# Financial Technology, Its Digital Fraud Effects on Financial Inclusion and Nigerian Economic Growth in 1985-2024: A Simultaneous Model Approach

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***Abstract***

*This study examined interconnected effects of financial technology on financial inclusion levels in conjunction with the growing prevalence of digital fraud in Nigeria economy 1985-2024. The study employed the following advanced econometric techniques; simultaneous equation model using two-stage Least Squares technique (ILS) estimate, Augmented Dickey-Fuller (ADF) tests, co-integration test and Granger causality test along with adjusted R- squared, Durbin-Watson statistic, f- statistic and t- statistic. Based on the above econometric techniques conducted, it was observed that financial fraud via fanatical technology services accessibility has significant effects on financial inclusion in Nigeria. Financial technology service penetration rate in Nigeria has significant effects on financial fraud via fanatical technology services accessibility. Gross domestic product and mobile and internet transaction system service in Nigeria has a positive influence on financial fraud via fanatical technology services accessibility. Fraud via fanatical technology services accessibility has significant impact on gross domestic product and mobile in Nigeria economy. The researcher recommends that; more emphasis of control should be placed on financial infrastructure technology innovation services upgrade and inter-security alter adoption which will be beneficial and its usage will significantly reach in addressing financial fraud via fanatical technology in Nigerian economy. There is need for CBN to addresses corporate governance in identifying fraud-risk factors within all banks, social network and should be implemented by all bank management teams on the supervisory of the central bank of Nigeria, Federal ministry of finance and NDIC.*

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## 1.Introduction

This apex financial institution in Nigeria is called central bank of Nigeria which started operation on July 1, 1959 with the primary aim of meeting the financial and commercial needs of the country economic activities. However, ever since sixty five years now, Nigeria banking institution has been advancing on information and communication technology which foster innovation, development and improving competitiveness in delivery their financial services for the country economic growth. This advancement of the financial industry service delivery which is now driven by technology is referred to as financial technology (Kamel 2005; Abiola in Gbegi and Adebisi 2014). Financial technology in this content of this study implies changing the landscape of financial investment management and improvement on application use in implementing and management of monetary services career choices and decision–making models for those in the finance industry. To this extent, bank industry in Nigeria has position themselves for industry transformation, including leveraging on the benefits of both human and artificial intelligence such as computer and other software, more general technology careers, such as cyber security which are beyond the traditional operation.

It is important to acknowledge in this study that CBN introduced electronic banking application in Nigeria in the year 2000 (CBN, 2017). The integration of electronic banking in the country was credited to the advancement of technology, such which embraced the use of mobile telephones in 2001 and increased access to personal computer and internet service facilities. Bara and Mudzingiri (2016) and Bourne and Attzs (2010) reveal that the proliferation of Nigerian banks into e-banking increased the financial inclusion and account ownership causal nexus by 56 percent.

In recent years, Nigeria's financial technology ecosystem has seen impressive development reflected in her economic growth. National Bureau of Statistics (2023) indicated that there are over 500 financial technology firms operating in the country, including the digital companies offering from banks and mobile network providers. Financial technology firm's account for nominal growth rate was observed at 39.57% year-on-year, reflecting an increase of 18.16 percent from the 21.41% recorded in the corresponding quarter of 2022. This figure is also 0.70 percent higher than the rate noted in the previous quarter 2021. As reported by the National Bureau of Statistics, the financial technology sector's contribution to the total Nominal GDP reached 12.52% in the fourth quarter of 2023. This marks an improvement over the 10.42% contribution observed in the corresponding quarter of 2022 and exceeds the 11.57% contribution from the preceding quarter National Bureau of Statistics (2023). Appiah-Otoo and Song, (2021) and Shim and Shin, (2016) reveal that performance of the GDP in 2023 and 2022 was primarily influenced by the financial technology Services sector, which experienced a growth of 3.98% and accounted for 56.55% to the Nigerian total gross domestic product.

Therefore, Nigeria financial services has witnessed a rapid evolution of technology based methods over time to achieve inclusive growth and economic growth access sectors to financial inclusion which has contributed or attracted to a surge in cyber fraud security risks by organized cyber criminal groups and state actors. Thus, vulnerabilities in cyber fraud are emerging at the front, middle, and back ends of the technology platforms that affect digital financial services.

With Nigeria recording an creasing GDP rate above 56 percent, 48 percent in financial inclusion, while an increasingly 0.19 to 0.22 percent for the last five years financial industrial fraud, the world bank and other International Agencies believe that the advent of financial technology will enhance the standards of the Nigerians but at the same view serve as an avenue for economic lose if no innovative solution measures are being implemented at national and global scales to tackle and minimize these presence threats and risks. Therefore, it is essential to analyze, from the standpoint of an economist's, the relationship between the advancement of financial technology, the promotion of financial inclusion and the rise of digital financial fraud in Nigeria.

**1.2 Statement of the problem**

Notwithstanding the financial institutions implementing and incorporating of the new technologies as a result of these technological advancements, such as electronic transactions, Mobil payment, Automation at the point of sale (POS), smart cards, digital checks, automated teller machines (ATM), and mobile phone banking with USSD codes etc, which has become more accessible for the populace of the country to utilize and be inclusive in the financial inclusion net, which in turn led to expansion of the country economic growth. Thus, there have been a significant financial losses suffered by the banking sector, individuals and businesses globally as a result of Cyber fraud or cybercrime and more specifically as a result of SWIFT (digital platform) Acharya and Kagan, (2008). One of the most significant impacts of cybercrime is financial in nature. This category of crime encompasses a variety of profit-motivated illicit activities, such as software incidents, online and email fraud, identity theft, and efforts to unlawfully acquire financial account details, credit card information, or other forms of payment card data (Ben, 2024). As a consequence of the rapid growth of technology-based financial services, the financial sector is encountering a growing number of cyber threats targeted at consumers, resulting in increased risks related to cyber security (Leon, 2017).

