Digital Payment Fraud and Bank Fragility: Evidence from Deposit Money Banks in Nigeria

Rahmon A. Folami,[†] Ganiu O. Yinusa[‡] & Anu K. Toriola[§]

Abstract

Digital payment is revolutionising the banking sector globally, offering real time, convenient and efficient services to customers. However, this transformation is also creating new challenges including digital payment fraud. This study investigated the relationship between digital payment fraud and bank fragility in Nigeria's deposit money banks. The study used the Panel Fully Modified Least Squares (FMOLS) method to analyse the data collected from the annual report and statement of accounts of a sample of fourteen deposit money banks over the period of ten years (2014 to 2023). The findings revealed that digital payment fraud exerts a significant effect on bank fragility, with implications for profitability returns. Additionally, the study highlighted the importance of bank size as a mitigating factor in reducing fragility and enhancing financial performance. These findings contribute to the understanding of the risks associated with digital payment fraud and provide insights for policymakers and practitioners in addressing this growing concern in the Nigerian banking sector. The study recommended the need for banks to prioritise and strengthen Cybersecurity measures and implement effective fraud detection systems to mitigate the risks associated with digital payment fraud.

Keywords: Digital Payment Fraud; Bank Fragility; Bank Size; Fully-Modified OLS
JEL Classification Codes: B26, C33, E42, G21

[†] Department of Banking and Finance, Olabisi Onabanjo University, Ago-Iwoye, Nigeria. Correspondence Email: abeylinkeco@gmail.com

[†]Department of Banking and Finance, Olabisi Onabanjo University, Ago-Iwoye, Nigeria, Email: yinusa2016@gmail.com

[§] Department of Economics, Hallmark University, Ijebu-Itele, Nigeria. Email:aktoriola@hallmarkuniversity.edu.ng

1. Introduction

In the rapidly evolving landscape of financial transactions, digital payment systems have transformed how individuals and businesses manage their financial activities. The convenience and efficiency brought about by innovations such as mobile banking, internet banking, and point-of-sale (POS) platforms have significantly contributed to financial inclusion and economic growth in Nigeria. However, these advancements have also introduced new challenges, particularly for Deposit Money Banks (DMBs), where the risk of digital payment fraud is increasingly prominent. The rise in fraud not only threatens the financial integrity of these institutions but also undermines customer trust and overall bank stability (Omondi, 2015; Banna *et al*., 2022).

Digital payment fraud, which includes ATM fraud, mobile banking fraud, and internet banking fraud, poses a significant threat to the stability of Nigerian banks. Kanu and Isu (2020) submit that criminals employ sophisticated techniques, such as card skimming, phishing, malware attacks, SIM card swapping, and PIN theft, to compromise the security of customer funds and personal information. The complexity and variety of fraud techniques highlight the evolving nature of cybercrime in the banking industry. Malware attacks for instance, target banking systems and mobile devices to gain unauthorized access to customer accounts, while SIM card swapping allows fraudsters to intercept two-factor authentication codes sent to customers' mobile phones. Each of these methods undermines the security protocols that banks put in place, revealing systemic vulnerabilities in the digital payment ecosystem (Okoye *et al*., 2024).

As noted by Okafor (2019), the proliferation of digital payment systems has created opportunities for financial empowerment. However, it has also left banks vulnerable to fraud, which can lead to financial losses, reputational damage, and legal or regulatory challenges. These factors collectively erode customer confidence and contribute to bank fragility (Akintoye *et al*., 2022).

Bank fragility, in this context, refers to the susceptibility of banks to financial distress due to the impact of fraud on their deposit liabilities and capital reserves. When fraud results in significant financial losses, banks face increasing regulatory scrutiny and legal penalties, which, combined with a loss of customer trust, can weaken their financial standing (Beck *et al*., 2016; Kanu & Okafor, 2013).

Financial losses incurred by banks as a result of fraud can be substantial, straining their financial resources and reducing their capacity to lend. This, in turn, affects the banks' profitability and overall financial health. Moreover, fraud often results in significant reputational damage, as customers lose confidence in the bank's ability to safeguard their assets. When fraud occurs, customers may revert to cash-based transactions or opt for alternative financial service providers, further weakening the affected bank's competitive position (Jolaiya, 2024).

In addition to financial and reputational risks, banks must also contend with legal and regulatory challenges that arise from digital payment fraud. Nigerian banks are subject to strict regulatory frameworks designed to protect customer funds and ensure the stability of the financial system. When fraud occurs, banks may face penalties, increased regulatory scrutiny, and the possibility of legal action from affected customers. Compliance costs may also rise, as banks are forced to invest in more sophisticated fraud detection and prevention systems to meet regulatory standards. Failure to comply with these regulations not only invites financial penalties but can also lead to a loss of operating licenses in severe cases, further compounding the fragility of the banking sector (Ashiru, Balogun & Paseda, 2023).

