

Cyber Security and Financial Innovation of Selected Deposit Money Banks in Nigeria

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Abstract This paper examined the impact of cybersecurity in driving the financial innovation of Deposit Money Banks in Nigeria. The rapid growth in population coupled with the challenge of reducing the rate of the financially excluded has made the need for financial innovation by Deposit Money Banks in Nigeria a matter of serious importance. However, due to a mix of factors ranging from poor design, design vulnerabilities to lopsided adoption and implementation of new financial technology products, this need has remained largely unmet with attendant negative consequences on the financial system. The study adopted a survey research design with primary data obtained via a structured questionnaire administered to a sample size of fifty-six (56) Deposit Money Banks Staff purposively selected. The sampled staffs were senior member staff of key impacted departments while the Banks selected accounted for 93% of total market capitalization as on December 31, 2021. The primary data collected were analyzed using descriptive and inferential statistics. The study found that cybersecurity proxied by risk management and bank monitoring had a statistically and positively significant impact on financial innovation of deposit money banks in Nigeria ($Adj.R^2 = 0.447$, $F_{(2,55)} = 23.274$, $p < 0.05$). It recommended that deposit money banks should ensure regular review, revision and strengthening of their risk management framework to meet with emerging challenges from the deployment of financial innovative products and services. Additionally, deposit money banks should

improve on the level of monitoring of the deployed e-banking channels (Card products, POS, ATMs and other channels) to facilitate greater reliance on them for the consummation of financial transactions.

Keywords Cyber Security, Financial Innovation, Risk Management, Banks Monitoring, Deposit Money Banks

1. Introduction

Financial innovation has been viewed as a key driver in enhancing financial inclusion, reducing operational costs while also eliciting improved banking efficiency and service delivery [1,2]. Deposit money banks are part of the key impacted industries in nation-states, including Nigeria [3]. Weidong and Yuan [4] contend that with the emergence of China as one of the global leaders in digital finance and financial technology, the use and adoption of financial innovation is capable of lowering the threshold of financial services and promoting operational efficiency with new models, delivery channels and products. In other key developed economies such as USA, Russia and Singapore, financial innovation has been found to aid the elimination of geographical boundaries [1], improving credit asset portfolio quality [5] and increasing the speed of service development [6]. Several scholars have classified financial innovation for the banking industry along the

lines of process, product and institutional innovation [7-9]. While process innovation concentrates on outlets for interpreting new technology initiatives such as Automated Teller Machines (ATMs), internet banking and mobile banking, product innovation on the other hand focuses instead on exotic and financial instruments such as hedge funds and securitized assets. Institutional innovation which is the third layer consists of the establishment of non-traditional financial firms such as online lending outfits and discount houses [10]. Bank executives must consciously weigh decisions they make around financial innovation to ensure sustenance of organizational value [11].

Although the use and adoption of financial innovation have gained significant traction in developed economies, the narrative in emerging economies is less than palatable because of a myriad of challenges, including but not limited to poor product design, design vulnerabilities, lopsided adoption and implementation of new financial technology products. These deficiencies have become more worrisome as population growth in emerging countries has been found to consistently outpace economic growth [12], which is further compounded by the high rate of financial exclusion currently prevalent in Sub-Saharan Africa with Nigeria topping the unenviable charts at over 36% of bankable adults amounting to 38m persons as at 2020 [13]. The implication therefore is that if the challenge of financial innovation is not sufficiently met, all the goals and aspirations towards addressing financial exclusion issues in developing economies will also not be attained. Ajide [14] affirms that if these challenges are not met, then inefficiencies built-in will negatively affect the proper functioning of the financial system. Dunne and Kasekende [15] also document that if proper attention is not paid to financial innovation, future monetary policy initiatives and direction may be negatively impaired.

Nonetheless, an unfortunate corollary to this is that as measures are taken to develop and deepen financial innovation via the deployment of diverse e-banking products, fraudulent cyber activities have been on the steady increase resulting in a whittling down of financial and public trust needed to sustain the impact of financial innovative measures in the financial system. For example, according to Serianu [16] cyber security report, cybercrime cost Nigeria the sum of \$649 million in 2019 which is about \$100m more than the preceding year. In 2020, according to the Nigerian Communication Commission (NCC), the country ranked third globally for cybercrime incidents further underscoring the need for a strong cybersecurity mechanism. It is our contention that a strong cyber security framework is a necessary requirement for growth in the acceptance and usage of new products driven by financial innovation of players in the financial services sector. Machine learning and artificial intelligence represent some of the new technological tools aiding the fight against cybercrimes [6,17]. In Nigeria, considering the importance of cyber security in the financial services

sector, the monetary authorities issued a framework on cyber security for Deposit Money Banks (DMBs) and Payment Service Providers' (PSPs). The framework established a minimum cyber security reference point to be put in place by DMBs and PSPs in their respective institutions [18]. To succeed therefore, these baselines must be reflected in the risk management practices and regular monitoring of such financial services organizations.