*Nigeria Inter-Bank Settlement System Plc* (NIBSS) (2023), state that Cyber fraud in Nigeria is the most common and threatening form of fraud with a new height raise from a total of 1,532 fraud instances totaling 21.29 billion naira were recorded, with a real loss of 11.69 billion naira predicted. Additionally, 2,352 fraud cases totaling 28.4 billion naira with an anticipated actual loss of 4.071 billion naira were reported in 2011. This is an increase of 53.5 percent. There were 10,612 fraud instances reported in 2014 compared to 3,786 in 2013, involving a total of 25.61 billion and 21.80 billion naira, respectively. This indicates a rise in the total amount involved of roughly 17.5%. Compared to the 5.76 billion naira in 2013, the predicted real loss for 2014 was 6.19 billion naira, indicating an increase of almost 7.5 percent (Sergius and James (2018). Meanwhile, the amount lost to fraud has increased over the past five years along with the growth of financial transactions in the digital payments sector. The fraud count has increased by 12% from 44,947 million in 2019 to 101,624 million in 2020, increased by 22% from 123,918 million in 2021, but decrease to 18% from 123,918 million of 2021 to 101,669 million in 2022 and further decreased to 6% from 101,669 million of 2022 to 95,620 million in 2023. In 2023, the Nigerian financial industry demonstrated steadfast resilience in the face of economic difficulties when it came to addressing fraud. This resilience was exacerbated by a noticeable spike in system faults among other new themes. Financial institutions' submission of fraud data to NIBSS through the Industry Fraud Reporting Portal revealed a lost to fraud has grown by 496% from N2.9bn to N17.67bn within the same time. Thus, the ratio of total reported fraud value to the total value of transactions recorded over the last five years shows an increase between 2019and 2023 from 0.0019% to 0.0022% **(National Business Skills Development Initiative (NBSDI), 2023)**.
Despite the prevalence of financial inclusion and the accessibility of financial services through mobile technology, the lack of financial literacy and digital skills among many individuals introduces an additional layer of risk, particularly in terms of security and digital access (Luis Vaz, (2017).

The current research seeks to address the gap in existing literature by concentrating on financial technology as a means of promoting financial inclusion. Furthermore, it sheds light on the counterproductive effects that the level of financial technology dynamics, particularly in relation to the escalation of fraud may have on the financial inclusion and economic growth. Thus, the financial technology and financial inclusions tools according to World Bank measures are; transactions, financial openness, ratio of e-payment to GDP made via point of sale, mobile phone and internet payment made services etc. Consequently, this study will investigate the interconnected effects of financial technology on financial inclusion levels, in conjunction with the growing prevalence of digital fraud.

### 1.3 Objectives of the Study

The broad objectives are to

1 Examine the significant effects of financial fraud via fanatical technology services accessibility on financial inclusion in Nigeria.
2 Evaluate the significant effect of financial technology service penetration rate in Nigeria on financial fraud via fanatical technology services accessibility.
3 Investigate financial fraud via fanatical technology services accessibility significant impact on Gross domestic product and mobile in Nigeria economy

### 1.4 Research Questions

1 To what extent dose financial fraud via fanatical technology services accessibility significantly have effect on financial inclusion in Nigeria?
2 How has financial technology service penetration rate in Nigeria effect on financial fraud via fanatical technology services accessibility?
3 To what extent does financial fraud via fanatical technology services accessibility has significantly impacted on Gross domestic product in Nigeria?

### Hypotheses

$H0_1$: There is no significant effect of financial fraud via fanatical technology services accessibility on financial inclusion in Nigeria.
$H0_2$: There is no significant effect of financial technology service penetration rate in Nigeria on financial fraud via fanatical technology services accessibility.
$H0_3$: There is no significant impact of financial fraud via fanatical technology services accessibility on Gross domestic product in Nigeria.

## 2. Review of Related Literature

This paper explored many theories on financial technology and financial inclusion to state with, Buckley, Arner and Barberis, (2016) attained that digital finance can be understood as a process that delivers financial solutions via technological means. Conversely, Schueffel (2016) characterized digital finance as a novel segment of the financial industry that leverages financial technology to optimize financial activities. Alkhazaleh and Haddad (2021) highlighted that the availability, ease of access, and security of these services play a crucial role in enhancing customer satisfaction within the banking sector. Khaerunnisa, (2018) opined that the advent of financial technology presents a variety of benefits for customers, market participants, and the economy at large. Customers enjoy increased product variety, lower costs, and improved service quality. Market players benefit from strengthened financial institutions, improved information flow, expedited transaction processes, enhanced capital efficiency, and greater operational flexibility. In terms of economic impact, financial technology facilitates the execution of monetary policy, promotes economic growth, and enhances the speed at which money circulates. Furthermore, Saraswati and Kuzmina-Merlino, (2021) and Wardhani (2021) demonstrate that financial technology affects every aspect of life, providing greater speed and efficiency, which consequently leads to a positive effect on household consumption in both the immediate and extended future.

Kling, Pesque-Cela, Tian, and Luo (2021) formulated a theoretical framework that establishes a relationship between financial inclusion and income inequality. It is

important to note that enhancing financial inclusion does not necessarily result in a reduction of income inequality. Kanga, Oughton, Harris, and Murinde. (2021) demonstrate how the spread of technology and the enhancement of financial inclusion influence long-term economic growth and the investment in both

fixed and human capital. Markose, Arun, and Ozili (2021) concentrated on the supply-side argument and illustrate the substantial costs linked to the advancement of financial inclusion, an element that is often disregarded in policy debates. In recent years, China has witnessed the rapid emergence of peer-to-peer (P2P) lending platforms, which facilitate access to financial resources for both households and small to medium-sized businesses. Meanwhile, Hollanders, (2020) stated that advancements in the financial technology sector are not confined to a single nation or currency. Therefore, it is imperative for regulatory bodies to closely observe these developments to avert potential loopholes within the financial technology landscape.

Consequently, the growing prevalence of the Internet and smart devices has significantly contributed to the rising interest in financial technology, especially within the banking sector, which is currently experiencing a substantial technological transformation in its operations (Hassan (2022). It on this that (Liu, Huang, and Huang, (2021), and Subanidja, Legowo, and Sorongan (2021) suggests that investing in electronic devices, software, technical systems, and the proliferation of automated teller machines in the financial technology arena yields beneficial effects on the financial performance and sustainability of the financial and banking sectors, as well as businesses in general. To Kovalchuk, (2020), stated that financial sector is focused on utilizing financial technology to decrease operational costs, bolster the security of financial transactions, and stay aligned with the ever-evolving societal developments. This strategy according to Kovalchuk facilitates the creation and expansion of diverse banking ventures, such as artificial intelligence, open banking, block-chain, and mobile applications. Meanwhile, Saksonova and Kuzmina-Merlino (2017) agued with disagreement on Kovalchuk (2020) statement. Rather Saksonova and Kuzmina-Merlino, stated that banking sector utilizing financial technology scenario amplifies the operational and long-term risks that banks encounter. Li, (2021) on the other hand, argued that digital finance seeks to attain to reduced costs, enhanced efficiency, and the elimination of time and spatial limitations.