Given these challenges, this study aims to investigate the link between digital payment fraud and bank fragility within Nigeria's DMBs, providing empirical evidence on how fraud can contribute to financial instability. By understanding this relationship, we can assess the extent to which specific types of fraud, such as ATM, mobile, and internet banking fraud, contribute to the instability of banks in Nigeria's financial system. The research will adopt an empirical methodology to analyse data on digital payment fraud and its effects on bank fragility. The study's results will provide valuable insights into how different fraud mechanisms undermine the stability of Nigeria's banking sector. Additionally, the study will offer value to the existing body of knowledge by addressing the gaps in literature related to digital payment fraud in developing economies, particularly Nigeria. Robustness checks will be conducted to ensure the reliability of the results, and policy implications will be drawn from the findings. Specifically, recommendations will be provided for strengthening the Nigerian banking system against fraud-induced vulnerabilities.

The limitations of this study include data constraints and the difficulty in isolating the effects of fraud from other external factors that may contribute to bank fragility. Despite these limitations, the research will provide a strong foundation for future studies on digital payment fraud and financial stability in emerging markets.

In the following sections, the study will be organised as follows: Section 2 reviews relevant literature on digital payment fraud and bank fragility. Section 3 outlines the empirical methodology, followed by Section 4, which presents the results of the analysis. The section 5 discusses the policy implications of the findings and the final section concludes the study by highlighting its recommendations and potential areas for future research.

2. Literature Review

Digital payment fraud encompasses fraudulent activities that occur as a result of the use of modern payment channels. These frauds are associated with various malicious actions such as card theft, PIN theft, hacking, phishing, cloning, and data theft, which exploit vulnerabilities within the banking system. According to Omondi (2015), the presence of banking innovations has facilitated the occurrence of various types of new frauds. According to Zouari and Abdelmalek (2020), digital payment fraud is an inherent risk in payment innovation, which banks and similar financial institutions must design effective risk management strategies to effectively reduce possible losses. Akintoye *et al*. (2022) pointed out that the digital payment in the banking sector does not only bring about convenience and efficiency but also amplifies the inherent risks associated with these innovative channels. These are new forms of financial malpractices emanating from the new payment channels comprising of ATM banking, mobile and internet banking, and Point of Sales (POS) banking (Nigeria Deposit Insurance Commission: NDIC, 2021).

ATM banking fraud involves the exploitation of vulnerabilities in automated teller machines (ATMs) to gain unauthorised access to individuals' accounts and funds. Fraudsters employ various techniques such as card skimming, where devices are installed on ATMs to capture card information, or PIN theft, where hidden cameras or keypad overlays are used to obtain personal identification numbers. (NDIC, 2021; Okafor, 2019).

Mobile banking fraud occurs when fraudsters target mobile banking applications or exploit weaknesses in the mobile banking infrastructure to gain unauthorised access to users' financial information (Banna *et al*., 2022). Tactics such as SIM card swapping, phishing attacks via text messages or malicious apps, or malware infections can compromise the security of mobile banking transactions.

Internet banking fraud involves fraudulent activities conducted through online banking platforms (Okafor, 2019; Akintoye *et al*., 2022; Kasmir *et al*., 2022). Fraudsters may employ various tactics, including hacking, phishing emails or websites, unsecure logins, cloning of websites, or data theft (NDIC, 2021).

The concept of bank fragility refers to the vulnerable state of a bank when it is exposed to financial instability and potential crises (Beck *et al*., 2016). This state is characterised by various factors, including inadequate capital reserves, poor asset quality, liquidity challenges, bank fraud, and susceptibility to external shocks and internal weaknesses. Insufficient capital reserves can contribute to bank fragility by limiting the bank's ability to absorb losses and maintain solvency. A lack of capital buffers increases the bank's vulnerability to financial shocks and economic downturns, heightening the risk of insolvency (Banna *et al*., 2022). Poor asset quality, marked by a high proportion of non-performing loans or risky assets, can also contribute to bank fragility. These assets generate lower returns or result in significant losses, eroding the bank's profitability and overall financial health. Additionally, liquidity problems, such as difficulties in obtaining sufficient funding or meeting short-term obligations, further weaken the bank's stability (Kasri *et al.*, 2022). Internal weaknesses within a bank, such as inadequate risk management practices, ineffective governance, or deficiencies in internal controls, exacerbate its vulnerability to financial instability. These weaknesses increase the likelihood of mismanagement, fraud, or misconduct, which further contribute to bank fragility (Kanu & Isu, 2016; Offiong, Udoka, & Ibor, 2016). Bank fragility has far-reaching implications for the stability of the banking system and the broader economy. It can trigger a loss of depositor confidence, as customers withdraw their funds due to concerns about the bank's viability. This, in turn, can lead to a liquidity crisis or a bank run, intensifying financial instability. To mitigate these adverse effects, regulators, policymakers, and stakeholders actively monitor and address bank fragility, aiming to maintain a stable banking sector and a healthy economy overall (Kasri *et al*., 2022).