Despite the recognized importance of research on cyber security and financial innovation especially in developing economies like Nigeria, there have been surprisingly few empirical studies in this area of research. The majority of the previous studies examined the impact of financial innovation on either the performance of deposit money banks [19-22] or other variables such as efficiency [23], money demand [15] and market share of deposit money banks [24]. Others such as [25,26] interrogated the effect of cyber-security on the 'performance of deposit money banks with the findings producing mixed results. We note, however, that there is a paucity of available studies assessing directly the relationship between cyber-security and financial innovation in the financial services sector. This study is, therefore, intended to fill this identified gap by examining the nexus between cyber-security and financial innovation of selected deposit money banks in Nigeria.

The rest of the study is arranged as follows: Section 2 considered the relevant related literature from the viewpoint of conceptual development, theoretical framework, and empirical reviews. Sections 3 and 4 consider the materials and methods employed, results, and discussion of the research findings while Section 5 provides the conclusion and recommendations of the paper.

2. Literature Review

2.1. Financial Innovation

Financial innovation is the total of activities carried out that dovetail into the creation of new financial markets, technologies, products and financial instruments which have a significant impact on the stability and growth of the financial system [27,28]. They are thus a collection of ventures that appeal to the creative side of financial players in their drive to meet new and emerging challenges in finance. To excel in financial innovation, financial services sector players must see investment in information and communication technology as vital [29]. Financial innovators in a sense can be equated as inventors of financial tools and techniques [30]. In the financial services industry, financial innovation is reflected and measured by the degree of investments in information and communication technologies, electronic banking channels deployment (internet banking, mobile banking, ATMs,

POS, Card products) and agency banking [20-22]. This study shall therefore utilize these electronic banking channels deployment as proxies for the financial innovation. When profitably deployed, financial innovation has the potential to facilitate modernization of financial transactions [31], positively impact financial performance [32-34], predict firm valuation [35], firm efficiency [36] and financial services diversification [37]. Conversely however, inefficient or poorly deployed financial innovation is capable of precipitating negative consequences for the economy [38]. Similarly, the increasing complexities of the financial landscape, globalization of financial products have made proper measurements of the social welfare implications of financial innovation an arduous task [27]. As a result of these and other associated factors therefore, no efforts must be spared by financial service entities such as deposit money banks in tapping into their creative side in the form of financial innovation.

2.2. Cybersecurity

Cybersecurity refers to a series of practices and activities fashioned out with a view to ensuring the protection of personal and organizational data, information and networks from all possible threats whether internally or externally induced [39- 41]. These threats could include unauthorized access and disclosures, misuse of data/information, network hacking and organized attacks in the form of the introduction of malware and similar extraneous viruses [42-44]. According to Li and Liu [40], cybersecurity measures can be broadly categorized into five main types namely: measures focusing on application security, network security, operational security, cloud security, user training and information security. Further broken down, some of these measures include password and authentication protocols, firewalls and data encryption methodologies, malware scanners and the use of anti-virus software [25,45,46]. Cybersecurity is often used interchangeably with the term 'information security' because according to the International Telecommunications Union [47], the chief objectives of cybersecurity revolves around ensuring the confidentiality, integrity and availability of information in the right amount, place and to the right person. This CIA (Confidentiality, Integrity and Availability) triad is considered very germane for the financial services sector into which deposit money banks belong because of the sensitivity of data and information in the hands of handlers as well as the far-reaching consequences that breaches in them hold for the industry and the economy at large. For example, according to the 2020 report of the electronic fraud tracker ('Nigerian Electronic Fraud Forum'), the total value of cyber induced electronic fraud was in excess of N6.1 billion as at 2019. This thus provides the basis for the renewed focus by deposit money banks to strengthen their cybersecurity architecture via the instrumentalities of a

more robust risk management framework and consistent bank monitoring in line with regulatory requirements [18]. Specifically, the guidelines provide inter alia that each deposit money bank must employ "a risk management system to reduce the incidence of significant adverse impact" as well as put in place metrics for effective monitoring. In this study therefore, these two measures (risk management framework and bank monitoring) shall serve as proxies for the measurement of cybersecurity activities of deposit money banks in Nigeria.