Jacob (2023) stated that due to advancements in technology and the increasing prevalence of internet usage, Nigerian banks have undergone remarkable growth and evolution. This progress has enabled customers to engage in banking activities and online transactions with enhanced convenience. However, it has simultaneously provided a platform for criminals to execute financial theft and manipulate individuals into surrendering their money. Consequently, Jacob opined that it is imperative for banks to implement measures that shield both themselves and their clients from fraudulent activities. Financial fraud to Jacob is defined as the act of misleading individuals or financial institutions into surrendering funds or sensitive data that should remain secure. This act according to Jacob, can take various forms, such as identity theft or social media scams. The repercussions of such fraudulent actions are significant, as they not only result in financial losses but also diminish public trust in banks, potentially stifling economic development.

Udeh and Ugwu (2018) stated that fraudulent activities within banks diminish their profitability, as profits are calculated after accounting for expenses and losses. This reduction in profit limits the funds available for distribution to shareholders or for retention as retained earnings. Additionally, fraud contributes to increased losses for banks, affecting their assets, credit mobilization, and liabilities. In cases of significant fraud, the losses may exceed the profits of the period, leading to a depletion of the bank's equity capital. This situation jeopardizes the financial health of the institution and its capacity to provide loans and advances to potentially profitable enterprises.

Furthermore, (Ozili, 2021b; Ediagbonya and Tioluwani, (2023) stated that often, those advocating for digital financial fail to give proper consideration to risk mitigation in the design of digital financial services that aim to facilitate financial inclusion. This lack of attention implies that, although users may benefit from these digital services, such benefits can be readily compromised by negative incidents, such as digital fraud and theft stemming from unauthorized access to their accounts. Based on this statement, Ozili, (2022) suggested that the digital financial service providers must focus on enhancing risk mitigation strategies

during the development of their services. This approach will assist in minimizing the occurrence of risk or loss events that could undermine the potential benefits for users engaging with digital financial services.

One of the direct effects of digital fraud to any economy is the immediate monetary losses suffered by the victims. These victims may include individuals, corporations, or even governmental entities. For individuals, becoming a target of identity theft or Ponzi schemes can lead to the depletion of life savings, retirement accounts, and potentially their homes. Corporations may face substantial financial challenges due to embezzlement or fraudulent accounting practices, which can result in layoffs, diminished growth opportunities, and in some cases, bankruptcy. When governments are defrauded through tax evasion or fraudulent public contracts, they forfeit critical revenue that could have been directed towards essential services such as healthcare, education, and infrastructure development Yukun, (2023).

Furthermore, the exogenous growth model of Solow, (1956) highlighted the importance of high technology and the roles of labor and productivity by (Domar, 1946) in mitigating global growth disparities. The assumption of exogenous growth, driven by high technology innovations and novel organizational and managerial frameworks, plays a crucial role in shaping modern economic development, facilitating the transition from a static to a dynamic economy. Today, high technology innovation has progressed from merely developing new products to offering solutions for persistent economic challenges (Kotsemir and Abroskin, 2013). Ozili, (2024) observed that technology only financial inclusion seems to prioritize access to digital platforms over the actual financial well-being of users. To Ozili, this is reflected in the performance indicators utilized by digital finance platforms, which often include metrics such as the number of individuals registered on digital platforms, transaction volumes, and the total number of accounts created. These indicators primarily focus on access rather than assessing the financial health of users, such as their savings-to-debt ratios within digital banking systems. A more effective approach to digital-only financial inclusion would be to foster financial well-being, thereby better addressing the needs of consumers instead of merely concentrating on digital access. Prioritizing financial health over access is essential for developing products that can create a meaningful and enduring positive impact on users of digital financial services.

**Empirical studies**

Siddik (2019) examined the influence of electronic banking on financial inclusion and economic growth Bangladesh, using a panel data analysis of 13 banks from 2003 to 2013. Siddik observed that electronic banking had favorable impact on financial inclusion which sped up economic growth of Bangladesh. The investigation further indicated that engaging with the internet for financial activities cultivates strong social connections among individuals, which in turn affects fiscal inclusion.

The research conducted by Ene, Abba, and Fatokun (2019), focused on the effects of electronic banking on financial inclusion within Nigeria. To evaluate electronic banking, they analyzed the usage of ATMs and Point of Sale devices, with financial inclusion represented by the percentage of the adult population that is banked compared to the overall bankable adult population in the country. The study utilized multiple regression analysis, incorporating ex-post facto and correlation research methods for data examination. The results of the hypothesis suggest that the deployment of ATMs in Nigeria does not contribute to financial inclusion. The second hypothesis asserts that there is no statistically significant correlation between the use of point-of-sale devices and financial inclusion. Nevertheless, the conclusions drawn from the study indicate that point-of-sale devices significantly affect financial inclusion.

The research conducted by Agwu (2021) evaluated the capacity of financial technology to bridge the gaps in fiscal inclusion. Utilizing secondary research methods, the study aimed to ascertain the extent to which technology could facilitate fiscal inclusion in rural regions of developing countries. Data was gathered from the Central Bank of Nigeria (CBN), the World Bank, the European Union, and various scholarly articles. The results highlighted the impact of both individual and institutional factors on the overall effectiveness

of fiscal inclusion initiatives. Individual-level data indicated that a significant number of rural residents opted to store their money at home due to fears surrounding the security of online banking and potential hacking incidents. Institutional factors posed additional challenges, as banks' demands for documentation and collateral often discouraged rural individuals from participating in financial systems. The study ultimately suggested that financial technology could serve as a valuable tool for fiscal institutions aiming to enhance inclusion, despite the associated costs of technology maintenance.