Theoretically, the Fraud Diamond Theory, proposed by Wolfe and Hermanson (2004), expands upon the Fraud Triangle Theory and offers a comprehensive framework for understanding digital payment fraud and its impact on bank fragility. This theory takes into account four key factors: pressure, opportunity, rationalisation, and capability. By incorporating the capability factor, the Fraud Diamond Theory provides a more nuanced understanding of fraud dynamics, particularly in cases involving collaboration between staff and external actors. Fraud diamond theory assumes that individuals, both external actors and staff members, may face pressures that motivate them to engage in digital payment fraud. These pressures can arise from various factors such as economic circumstances, debts, or personal hardships. Furthermore, the theory recognises that fraud occurs when individuals identify vulnerabilities within the payment ecosystem, such as weaknesses in security measures or gaps in internal controls. These opportunities are exploited by fraudsters to carry out fraudulent activities (Abdullah &Mansor, 2015).

Rationalisation plays a crucial role in the fraud diamond theory, as individuals engaging in digital payment fraud may justify their behaviour based on grievances against the organisation or perceive the fraud as a means to rectify perceived injustices or financial imbalances. This rationalisation helps them reconcile their actions with their own moral compass. The fourth factor in the fraud diamond theory is capability. It highlights the importance of individuals possessing the necessary skills, knowledge, and access to execute digital payment fraud successfully. In cases where staff members collaborate with external actors, their internal position, understanding of processes and access to information can significantly contribute to the capability factor.

Fraud Diamond Theory is highly relevant in understanding the relationship between digital payment fraud and bank fragility. By considering the four dimensions, the theory provides a more comprehensive perspective on the underlying factors contributing to fraud (Normah & Hesri, 2010). It emphasises the need for robust internal controls, enhanced employee training, and stronger authentication mechanisms to mitigate fraud risks. Implementing these measures helps safeguard the stability of banks and protect customer assets. Financial institutions can utilise this framework to develop targeted strategies that prevent fraud, strengthen security measures, and foster a culture of ethics and integrity.

In order to ensure the comprehensiveness of this study on the effect of digital payment fraud on bank fragility, it is crucial to thoroughly examine previous empirical studies. These studies provide valuable insights into the objectives, methodologies, and findings related to the study. Omondi (2015) investigated the association between financial innovation and financial fraud in Kenyan commercial banks. The study used both primary and secondary data and discovered a link between financial innovation and cases of financial fraud in the banking sector. Similarly, Okafor (2019) conducted a comparative analysis to investigate the patterns of bank fraud before and after the introduction of payment innovation in Nigeria. Through trend analysis techniques and primary and secondary data, the study revealed a higher occurrence of fraud during the era of payment innovation compared to the traditional banking era. These findings align with the conclusions of Beck *et al*. (2016), that innovation in the banking sector has both positive and negative consequences. While innovation contributes to growth, it also introduces vulnerabilities that can lead to bank fragility and financial crises.

Further studies, such as Kasri *et al*. (2022) and Banna *et al*. (2022), have focused on exploring the effect of digital payment systems on the financial stability of banks in emerging economies. These studies highlight that the widespread adoption of payment innovation can increase unauthorised transactions, posing significant threats to the stability of banks. In addition to examining the impact of payment innovation fraud, it is important to consider the broader effects of fraud on bank performance. Owolabi (2010) conducted a study in Nigeria, revealing that bank fraud frequently leads to a decline in output and, in some cases, the collapse of banks. This underscores the detrimental effects of fraud on the overall financial health of banking institutions.

Building upon Owolabi's findings, Wewege *et al.* (2020) emphasised the negative consequences of fraud on banks' ability to fulfill their short-term commitments and optimise shareholders' capital.

