-.0278364	.012095
_cons	2.862385	.3712036	7.71	0.000	2.13484	3.589931
Test of parameter constancy: chi2(126) = 7449.31				Prob > chi2 = 0.0000		

Appendix 3: Test for Autocorrelation in Panel Data.

Wooldridge test for autocorrelation in panel data				
H0: no first-order autocorrelation				
F(1, 21) = 17.243				
Prob > F = 0.0005				
Variable	CD-test	p-value	average joint T	mean ρ mean abs(ρ)

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Lzscore	+ .583	0.560	13.00	+ 0.01	0.37	
normal_FT	+ 26.66	0.000	13.00	+ 0.49	0.62	
normal_FI	+ 17.264	0.000	13.00	+ 0.32	0.62	
LQAD	+ 12.187	0.000	13.00	+ 0.22	0.44	
INF	+ 7.662	0.000	13.00	+ 0.14	0.45	
FDI	+ 2.27	0.023	13.00	+ 0.04	0.38	

Appendix 4: Test for Cross-Sectional Dependence

Pesaran (2015) test for weak cross sectional dependence	
Post estimation. H0: errors are weakly cross sectional dependent.	
CD = -1.395	
p-value = 0.163	
. xtcsd, frees	
Frees' test of cross sectional independence = 1.357	
Critical values from Frees' Q distribution	
alpha = 0.10 : 0.1984	
alpha = 0.05 : 0.2620	
alpha = 0.01 : 0.3901	

Appendix 5: Levin-Lin-Chu unit-root test for Individual variables

Levin-Lin-Chu unit-root test for IZSCORE		

H0: Panels contain unit roots	Number of panels =	22
Ha: Panels are stationary	Number of periods =	13
AR parameter: Common	Asymptotics: N/T -> 0	
Panel means: Included		
Time trend: Not included		
ADF regressions: 1 lag		
LR variance: Bartlett kernel, 7.00 lags average (chosen by LLC)		

Statistic	p-value	

Unadjusted t	-10.7614	
Adjusted t*	-5.2601	0.0000

Levin-Lin-Chu unit-root test for FinTech		

H0: Panels contain unit roots	Number of panels =	22

Ha: Panels are stationary	Number of periods =	13

AR parameter: Common	Asymptotics: N/T ->	0
Panel means: Included		
Time trend: Not included		

ADF regressions: 1 lag		
LR variance: Bartlett kernel, 7.00 lags average (chosen by LLC)		

	Statistic	p-value

Unadjusted t	-10.0664	
Adjusted t*	-6.3033	0.0000

Levin-Lin-Chu unit-root test for LQAD		

H0: Panels contain unit roots	Number of panels =	22
Ha: Panels are stationary	Number of periods =	13

AR parameter: Common	Asymptotics: N/T ->	0
Panel means: Included		
Time trend: Not included		

ADF regressions: 1 lag		
LR variance: Bartlett kernel, 7.00 lags average (chosen by LLC)		

	Statistic	p-value

Unadjusted t	-8.2071	
Adjusted t*	-4.5568	0.0000

Levin-Lin-Chu unit-root test for INF		

H0: Panels contain unit roots	Number of panels =	22
Ha: Panels are stationary	Number of periods =	13

AR parameter: Common	Asymptotics: N/T ->	0
Panel means: Included		
Time trend: Not included		

ADF regressions: 1 lag		
LR variance: Bartlett kernel, 7.00 lags average (chosen by LLC)		

	Statistic	p-value

Unadjusted t	-7.1120	
Adjusted t*	-4.5434	0.0000

Levin-Lin-Chu unit-root test for FDI		

H0: Panels contain unit roots	Number of panels = 22	
Ha: Panels are stationary	Number of periods = 13	

AR parameter: Common	Asymptotics: N/T -> 0	
Panel means: Included		
Time trend: Not included		

ADF regressions: 1 lag		
LR variance: Bartlett kernel, 7.00 lags average (chosen by LLC)		

	Statistic	p-value

Unadjusted t	-7.6407	
Adjusted t*	-2.2705	0.0116

Appendix 6: The Prais-Winsten regression, correlated panels corrected standard errors (PCSEs) Analysis

Prais-Winsten regression, correlated panels corrected standard errors (PCSEs)						
Group variable: id	Number of obs =		254			
Time variable: years	Number of groups =		22			
Panels: correlated (unbalanced)	Obs per group:					
Autocorrelation: panel-specific AR(1)	min =		2			
Sigma computed by casewise selection	avg =		11.545455			
	max =		13			
Estimated covariances =	253	R-squared =	0.7762			
Estimated autocorrelations =	22	Wald chi2(6) =	115.21			
Estimated coefficients =	7	Prob > chi2 =	0.0000			

	Panel-corrected					
zscore	Coefficient	std. err.	z	P> z	[95% conf. interval]	

norm_ft	.9266522	.318264	2.91	0.004	.3028662	1.550438
lqad	-.0807616	.0209421	-3.86	0.000	-.1218074	-.0397157
inf	.0617692	.0215242	2.87	0.004	.0195825	.1039559
lfdi	.2058077	.0894063	2.30	0.021	.0305747	.3810408
pop	-.0086378	.0183242	-0.47	0.637	-.0445526	.027277
rem	.0747897	.0457259	1.64	0.102	-.0148313	.1644108
_cons	16.02808	.8511943	18.83	0.000	14.35977	17.69639

rhos =	.9428822	.5909281	1	.9766729	1	1