2.3. Theoretical Framework

This study is anchored on Silber's Constraint Theory of Innovation which was postulated by Silber in 1975 in an attempt to provide rational motives for financial innovation employed by financial firms. The theory argues that financial innovation enhances the profitability of firms by reducing costs and increasing the speed at which financial services are delivered. The theory views that banks have both internal and external constraints which can be managed through the adoption of technologically enabled processes and products. Furthermore, the theory recognizes regulation as one of the key constraints to be overcome [48]. Scholars such as Tufano [49], Gakure and Ngumi [50] have supported the validity of the theory on the grounds of its applicability in predicting financial performance and establishing a competitive advantage in the marketplace. The theory has however been criticized as either being unconfirmed empirically or excessively focused on financial innovation to the detriment of other factors [51-53].

Notwithstanding the aforementioned criticisms, this theory is considered relevant for this study for a number of reasons. First, it recognizes the centrality of regulation as one of the motivations for financial innovation and we posit that cybersecurity measures proposed in this study as a panacea to the challenge of financial innovation will only work under an atmosphere of compliance to a robust risk management framework facilitated by regulation. Second, the theory is in alignment with the profit maximization objective of financial services sector where deposit money banks feature prominently. Additionally, in delivering financial innovation, the theory distinguishes technology as either physical (computers and networks related) or miscellaneous (applied information) and these two complements are fully at play when considering cybersecurity architecture for deposit money banks.

2.4. Empirical Review

Khalil et al [54] examined the relationship subsisting between cyber security costs and financial (product) innovation of Pakistani Banks. The study utilized a survey research design approach to elicit responses from the selected banking professionals. The study found that investments in cyber security significantly impact the

financial innovation of the affected e-Banks. It therefore recommended that Banks should continue to step up their efforts in creating innovative products to improve overall bank efficiency.

Njoroge [55] assessed the linkage subsisting between cybersecurity and financial innovation proxied by the rate of developed financial products on offer to the banking public in Kenya. A descriptive research design supported by an administered questionnaire was used for data gathering. The study found that cybersecurity costs proxied by prevention and detection costs have a positive but statistically insignificant relationship with financial innovation of banks in Kenya. On the other hand, other direct costs such as legal and business continuity costs had a positive and statistically significant impact on financial innovation. Based on the research findings, it is recommended that banks should sustain their efforts at creating more innovative banking products and services.

Wang, Nnaji and Jung [56] assessed internet banking in Nigeria from the perspective of cyber security breaches, practices and capability. The study used a descriptive research design and an online survey was conducted using one hundred (100) experienced banking professionals as a sample for the study. The study findings pinpointed a fast-paced growth in the levels of sophistication and depth of cybercrimes now prevalent in the banking sector of Nigeria. To stem the tide, the study recommended the strengthening of the legislative framework and the deployment of newer and stronger cyber technological tools.

Ezu et al [57] explored the effect of electronic fraud on the financial performance of deposit money banks in Nigeria covering a ten (10) year period from 2008 to 2018. Analysis of the secondary data collected was performed using the multiple regression tools and the study found that there is no significant relationship between electronic fraud and the financial performance of banks operating in Nigeria. It nonetheless called for improved synergy between all relevant stakeholders (banks and regulatory authorities) to stem the tide of electronic fraud. We note that these findings are also in alignment with the previous study of Adaora, Jisike and, Amalachukwu [60] who affirmed that electronic frauds when viewed from the prism of ATMs induced frauds had no significant influence on bank's financial performance when proxied by return on assets.

Ogunwale [22] examined the effect of cybercrime on the performance of deposit money banks in Nigeria using a theory paper approach. The study concluded that proper implementation of all related regulatory guidelines on cyber security will aid the reduction of cybercrimes while also fostering trust in the banking system.

Wilson et al, [58] empirically assessed the effect of financial innovation on the profitability of listed deposit money banks in Nigeria. The study found that contrary to the apriori expectations, investments in financial innovation had no significant effect on the reported

accounting numbers of deposit money banks in Nigeria. It however recommended that continued investment in financial innovation is crucial for each financial services sector player to maintain a competitive edge in the industry.

Ugwuja and Ekunwe [20] investigated cyber risks in electronic banking of women agro-entrepreneurs in South-South region of Nigeria using a survey research design approach through the use of questionnaire. The paper revealed that to mitigate emerging cyber risks, customers must become more aware, proactive and technologically savvy in their financial dealings. It further revealed that household size, educational level and internet access were significant predictors in determining the ease of access to electronic banking products and services.