They stressed the importance of prioritising forensic accountant facilities within banking institutions to detect and prevent fraud. Furthermore, conducting thorough evaluations of internal management structures is crucial for identifying and rectifying any weaknesses that could be exploited by fraudulent activities. Cavaliere *et al*. (2021) explored the empirical link between internet fraud and financial performance of banks in Lebanon. The study used survey method to collect primary data and analysed using a Likert scale. The study suggested that the higher the fraud, the poorer the bank's performance and the more online fraud occurs, the greater the negative influence on bank financial performance.

In conclusion, existing studies have examined the effect of payment innovation from the perspectives of bank profitability metrics. However, there is a knowledge gap in how digital payment frauds affect bank fragility using Z-score approach. Z-Score is traditionally associated with the issue of bank resilience and therefore more a measure of financial soundness (Borroni &Rossi, 2019), a measure of bank fragility (Beck *et al.,* 2016), used for bank stability (Prajapati & Shah, 2019). Addressing this gap will enable policy makers and DMBs in Nigeria to design strategies suitable for digital payment system and other factors contributing to several challenges in the sector.

3. Methodology

This study adopts e*x-post facto* research design with panel data because the adopted variables will be sourced from the annual reports of selected DMBs over time. The study spanned through 2014 and 2023 under the prevailing payment innovation. The sample size for this study is thirteen (13) listed DMBs in Nigeria. The selected DMBs have met the listing conditions and also have international coverage which means they engage both local and cross boarder payment which is another core innovation function in the modern banking payment.

The data is sourced from DMBs Annual Report, Central Bank of Nigeria Annual Statistical Bulletin and Nigeria Deposit Insurance Corporations (NDIC) Annual Reports. The data are categorised into three. First category comprises of data on dependent variables; return on asset, return on equity, net interest margin and standard deviations of these returns. Second category consists of data on independent variables; values of transactions and frauds from ATM, mobile and internet banking channels. The third category encompasses data on moderating variables which are considered influential to digital payment and bank fragility. Bank size, capital adequacy, and asset quality are the moderating variables for this study. This study adopted Fully Modified Ordinary Least Square (FMOLS) for the analysis.

The study of Beck *et al.* (2016) used Z-score to measure dark effect of financial innovation where bank fragility was measured using Z-score. Also, Nguena (2020) measured dark effect of Fintech innovation on bank performance with Z-score. The specified model of Beck *et al*. (2016) and adopted by Nguena (2020) is as follows:

$$Z_{i,k,t}=aXk_{t-1}+\alpha Xk_{t-1}+\beta Y_{i\ t-1}+\gamma FI_{i,t-1}+\delta FI_{i,t-1}+\varepsilon_{i,k,t} \quad (1)$$

Where Z is the log of the z -score of bank k in country i in period t and measures bank fragility; X is a vector of bank characteristics, Y is a vector of country characteristics and FI is bank-level indicator of financial innovation. Therefore, this study modified this model as follows:

$$BF_{it} = a_0 + \sum_{j=1}^{p} \beta_j DPF_{it} + \sum_{j=1}^{q} \beta_j DP_{it} + \sum_{k=1}^{r} \beta_k CAR_{it} + \sum_{j=1}^{s} \beta_j AQ_{it} + \sum_{j=1}^{s} \beta_j BZ_{it} + \mu_t \quad (2)$$

Where:

BF = *Bank Fragility*
DPF = *Vector for Digital Payment Fraud variables (ATMF, MBF and IBF)*
DP = *Vector for digital payment variables (ATM banking, mobile, POS and internet banking payment channels)*
CAR= *Capital Adequacy Ratio*
AQ= *Asset Quality*
BZ= *Bank Size*
μ_t= *The error term*

Table 3.1 Variables Measurement

S/N	Variable	Proxy	Measurement
		Dependent Variable	
1	Bank Fragility	Z-score (ROA, ROE & NIM)	$Zs = \frac{ROA + E/A}{\sigma ROA}$
		Independent Variables	
2	Digital Payment Fraud	Values of ATM fraud, mobile banking fraud and internet banking fraud	Vector of value of ATM fraud, mobile banking fraud and internet banking fraud
3	Digital Payment	Values of transactions on ATM, POS, mobile and internet banking payment channels	Vector of ATM value of POS, mobile and internet banking payment channels transactions
		Moderating Variables	
4	Bank Size	Total Assets	BZ = Natural log of total assets
5	Capital Adequacy	CAR	$CAR = \frac{Tier\ 1\ Capital + Tier\ 2\ Capital}{Risk\ Weighted\ Assets}$
6	Assets Quality	Asset Quality	$AQ = \frac{Non-PerformingLoans}{TotalAssets}$

4. Results and Discussion

The descriptive statistics of dependent and independent variables used in the study are presented in Table 4.1.