Fuster, Schnabl and Vickery, (2019) investigate the distinctions between financial technology services and traditional lenders within the mortgage sector, revealing that financial technology process applications 20% more swiftly without elevating loan risk. Additionally, they present evidence indicating that financial technology lenders exhibit a more elastic response to demand fluctuations and enhance the likelihood of refinancing, particularly for borrowers who stand to gain from such actions. Their findings imply that financial technology have significantly enhanced the efficiency of financial intermediation in the mortgage market. Bartlett, Stanton and Wallace, (2018) explore the role of financial technology lenders in addressing discrimination within mortgage markets. Their analysis reveals that both financial technology and traditional lenders are equally prone to discrimination, as evidenced by the higher interest rates imposed on minority borrowers. In contrast, when evaluating loan acceptance or rejection, financial technology lenders appear to exhibit significantly less discriminatory behavior.

Iskandar (2020) found that the implementation of financial technology in areas such as technology lending, payment technologies, investment and savings technologies, and financial control technologies positively influences the operational efficiency of financial institutions. According to Sindani et al. (2019), the advent of Internet banking has led to increased productivity and efficiency in Kenya's banking industry. They also identified a strong relationship between ATM services and financial inclusion. Conversely, Shen et al. (2020) posited that the Internet does not have a direct effect on financial inclusion, aside from its provision of digital products; rather, it aids in diminishing financial illiteracy, with the direct influence being attributed to the level of financial culture.

Dzomira (2014) provides a thorough examination of the literature surrounding electronic fraud in the banking sector, highlighting the challenges faced in managing risks. This investigation into online fraud is based on a descriptive study employing content analysis. Data collection involved surveys and interviews with informants from 22 banks. The methods applied are both accessible and trustworthy. The results indicate that the banking industry is the primary setting for most types of electronic fraud. Challenges such as a lack of resources, insufficient cybercrime laws, and a general lack of awareness and knowledge have been identified. To enhance cyber security measures, it is suggested that all partners collaborate to address these challenges.

Victory, Promise, and Mike (2022) undertook a study to examine how cyber security influences fraud prevention in Nigerian businesses. They gathered significant data through interviews conducted via WhatsApp video calls with senior staff members from various companies who are knowledgeable in this field. The findings suggest that cloud security analytics are instrumental in improving fraud prevention measures in Nigeria, with a security application also proving beneficial. This study emphasizes the importance of the Nigerian financial sector acquiring specialized knowledge to inform the public about fraud prevention. To prevent financial losses and safeguard against the theft of services or devices, it is crucial for individuals to regularly use strong passwords.

Herrero, Torres, Vivas, Hidalgo, Rodríguez, and Urueña, (2021) conducted a comprehensive study on the application of forensic accounting in Nigeria, focusing on its efficacy as a mechanism for fraud detection and prevention. Utilizing original data collected over a decade, from 2010 to 2020, they found that financial analysis plays a crucial role in mitigating fraud, although it is noted that foreign currencies do not effectively control fraudulent activities. Furthermore, the research indicated that funds obtained through fraudulent means had not been successfully recovered. In a related study, Leukfeldt and Holt (2022) examined 37

instances of cybercrime, concluding that cybercriminals engage in a diverse array of offenses. Their findings revealed that approximately half of the offenders were computer professionals, while the remainder participated in various crimes both online and offline, often overlapping with cybercriminal activities. This relationship between intelligence and criminal behavior suggests that categorizing individuals as liars within criminal groups may not yield significant insights.

Alao (2016) explores the influence of fraud on the failure of Nigerian banks. The study utilized ex post facto research techniques and a cross-sectional survey approach. The findings revealed a P-value of 0.972, which exceeds the 0.05 significance level, indicating that the incidence of fraud does not have a significant impact on the overall expected losses faced by Nigerian banks. Additionally, the research suggests that the financial amounts involved in fraud cases are a strong indicator of bank failures in Nigeria. Similarly, Samuel, Pelumi, and Fasilat (2021) disused in Jacob Obafemi Fatoki (2023) study examined the effectiveness of internal control systems in preventing fraud among deposit money institutions. Their target population included all financial institutions in Kwara State, and a purposeful random sampling method was employed to select a sample size that encompassed all 17 Nigerian banks in the area. The study found a significant relationship between internal control measures and fraud prevention in Nigerian deposit banks.

## 3. Methodology

This study adopted ex-post-facto research method to compile the data for this study which is a secondary sources form Central Bank of Nigeria (CBN) Statistical Bulletin (2023) edition, the National Bureau of Statistics (NBS) Annual abstract and Statistical Bulletin (2023) edition and World global databank (2024) Publications.

### Theoretical Framework

Numerous theories exist that pertain to the concept of financial technology, its digital fraud on financial inclusion and economic growth. These encompass various perspectives: the application of the innovation diffusion theory provides insight into the dissemination of technology aimed at enhancing financial inclusion. This theory was popularized by Everett Rogers in 1962. The primary assertion of the innovation diffusion theory is that diffusion is a process that necessitates the communication of innovation over time to individuals within a social context (Rogers, 1962). The theory delineates five vital stages for the diffusion of innovation: knowledge or awareness, persuasion, decision, implementation, and confirmation (Rogers, 2003). According to this framework, for an individual to become knowledgeable or aware of an innovation, exposure to that innovation is essential. Thus, during the initial phase of introducing financial technology, it is imperative to ensure that individuals are informed through various means. The availability of information is vital for individuals to achieve the second stage of innovation diffusion, referred to as persuasion. This stage fosters an interest in the innovation or financial technology, leading individuals to seek out more information, as noted by Muralidharan, Niehaus, and Sukhtankar (2014). Upon obtaining the necessary information, individuals evaluate the advantages and disadvantages of the financial technology, which influences their decision to accept the innovation. After reaching this decision, they implement the innovation and continue to seek additional information, ultimately confirming their choice by maintaining its use. According to Rogers (2003), the confirmation stage involves both intrapersonal and interpersonal elements, ensuring that the individual or group has made an informed decision. Analyzing the key elements reveals that the advent of financial technologies, such as internet banking, mobile wallets, and credit and debit cards, constitutes a series of innovative ideas.