Table 4.1: Descriptive Statistics

	ROA	ROE	NIM	ATMB	IB	MB	POSB	ATMF	IBF	MBF	AQ	CAR	BZ
Mean	0.02	0.16	0.04	5,415	104,22	2,757	221,040	1.00	1.57	0.94	0.04	0.13	7.35
Median	0.01	0.11	0.04	5,713	62,061	929	1,084	0.91	1.22	0.94	0.03	0.17	6.66
Maximum	0.07	6.26	0.13	9,456	314,001	9,908	1,240,242	2.64	3.85	1.93	0.30	0.64	9.99
Minimum	(0.11)	(3.94)	0.00	1,985	17,583	32	48	0.48	0.58	0.32	0.00	(2.15)	4.92
Std. Dev.	0.02	0.73	0.02	2,226	98,424	3,422	445,890	0.61	1.04	0.44	0.05	0.31	1.37
Skewness	(1.72)	4.26	0.89	0	1	1	2	1.77	1.25	0.77	2.72	(5.83)	0.49
Kurtosis	12.81	49.92	5.72	2	3	3	4	5.42	3.13	3.22	11.34	40.33	1.64
Jarque-Bera	630.91	13,267.59	61.73	6	33	29	60	107.08	36.58	14.16	578.86	8,922.05	16.41
Probability	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Observations	140	140	140	140	140	140	140	140	140	140	140	140	140

Source: Authors' Computations (2024) using E-views 9

The descriptive statistics reveals key insights about the variables. The average Return on Assets (ROA) is 0.02%, indicating a modest level of profitability, with a range between -0.11% and 0.07%. The distribution of ROA is negatively skewed and displays a peaked shape, suggesting more lower values. The Return on Equity (ROE) shows an average of 0.16%, with a wide range from 3.94% to 6.26%. The distribution of ROE is positively skewed and highly leptokurtic, indicating heavy tails and a very peaked shape. The Net Interest Margin (NIM) has an average of 0.04% and ranges from 0.00% to 0.13%. The distribution of NIM is positively skewed and displays leptokurtic characteristics.

The mean values of various banking transactions, such as ATM (-0.7053), mobile (-14.858), internet (-2.5092), and POS (-46.8144), indicate average declines in these activities. This suggests a downward trend in customer usage of traditional banking channels, possibly due to the increasing adoption of digital banking services. The wide range of minimum and maximum values for these transactions (ATM: -9.6970 to 0.4575, mobile: -163.36 to 0.7793, internet: -29.999 to 0.5677, POS: -508.267 to 0.8853) demonstrates significant fluctuations over time, reflecting the changing preferences and behaviours of bank customers.

Bank Size (BZ) shows an average size of N7.35 billion, with a range from N4.92 billion to N9.99 billion, and a slightly positively skewed and approximately normal distribution. The Capital Adequacy Ratio (CAR) has an average of 13%, with a range from -2.15% to 64%, a negatively. The inclusion of asset quality in this study is significant due to its influence on investment in technology. Banks with high-quality assets are expected to be more innovative. The standard deviation for asset quality is 5%, indicating a moderate level of variability. The distribution of asset quality is positively skewed, with a skewness measure of 2.72, suggesting an asymmetrical distribution with a longer tail on the right side. The kurtosis measure of 11.34 indicates a leptokurtic distribution, implying heavy tails and a more peaked shape compared to a normal distribution.

The Jaque-Bera test, which assesses skewness and kurtosis, indicates a value of 578.86, which is significantly greater than zero. This result suggests that the sample data for asset quality does not follow a normal distribution pattern.

Table 4.2: Correlation Matrix

	ROA	ROE	NIM	ATMB	IB	MB	POSB	ATMF	IBF	MBF
ROA	1.00	0.24	(0.04)	(0.02)	(0.00)	0.01	(0.01)	0.05	0.09	0.02
ROE		1.00	(0.03)	(0.06)	(0.04)	(0.03)	(0.02)	(0.02)	0.03	0.04
NIM			1.00	0.24	0.17	0.16	0.13	0.05	(0.08)	(0.04)
ATMB				1.00	0.90	0.87	0.74	0.39	(0.13)	0.26
IB					1.00	0.99	0.94	0.23	(0.19)	0.33
MB						1.00	0.91	0.18	(0.22)	0.31
POSB							1.00	0.07	(0.25)	0.26
ATMF								1.00	0.81	0.74
IBF									1.00	0.57
MBF										1.00