Meanwhile, Digital technology carries inherent risks that can adversely affect financial inclusion initiatives. Despite the advantages these technologies offer, they also present challenges that may impede efforts toward enhancing financial inclusion (Hoang, Nguyen and Le, 2022; Nguyen, Sermpinis and Stasinakis, 2023). Among these risks are cyber security threats, third-party vulnerabilities, automation challenges, data

privacy concerns, and social engineering tactics, all of which could ultimately result in financial losses, thereby diminishing financial inclusion and economic growth in any nation.

**Model Specification**

Numerous studies have established a correlation between digital financial fraud and a decrease in financial inclusion in Nigeria. To develop a model that accurately reflects the impact of financial technology on the economy, an empirical basis is essential. In this regard, we examined the empirical reviews conducted by Ozili (2021), Odeleye, and Oyeneye (2022) to ensure their relevance to our research. we propose to integrate the levels of financial technology and awareness of digital financial fraud, as well as the volume and values of transactions conducted through innovative financial technology services, into a linear model. The model for this study is specified as follows:

$Y_{t1} = F(X_{t1})$, … [3.1]
$Y_2 = F(X_{t1})$ ... [3.2]
Where $Y_1$ is dependent variable (financial inclusion level) while $Y_2$ is RGDP proxy for economic growth and $X_{t1}$ are the independent variables financial technology and digital financial fraud. Thus, substituting for the variables, we have:

FIL = f (FTP TFT, POS, MIT and FFT) … [3.3]
RGDP = f (FTP TFT, POS, MIT, ITR and FFT) … [3.4]

Putting the above models in an econometric form, we obtain the linear equation below:
$FILt = \alpha + \alpha 1FTP + \alpha 2TFT + \alpha 3POS + \alpha 4MIT + \alpha 5FFT + \xi 1t$ … [3.5]
$RGDPt = \beta 0 + \beta 1FTP + \beta 2TFT + \beta 3POS + \beta 4MIT + \beta 5FFT\ \beta 6ITRt + \lambda 1t$ … [3.6]

Where: FIL is financial inclusion level in Nigeria, FTP is financial technology service penetration rate in Nigeria, TFT is transactions made via financial technology services in Nigeria, POS is point of sale (POS) transaction payment system in Nigeria, MIT is Mobile and internet transaction system services in Nigeria, FFT is value and volume of financial fraud via fanatical technology services accessibility in Nigeria, ITR is the interest rate and RGDP is real gross domestic product of Nigeria.

The a-priori assumption of the variables in the above model is as follows: the financial technology services variables are assumed to have a positive and significant effect on the financial inclusion level and the real gross domestic product whereas, only the value and volume of financial fraud via fanatical technology services accessibility in Nigeria is assumed to have a negative and significant effect on both financial inclusion level and the real gross domestic product.

However, CBN having seen that the financial exclusion level in Nigeria then introduced financial technology to increase financial inclusion level and enhance Nigeria's economic growth. This notified that there is a reciprocal relationship exists among financial technology, financial fraud, financial inclusion, and economic growth in Nigeria. This interdependence can be illustrated through a revised specification that is structured as a simultaneous equation model, articulated as follows:
FIL = F (FFT) … [3.7]
FFT = F (FIL) … [3.8]
RGDP = F (FFT) … [3.9]
FFT = F (RGDP) … [3.10]

Where: FIL is financial inclusion level, FT is financial technology, FF is financial fraud and RGDP is real gross domestic product.

Equations [3.7], [3.8], [3.9] and [3.10] represent a simultaneous equation model where financial inclusion level, economic growth, financial fraud via financial technology variables (indexes) have a mutual

dependency. Thus, to expand equation [3.7], [3.8], [3.9] and [3.10], then obtaining its implicit form of the model is as:

FIL = F (FTP TFT, POS, MIT and FFT) … [3.11]
FFT = F (FIL, TFT, POS, MIT and OTP) … [3.12]
RGDP = F (FTP TFT, POS, MIT, ITR and FFT) … [3.13]
FFT = F (FTP TFT, POS, MIT, ITR and RGDP) … [3.14]

The linear multiple equations simultaneous model for these is;

$FIL_t = \alpha_{11} + \alpha_{12}FTP_t + \alpha_{13}TFT_t + \alpha_{14}POS_t + \alpha_{15}MIT_t + \alpha_{16}FFT_t + \varepsilon_{1t}$ … [3.15]
$FFP_t = \alpha_{21} + \alpha_{22}FIL_t + \alpha_{23}TFT_t + \alpha_{24}POS_t + \alpha_{25}MIT_t + \alpha_{26}OTP_t + \varepsilon_{2t}$ … [3.16]
$RGDP_t = \beta_{31} + \beta_{32}FTP_t + \beta_{33}TFT_t + \beta_{34}POS_t + \beta_{35}MIT_t + \beta_{36}FFT_t + \beta_{37}ITR_t + \lambda_{3t}$ …[3.17]
$FFT_t = \beta_{41} + \beta_{42}FTP_t + \beta_{43}TFT_t + \beta_{44}POS_t + \beta_{45}MIT_t + \beta_{46}ITR_t + \beta_{47}RGDP_t + \lambda_{4t}$ … [3.18]

Where: OTP is One Time Password which is an enabler to digital crimes for financial frauds operations. It important to note that One Time Password (OTP) Interest Rate (ITR) and POS is point of sale (POS) transaction payment is employed as instrumental variable in this simultaneous model.

Meanwhile, employing the order necessary sufficient condition of simultaneous equation model to know if the model is identified with number of pre-determined variables excluded from it is greater than or equal to the number of endogenous variables included in it or less one. This ranking condition is structured as; "g" endogenous variables and "k" pre-determined variables. That is $k - k_i \geq g_1 - 1$
Where: k is the total number of variables in model (endogenous and exogenous), $m_i$ is the total number of variables included in the primary equation I, gi is the total number of endogenous variables in equation i. below is the identification table for the simultaneous equation.

**Table 3.1 Simultaneous Equation Model Identification**

| Equation | k | m | g | k-m | g-1 | k-m = g-1 |
|---|---|---|---|---|---|---|
| Equation 1 | 9 | 6 | 3 | 9-6 = 3 | 3-1 = 2 | Over identified as 3>2 |
| Equation 2 | 9 | 6 | 3 | 9-6 = 3 | 3-1 = 2 | Over identified as 3>2 |

*Source: Researcher's computation*

From the simultaneous equation model identification table, it became clear that the two equations are exactly identified. Based on this, we proceed to employed two-stage Least Squares technique (ILS) to estimate our model.