Source: Authors' Computation (2024) Using E-views 9

The correlation analysis reveals that Return on Assets (ROA) has a positive but weak correlation with Return on Equity (ROE), indicating a tendency for both variables to move in the same direction. ROA also shows positive correlations with Mobile Banking, ATM Fraud, and Mobile Banking Fraud, supporting the notion of the dark side effect of payment innovation. However, ROA has negative relationships with Net Income Margin (NIM), ATM Banking, Internet Banking, and Point of Sales (POS) Banking, contradicting the profit-induced innovation hypothesis. Return on Equity (ROE) has positive associations with ROA, Internet Banking Fraud, and Mobile Banking Fraud, but negative associations with NIM, ATM Banking, Internet Banking, POS Banking, and ATM Fraud. Net Income Margin (NIM) exhibits positive correlations with various forms of financial innovation and negative correlations with ROA, ROE, Internet Banking Fraud, and Mobile Banking Fraud, highlighting the relevance of NIM as a performance indicator in the banking sector.

For stationarity test, two panel unit roots were carried out. Table 4.3 and 4.4 indicate the IPS and LLC results respectively.

Table 4.3: Im, Pesaran and Shin (IPS) W-stat Panel Unit Root Test Results for the variables

	Level		First Difference	
	Statistic	Prob.	Statistic	Prob.
Digital Payment l Vector	1.96104	0.9751	-2.0994	0.0179
Digital Payment Fraud Vector	-0.56186	0.2871	-1.2762	0.1009

Source: Authors' Computation (2024) Using E-views 9
** Significant at 5% level of significance

Table 4.3 shows that the IPS results for all variables are not stationary at level but tend stationary at first difference for payment innovation vector. These results was further subjected to LLC test and the results as shown in table 4.4 revealed that all the data are non-stationary at level but becomes stationary at first difference in accordance with the IPS result.

Table 4.4: Levin, Lin & Chu (LLC) t* Panel Unit Root Test Results

	Level		First Difference	
	Statistic	Prob.	Statistic	Prob.
Digital Payment Vector	2.7038	0.0034	-12.4730	0.0000
Digital Payment Fraud Vector	-7.7368	0.0000	-9.8907	0.0000

Source: Authors' Computation (2024) Using E-views 9
** Significant at 5% level of significance
The result of Pedroni residual cointegration test is presented in table 4.5 below:

Table 4.5: Pedroni Residual Cointegration Test Result

Common Auto-Regressive coefficients (within-dimension)	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	-0.569527	0.7155	-1.533746	0.9375
Panel rho-Statistic	3.294797	0.9995	3.524032	0.9998
Panel PP-Statistic	-7.131043	0.0000	-6.138622	0.0000
Panel ADF-Statistic	-6.044865	0.0000	-4.784654	0.0000

Individual Auto-Regressive coefficients (between-dimension)	Statistic	Prob.
Group rho-Statistic	4.976795	1.0000
Group PP-Statistic	-9.440996	0.0000
Group ADF-Statistic	-5.674086	0.0000

Source: Authors' Computation (2024) Using E-views 9

In this case, the rejection of the null hypothesis of no cointegration by the Panel PP and ADF statistics within the common auto-regressive coefficients (within-dimension) indicates that there is a long-term relationship among the variables considered in the panel analysis. Similarly, the rejection of the null hypothesis by the Group PP and ADF statistics within the individual auto-regressive coefficients (between-dimension) implies that there are also long-term relationships among the variables across different groups or dimensions.

These findings are important because they suggest that changes in one variable can have a lasting impact on the others, and the relationships identified through cointegration can provide insights into the underlying dynamics and interactions among the variables. Table 4.6 below presents the result of the FMOLS analysis, demonstrating that the panel has met all the required conditions.

Table 4.6: Panel Fully Modified Least Squares (FMOLS) Result

	ZPROE	ZPROA	ZPNIM
Digital Payment Fraud	1.0198	0.8226	-0.3985
Vector	(0.0384)*	(0.0429)*	(0.0365)*
	[2.6252]	[1.9221]	[-1.081]
Digital Payment Vector	0.6219	0.0286	0.2851
	(0.0231)*	(0.2590)	(0.2230)
	[2.6447]	[0.1106]	[1.2782]
Asset Quality	-0.0726	0.0400	-0.0145
	(0.1786)	(0.1968)	(0.1695)
	[-0.4064]	[0.2032]	[-0.0856]
Capital Adequacy	0.3643	0.8103	0.8679
Ratio	(0.06975)**	(0.07684)**	(0.06616)**
	[0.5223]	[1.0546]	[1.3118]
Bank Size	-2.7177	-1.8903	2.8222
	(0.0479)*	(0.0342)*	(0.0332)*
	[-3.5254]	[-2.2258]	[3.8594]
S.E regression	0.903980	0.872330	0.725304
Long-run variance	0.710000	0.861696	0.638825
Mean dependent var	-0.041172	-0.042007	0.144103
S.D Dependent var	0.914790	0.885828	0.890713

Source: Author's Computation Using E-views 9
*Significant at 5% level of significance
** Significant at 10% level of significance

The table 4.6 presents the results of a Panel Fully Modified Least Squares (FMOLS) analysis examining the relationship between Digital Payment Fraud and Bank Fragility. Bank fragility is measured using three variables: Z-score ROA, Z-score ROE, and Z-score NIM.