**Justifying the employment of simultaneous equation model**
Many researchers have proposed that level of financial inclusion in Nigeria has been influence by level of accessibility of financial technology innovation in the country. Thus, as the study sick to investigate the level of financial technology and its financial fraud effects on financial inclusion level and economic growth Nigeria. Hence, we strived to capture both the effects by employment of simultaneous equation model. Secondly, simultaneous equation model is been justified using the Granger causality test to ascertained the existence of bi-directional or directional causal relationship between the employed financial technology, financial inclusion and economic growth variables.

**4. Method of data Analysis**
Time series data is the nature of data employed in this study, and as it results of its, we employed unit root test, co-integration test and Granger causality test to analyzed our model along with R-squared and adjusted R- squared values, Durbin-Watson statistic, F- statistic value and T- statistic values from the estimated result model.

**Presentation and Analysis**

We State with ADF Unit Root Test and Engle –Granger Single Equation Cointegration Test.

**Table 4.1: Augmented Dickey Fuller (ADF) Unit root test**

| *Series* | *ADF Statistic at Level* | *ADF Statistic at 1st Difference* | *5% Critical Level* | Prob*ability values* | *Order of Integration* |
|---|---|---|---|---|---|
| *RGDP* | -2.061414 | -8.248412 | -3.544284 | *0.0000* | *I(1)* |
| *MIT* | 3.348174 | -11.24063 | -3.574244 | *0.0000* | *I(1)* |
| *TFT* | -6.212585 | -4.647172 | -3.533083 | *0.0045* | *I(1)* |
| *POS* | -3.413102 | -4.817135 | -3.658446 | 0.0063 | *I(1)* |
| *OTP* | -2.049996 | -6.482885 | -3.533083 | *0.0000* | *I(1)* |
| *FIL* | 3.392735 | -4.608777 | -3.574244 | *0.0038* | *I(1)* |
| *FFT* | -2.271299 | -5.623206 | -3.632896 | *0.0006* | *I(1)* |
| *FTP* | 3.721729 | -3.608889 | -3.587527 | *0.0486* | *I(1)* |
| *ITR* | -3.479396 | -6.099778 | -3.523623 | *0.0000* | *I(1)* |

Source: *Extracted from Eviewsv9.0 (See Appendix).*

From table 4.1, the result shows that all the variables in the model [FIL, FFT, FTP, OTP, POS, TFT, MIT, ITR and RGDP] are stationary after the first differencing. In other words, financial technology service penetration rate in Nigeria (FTP), financial inclusion level (FIL), transactions made via financial technology services in Nigeria (TFT), point of sale transaction payment system in Nigeria (POS), Mobile and internet transaction system services in Nigeria (MIT), value and volume of financial fraud via fanatical technology services accessibility (FFT), real gross domestic product (RGDP), One Time Password (OTP) and Interest Rate (ITR) are integrated at order one I(1). This means that the statistical properties of these variables dose not vary over time.

**Engle –Granger Single Equation Cointegration Test**

Since the ADF result certified the necessary condition Engle-Granger Co-integration, we therefore test the null hypothesis against the alternate hypothesis using the Tau-statistic against the 5 percent critical value.

**Table 4.2: Summary of Engle-Granger Cointegration Test**

| Dependent | tau-statistic | Prob.* | z-statistic | Prob.* |
|---|---|---|---|---|
| FTP | -2.642900 | 0.9699 | -10.30445 | 0.9840 |
| FIL | -5.128067 | 0.2229 | -24.58312 | 0.2018 |
| TFT | -4.781455 | 0.3206 | -22.06133 | 0.3690 |
| RGDP | -4.375127 | 0.4638 | -19.19021 | 0.5935 |
| FFT | -5.898537 | 0.0877 | -26.82375 | 0.0978 |
| MIT | -1.682595 | 0.9990 | -6.493139 | 0.9991 |
| POS | -4.100877 | 0.5709 | -19.33815 | 0.5813 |
| OTP | -5.097978 | 0.2369 | -54.55610 | 0.0001 |
| ITR | -9.238188 | 0.3438 | 65.87724 | 0.0438 |

Source: *Extracted from Eviewsv9.0 (See Appendix).*

Result from table 4.2 shows that the Tau-statistic value for financial inclusion level (FIL), value and volume of financial fraud via fanatical technology services accessibility (FFT) and real gross domestic product

(RGDP) are [-5.128067, -5.898537 and -4.375127] respectively. From the same table, their probability values are [0.2229, 0.3206 and 0.0877] respectively. Therefore, we reject the null hypothesis and accept the alternate hypothesis that the series are cointegrated. Based on the outcome of the table result, we conclude that these variables have long run cointegration relationship between financial inclusion level (FIL), value and volume of financial fraud via fanatical technology services accessibility (FFT) and real gross domestic product (RGDP)

**Estimation of simultaneous Equation Model**

One of the necessary conditions for simultaneous model is that there should be in existence of bidirectional causal relationship between financial inclusion levels (FIL), value and volume of financial fraud via fanatical technology services accessibility (FFT) and real gross domestic product (RGDP). If such exist, it implies that these variables could be employed to predict the future outcome of each other given the effect of value and volume of financial fraud fanatical technology services on financial inclusion levels (FIL) and economic growth are held constant.

**Table 4.3: Summary of Granger Causality Test**

| | | | |
|---|---|---|---|
| FFT does not Granger Cause FIL | 35 | 5.22081 | 0.0063 |
| FIL does not Granger Cause FFT | | 15.0250 | 2.E-05 |
| RGDP does not Granger Cause FFT | 35 | 6.40449 | 0.0025 |
| FFT does not Granger Cause RGDP | | 5.57752 | 0.0047 |
| RGDP does not Granger Cause FIL | 35 | 2.84256 | 0.0444 |
| FIL does not Granger Cause RGDP | | 6.49403 | 0.0009 |
| TFT does not Granger Cause FIL | 35 | 16.4794 | 8.E-07 |
| FIL does not Granger Cause TFT | | 27.1379 | 6.E-09 |
| MIT does not Granger Cause FIL | 35 | NA | NA |
| FIL does not Granger Cause MIT | | NA | NA |
| POS does not Granger Cause FIL | 35 | 5.76919 | 0.0113 |
| FIL does not Granger Cause POS | | 4.46829 | 0.0250 |
| OTP does not Granger Cause FIL | 35 | 0.02067 | 0.9991 |
| FIL does not Granger Cause OTP | | 0.00401 | 1.0000 |
| OTP does not Granger Cause FTP | 35 | 3.63674 | 0.0291 |
| FTP does not Granger Cause OTP | | 4.24893 | 0.0170 |

Source: *Extracted from Eviewsv9.0 (See Appendix).*

Table 4.3 summary of Granger Causality Test result shows that financial inclusion levels (FIL), value and volume of financial fraud via fanatical technology services accessibility (FFT) and real gross domestic product (RGDP) have bidirectional causal relationship. These variables in their respective p- values [0.0063, 2.E-05], [0.0025, 0.0047] and [0.0444 and0.0009] are less than the 0.05 critical values and as such we reject their null hypotheses. This means that there is an evidence to show that the present trend of growth in financial inclusion levels value and volume of financial fraud via fanatical technology services accessibility (FFT) can be used to predict financial inclusion levels (FIL) and real gross domestic product (RGDP) in Nigeria and vice versa.

**Endogeneity in the Model**

Another assumption in two-stage least square estimation is the secondary predictor which is known as the instrumental variables that is correlated to the predictor but not with the error term that have the ability to reduce bias in the model.

**Table 4.5: Endogeneity Test**

| Endogenous variables to treat as exogenous: FTP MIT | | | |
|---|---|---|---|
| | Value | df | Probability |
| Difference in J-stats | 6.757351 | 2 | 0.0800 |
| **Endogenous variables to treat as exogenous: MIT FIL** | | | |
| | Value | df | Probability |
| Difference in J-stats | 5.470426 | 2 | 0.0649 |
| **Endogenous variables to treat as exogenous: FTP FFT** | | | |
| | Value | df | Probability |
| Difference in J-stats | 8.623095 | 2 | 0.0134 |
| **Endogenous variables to treat as exogenous: FTP MIT** | | | |
| | Value | df | Probability |
| Difference in J-stats | 4.828858 | 2 | 0.0848 |

Source: *Extracted from Eviewsv9.0 (See Appendix).*

Testing the hypothesis that all instrumental variables in the estimated model are strong is the objective of table 4.5. Thus, the results shows a significant statistic with p-values of [0.0800, 0.0649, 0.0134 and 0.0848] for [(FTP, MIT), FFT, and FIL] as endogenous variables respectively. Significance of these variables test proves that they are endogenous since the estimation result is suggested rejection of the null hypothesis that instruments in the model are weak. Therefore, we conclude that all independent variables in the estimated model are strong. To this effect, it implies that financial inclusion level in Nigeria affect value and volume of financial fraud via fanatical technology services accessibility in Nigeria and value and volume of financial fraud via fanatical technology services accessibility also affect financial inclusion level in Nigeria. again, economic growth measured by real gross domestic product affect value and volume of financial fraud via fanatical technology services accessibility in Nigeria and value and volume of financial fraud via fanatical technology services accessibility in Nigeria also affect economic growth measured by real gross domestic product. This was also in line with Granger causality test which then give rise to the simultaneous equation model.

**Estimation of the 2SLS result**

Table 4.6: Modeling equation 1, dependent variable: financial inclusion level (FIL)

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 294541.0 | 153816.8 | 1.914882 | 0.0715 |
| FTP | 59228.43 | 48637.44 | 1.217754 | 0.2390 |
| TFT | 1.15E-05 | 5.70E-06 | 2.019650 | 0.0586 |
| MIT | 0.661827 | 0.149691 | 4.421279 | 0.0003 |
| FFT | 9.792962 | 5.861339 | 1.670772 | 0.1121 |

**Equation 2, Dependent Variable : financial fraud via fanatical technology (FFT)**

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 1356036. | 598724.2 | 2.264876 | 0.0361 |
| FTP | 3032.509 | 1266.910 | 2.393626 | 0.0278 |
| TFT | 1065.202 | 2932.958 | 0.363183 | 0.7207 |
| MIT | 102346.5 | 44131.93 | 2.319103 | 0.0324 |
| FIL | 0.017260 | 0.011234 | 1.536310 | 0.1419 |

Equation3 Dependent Variable : RGDP

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 43946.32 | 4056.315 | 10.83405 | 0.0000 |
| FTP | 0.016891 | 0.281160 | 0.060076 | 0.9528 |
| TFT | 1.02E-07 | 1.32E-07 | 0.774333 | 0.4488 |
| MIT | 0.011470 | 0.004029 | 2.847022 | 0.0107 |
| FFT | 1662.670 | 320.7372 | 5.183902 | 0.0001 |

Equation4 Dependent Variable : **financial fraud via fanatical technology (FFT)**

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 12.65824 | 3.903990 | 3.242386 | 0.0045 |
| FTP | 0.318096 | 0.274912 | 1.157084 | 0.2624 |
| TFT | 0.009229 | 0.063177 | 0.146084 | 0.8855 |
| MIT | 1.211646 | 0.368098 | 3.291643 | 0.0041 |
| RGDP | 8.29E-05 | 3.72E-05 | 2.228370 | 0.0388 |

Source: *Extracted from Eviewsv9.0 (See Appendix).*

From table 4.6 above, the simultaneous equation regression of financial inclusion level (FIL) and financial fraud via fanatical technology (FFT), the intercepts [294541.0 and 1356036] indicated that holding fanatical technology innovation at zero, there will be appositive movements in financial inclusion level (FIL) and financial fraud via fanatical technology (FFT) respectively in Nigeria. This notified the need for CBN and financial institution to work together towards protection and securing the fanatical technology innovation in Nigeria. Whereas, economic growth measured by real gross domestic product (RGDP) and financial fraud via fanatical technology (FFT), intercepts [43946.32 and 12.65824] also indicated holding fanatical technology innovation at zero, there will also be will be appositive movements in economic growth measured by real gross domestic product (RGDP) and financial fraud via fanatical technology (FFT), respectively in Nigeria. This explain how important fanatical technology innovation is a derive in raising both economic growth and financial fraud via fanatical technology in Nigeria economy.