The Digital Payment Fraud Vector shows that an increase in Digital Payment Fraud is associated with an increase in Z-score ROE, as indicated by the coefficient estimate of 1.0198. This result is statistically significant at the 5% level. Additionally, an increase in Digital Payment Fraud is associated with a significant increase in Z-score ROA, with a coefficient estimate of 0.8226, indicating a positive relationship.

The Digital Payment Vector also demonstrates a positive association between Digital Payment and Z-score ROE, as indicated by the coefficient estimate of 0.6219, which is statistically significant at the 5% level. However, the coefficient estimate for Z-score ROA is not statistically significant, suggesting that Digital Payment may not have a significant impact on this measure of bank fragility. The coefficient estimate for Z-score NIM is also not statistically significant, indicating that Digital Payment does not have a significant effect on this aspect of bank fragility.

Examining the other independent variables, Asset Quality, Capital Adequacy Ratio, and Bank Size, the results reveal mixed findings. Asset Quality does not have a statistically significant impact on any of the bank fragility measures. The Capital Adequacy Ratio shows a significant effect on Z-score ROE, Z-score ROA, or Z-score NIM. This indicates that there is significant positive relationship between the capital regulations and the bank fragility measures. However, Bank Size exhibits significant associations with bank fragility. An increase in Bank Size is associated with a decrease in Z-score ROE and Z-score ROA, as indicated by the negative coefficient estimates of -2.7177 and -1.8903, respectively. These results are statistically significant 5% level. Moreover, Bank Size has a positive and significant effect on Z-score NIM, with a coefficient estimate of 2.8222, indicating that larger banks tend to have higher Z-score NIM values. Similarly, the coefficient of determination (R-square) value of 0.44 suggests that approximately 44% of the variations in bank fragility measures, such as Z-score ROA, Z-score ROE, and Z-score NIM, can be explained by changes in variables including payment innovations and payment innovation fraud at the firm level. This indicates that these variables have a substantial impact on bank fragility. Additionally, the standard error of the regression value of 0.725 supports the overall fitness of the model in explaining bank fragility.

Table 4.7: **Post-Test Analysis**

Post-Test	ZPROE	ZPROA	ZPNIM
Adjusted R^2	0.6214	0.6572	0.5883
F-statistics	32.296	13.892	41.761
p-Value	0.0184	0.0321	0.0246
Long-run Variance	0.0170	0.0327	0.0000

Source: Author's Computation Using E-views 9

The Adjusted R^2 values for ZPROE (0.6214), ZPROA (0.6572), and ZPNIM (0.5883) suggest that the models explain a substantial portion of the variance in each of the dependent variables. ZPROA, with the highest Adjusted R^2value of 0.6572, indicates the strongest model fit, while ZPNIM, with an Adjusted R^2 of 0.5883, indicates a relatively lower but still considerable explanatory power. The F-statistics for ZPROE (32.296), ZPROA (13.892), and ZPNIM (41.761) are all significant, with p-values below 0.05 (0.0184, 0.0321, and 0.0246, respectively). These results indicate that the models are statistically significant, rejecting the null hypothesis that the model coefficients are jointly zero. This significance supports the reliability of the models in explaining variations in the respective dependent variables. The long-run variance values, with ZPROE at 0.0170, ZPROA at 0.0327, and ZPNIM at 0.0000, reflect the expected variability in each variable over the long term. ZPNIM's long-run variance of 0.0000 suggests minimal long-term variability, possibly indicating a stable relationship or lower sensitivity to long-run shocks. In contrast, ZPROA's higher long-run variance (0.0327) indicates greater variability over time, which could be attributed to fluctuations in underlying factors affecting return on assets.

The results from Table 4.7 provide strong evidence for the models' explanatory power and statistical significance across all three variables. The high Adjusted R^2 values and significant F-statistics demonstrate that the post-test models are well-suited for explaining variations in ZPROE, ZPROA, and ZPNIM, although each variable exhibits different levels of long-term variability as indicated by the long-run variance values.

5. Discussion of Results.

The results of the analysis reveal significant economic implications regarding the relationship between digital payment fraud and bank fragility. The positive and statistically significant relationship between digital payment fraud and ROE, as well as ROA, indicates that fraudulent activities in digital payment channel can have detrimental effects on a bank's profitability. These findings support prior research conducted by Cavaliere *et al*. (2021), Owolabi (2010), and Beck *et al*. (2016), highlighting the importance of addressing digital payment fraud to safeguard the financial health of banks.

Furthermore, the significant relationship between digital payment fraud and NIM suggests that fraudulent activities do have a significant direct impact on a bank's net interest margin. This could be attributed to the specific nature of payment fraud and its direct effect on a bank's interest income and expenses. Nevertheless, it is crucial to acknowledge that payment innovation fraud can also have indirect implications for a bank's overall financial health and reputation, potentially affecting its ability to attract and retain customers and business partners, as noted by Okafor (2019) and Zouari and Abdlemalik (2020).

The significant relationship observed between bank size and bank fragility highlights an important factor in assessing vulnerability to financial distress. The negative coefficients for bank size in relation to Z-score ROE and Z-score ROA indicate that larger banks generally exhibit lower levels of fragility. This finding aligns with Beck *et al*. (2016), who established that larger banks have the capacity to reduce bank fragility through research and development efforts focused on minimizing inherent risks in payment and related innovations. The advantages of economies of scale, greater diversification of assets and liabilities, and increased market power enjoyed by larger banks contribute to enhanced stability and resilience. This supports the finding of Ilo *et al*. (2022). These factors enable larger banks to better withstand shocks and economic downturns, resulting in higher profitability.

Conversely, the positive relationship between bank size and NIM implies that larger banks tend to have higher net interest margins. This finding suggests that larger banks benefit from economies of scale, as their operational costs per unit decrease with size. This cost advantage allows larger banks to potentially offer more competitive interest rates to borrowers while maintaining profitable interest spreads. Furthermore, the extensive customer base and network of larger banks provide opportunities for cross-selling and offering a wide range of financial products and services. By leveraging their relationships and product offerings, larger banks can enhance customer loyalty, attract new customers, and generate additional fee-based income streams, contributing to overall profitability and net interest margins. It is essential to note that while larger banks enjoy these advantages; their success is contingent upon effective risk management practices, regulatory compliance, and the ability to adapt to evolving market conditions. Managing the risks associated with a larger customer base and maintaining the quality of lending activities remain critical considerations for larger banks to sustain their profitability and stability.

The occurrence of digital payment fraud imposes costs on banks, including indemnity costs and losses due to bank forgeries (NDIC, 2021). Studies indicate significant growth in electronic payment channels and an increase in losses due to frauds relating to payment innovation. These findings underscore the negative consequences of payment innovation fraud on bank performance, including lower returns on assets, returns on equity, and net interest margins.

In summary, this study validates previous research by highlighting the significant impact of digital payment fraud on bank fragility. The emergence of various fraudulent activities associated with digital payment, such as hacking, identity theft, phishing, and card cloning in ATM payment channel, mobile and internet banking payment channels reinforces the negative consequences brought about by digital payment. It is empirically established that digital payment fraud contributes to lower returns on assets and returns on equity for banks. These findings emphasise the importance of addressing digital payment fraud to safeguard the financial health of banks.

6. Conclusion and Recommendations

In conclusion, this study establishes that digital payment fraud has a substantial impact on bank fragility. It is observed that larger banks demonstrate lower levels of fragility and enjoy higher net interest margins. This relationship can be attributed to the advantages of economies of scale, greater diversification, and increased market power that larger banks possess. The findings highlight the need for effective measures to combat payment innovation fraud and recognise the importance of size and associated benefits in enhancing bank stability and profitability.

The study recommended that banks should prioritise strengthening Cybersecurity measures and implementing effective fraud detection systems to mitigate the risks associated with digital payment fraud. Regulatory bodies should establish and enforce robust frameworks to address payment innovation fraud, ensuring that banks have adequate safeguards in place to protect against fraudulent activities. Banks should focus on effective risk management practices to mitigate the potential vulnerabilities associated with payment innovation fraud and to maintain stability and resilience.

As a suggestion for further studies, future studies can investigate the specific types and methods of payment innovation fraud that have the most significant impact on bank fragility; explore the effectiveness of different fraud prevention and detection measures implemented by banks in addressing payment innovation fraud and compare across different countries or regions to assess the variations in the impact of payment innovation fraud on bank fragility.

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