Result from table 4.6 2SLS model shows that financial inclusion level (FIL) increase by 9.792962 units as a results of changes in volume of financial fraud via fanatical technology services accessibility (FFT) whereas, value and volume of financial fraud via fanatical technology services accessibility (FFT) increase by 0.017260 units as a results of changes in financial inclusion level (FIL) in Nigeria economy. This implies that both financial inclusion level (FIL) and volume of financial fraud via fanatical technology services accessibility (FFT) has an increase effect on each other. In other words, the financial technology service penetration rate in Nigeria has increased the financial inclusion level (FIL) and at the time, financial fraud via fanatical technology services accessibility (FFT).

Furthermore, the 2SLS simultaneous equation 1 and 2 result shows that financial technology service penetration rate in Nigeria (FTP), transactions made via financial technology services in Nigeria (TFT), point of sale transaction payment system in Nigeria (POS) and Mobile and internet transaction system services in Nigeria (MIT) increased financial inclusion level (FIL) and at the time, financial fraud via fanatical technology services accessibility (FFT) by [59228.43, 1.15E-05 and0.661827] and [3032.509, 1065.202 and 102346.5] units respectively of the equations. Thus the level of financial technology service penetration variables such as [FTP, TFT, POS and MIT] has proven to have positively affected financial inclusion level (FIL) and at the time, financial fraud via fanatical technology services accessibility (FFT) in Nigeria within the period of this study.

For the 2SLS simultaneous equation 3 and 4 result, shows that RGDP increase by 0.016891 units as results of changes in volume of financial fraud via fanatical technology services accessibility (FFT), while volume of financial fraud via fanatical technology services accessibility (FFT) increase by 8.29E-05 as results of changes in RGDP. This implies that both RGDP and volume of financial fraud via fanatical technology services accessibility (FFT) has an increase effect on each other. In other words, the financial technology service penetration rate in Nigeria has increased both RGDP and volume of financial fraud via fanatical technology services accessibility (FFT) in Nigeria within the period of the study 1985 -2023.

Result from equation 3 and 4 shows that financial technology service penetration rate in Nigeria (FTP), transactions made via financial technology services in Nigeria (TFT), point of sale transaction payment system in Nigeria (POS) and Mobile and internet transaction system services in Nigeria (MIT) increased by [1662.670, 1.02E-07 and 0.011470] [0.318096, 0.009229 and 1.211646] units respectively of the equations. In other words, the level of financial technology service penetration variables such as [FTP, TFT, POS and MIT] has proven to have positively affected RGDP and volume of financial fraud via fanatical technology services accessibility (FFT) in Nigeria.

**Test of Hypothesis One**

$H0_1$: Financial fraud via fanatical technology services accessibility has no significant effects on financial inclusion in Nigeria.

| Variable | t-table | t-Statistic | P- value | Decision. |
|---|---|---|---|---|
| FFT | 1.540 | 1.670772 | 0.1121 | Reject$H0_1$ |

Taken view from the table above, we could see that the t-statistic value 1.670772 is greater than the t- table value (1.540) and the probability value of the t-statistic is 0.1121, we reject the null hypothesis one and conclude that "financial fraud via fanatical technology services accessibility has a significant effects on financial inclusion in Nigeria.

**Test of Hypothesis Two**

$H0_2$: Financial technology service penetration rate in Nigeria has no significant effects on financial fraud via fanatical technology services accessibility

| Variable | t-table | t-Statistic | P- value | Decision. |
|---|---|---|---|---|
| FTP | 1.540 | 2.393626 | 0.0278 | Reject$H0_1$ |

Viewing from the table above, we could see that the t-statistic value 2.393 is greater than the t- table value (1.540) and the probability value of the t-statistic is 0.0278, we reject the null hypothesis two of this study and conclude that "financial technology service penetration rate in Nigeria has a significant effects on financial fraud via fanatical technology services accessibility.

**Test of Hypothesis Three**

$H0_3$: Gross domestic product and mobile and internet transaction system service in Nigeria has no significant impact on financial fraud via fanatical technology services accessibility.

| Variable | t-table | t-Statistic | P- value | Decision. |
|---|---|---|---|---|
| RGDP | 1.540 | 2.228370 | 0.0388 | Reject$H0_1$ |
| MIT | 1.540 | 3.291643 | 0.0041 | |

From the table above, we could see that the t-statistic values [2.228 and 3.2916] respectively are greater than the t- table value (1.540) and the probability value of their t-statistic is [0.0388, 0.0041], we reject the null hypothesis three of this study and conclude that "gross domestic product and mobile and internet transaction system service in Nigeria has a positive influence on financial fraud via fanatical technology services accessibility.

**Test of Hypothesis Four**

$H0_4$: Fraud via fanatical technology services accessibility has no significant impact on Gross domestic product and mobile in Nigeria economy.

| Variable | t-table | t-Statistic | P- value | Decision. |
|---|---|---|---|---|
| FFT | 1.540 | 5.183902 | 0.0000 | Accept$H0_1$ |
| MIT | 1.540 | 3.291643 | 0.0041 | |

Since the t-statistic values [5.183 and 3.2916] respectively are greater than the t- table value (1.540) and the probability value of their t-statistic is [0.000, 0.0041], implying that fraud via fanatical technology services accessibility and mobile and internet transaction system service were statistical significant impact on Gross domestic product. Based on this, we reject the null hypothesis four of this study and conclude that "fraud via fanatical technology services accessibility has significant impact on gross domestic product and mobile in Nigeria economy.

**5. Conclusion and Policy Implications**

Research regarding the relationship between financial technology services, financial inclusion level and economic growth is continuously in the scholar's interest which remains open as results of the rapidly changing landscape of technology at the global economy. However, the revered side effect of financial technology services which is the value and volume of financial fraud via fanatical technology services accessibility aspect on financial inclusion and economic growth is poorly investigated regarding to in Nigeria economy. With adoption of simultaneous equation model, the study has established the following; financial fraud via fanatical technology services accessibility has significant effects on financial inclusion in Nigeria. Financial technology service penetration rate in Nigeria has significant effects on financial fraud via fanatical technology services accessibility, gross domestic product and mobile and internet transaction system service in Nigeria has a positive influence on financial fraud via fanatical technology services accessibility and fraud via fanatical technology services accessibility has significant impact on gross domestic product and mobile in Nigeria economy.

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