Ibekwe [30] studied the relationship between financial innovation and the financial performance of deposit money banks in Nigeria. Data for the study was sourced from the Central Bank of Nigeria Statistical Bulletin, CBN Annual Report and Statement of Accounts while analysis was undertaken using the multiple regression tool. The study produced mixed results in respect of the various proxies used. While ATM, POS and mobile banking (as proxies of financial innovation) yielded a positive and statistically significant impact on profit performance, internet banking (as a proxy of financial innovation) on the other hand produced a negative and statistically insignificant impact on profit performance.

Ojeka and Egbide [46] analysed the relationship between cyber security and the effectiveness of Audit Committees as it relates to listed deposit money banks operating in Nigeria. The study utilized the survey research design technique while inferential statistics was conducted with the aid of regression and correlation analytical tools. The research outcome from the study indicates that the current characteristics of Audit Committees in Nigeria are incapable of positively influencing cyber security measures. Consequently, the researcher recommended urgent improvement in the composition of Audit Committees by ensuring that more technologically competent persons are brought on board.

A critical look at available previous literature showed that the majority of the studies have concentrated on either assessing the impact of financial innovation on the financial performance of the financial services sector or the effect of cyber-crime on the financial performance of the sector with little focus on the relationship between cybersecurity and financial innovation. Similarly, the findings from prior studies have produced mixed results as indicated above, consequently, there is a need for a study that clearly establishes the linkage between adherence to a robust cybersecurity framework and the financial innovative strengths of deposit money banks.

Accordingly, therefore, the central hypothesis of the work is as follows:

H₀: There is no significant relationship between cybersecurity and financial innovation of deposit money

banks operating in Nigeria.

3. Methodology

This study adopted the survey research design. This design was considered appropriate because it is tailored towards studying a sample from a large population from where inferences would be drawn about the characteristics of the defined population. The researchers therefore, reported the situations as they had occurred without the manipulation of the variables. A well-structured questionnaire was administered to a sample size of fifty-six (56) respondents made up of senior management cadre staff purposively selected from eight (8) of the listed deposit money banks in Nigeria. The questionnaire was validated using both content and face validity method. The answers were classified according to five Likert scale for data or information extraction. The first section contained data relating to personal information while the second section of the questionnaire contained data involving the research variables.

The Banks under review are Access Bank Plc, Ecobank Plc, FCMB Plc, GTB Plc, First Bank Plc, UBA Plc, Union Bank Plc and Zenith Bank Plc respectively. The justification for the selection of these Banks is that they constitute about 93% of the total market capitalization of all listed banks in Nigeria as of December, 31, 2021 [59]. The senior management staff selected were drawn mainly from the ICT, risk management and compliance work functions based upon the centrality of their roles in driving cyber security and financial innovation activities in their respective organizations. Primary data collected were analyzed using the descriptive statistics tool of mean and standard deviation while the inferential statistics tool used to conduct the data analysis was multiple regressions. This was conducted using the Statistical Package for Social Sciences software (SPSS).

The regression model utilized for the study is formulated thus:

$$Y=f(X)$$

Y=Dependent Variable = Financial Innovation (FINT)
 X=Independent Variables= Cyber Security (CYS)
 $X=x_1, x_2$
 $FINT = f(RMG, BMT)$
 $FINT = \alpha_0 + \alpha_1RMG+ \alpha_2BMT + \mu_1$
 Where:
 x_1 = Risk Management = RMG
 x_2 = Bank Monitoring =BMT
 α_0 = Intercept
 α_1,α_2 = Coefficients
 μ_1 = error term

4. Results and Discussion of Findings

The bio-data of the respondents as obtained from the

filled and returned structured questionnaire were presented and analyzed in Table 1. The table showed the diverse mix of the respondents which is an indication of the representative nature of the data collected.

Table 1. Demographic Profiles of the Respondents

S/N	Features	Group	No of Respondents	Percent age (%)
1	Gender	Male	27	48.2
		Female	29	51.8
2	Respondents Age	20-30 years	8	14.3
		31-40 years	18	32.1
		41-50 years	25	44.6
		51 years above	5	8.9
3	Marital Status of the Respondents	Single	11	19.7
		Married	45	80.3
4	Educational Status of the Respondents	Diploma	4	5.4
		B.Sc.	26	46.4
		M.Sc.	24	42.9
		PhD	2	3.6
5	Respondents' Professional Qualification	ACA/FCA/ FCCA	21	37.5
		CISA/CCN A/Others	35	62.5
6	Respondents' years of work Experience	Less than 6 years	8	14.3
		6 -9 years	5	8.9
		10 years & above	43	76.8

Source: Researchers' Field Survey, 2021

Interpretation

Table 1 above provides a snapshot of the demographic profile of the sampled respondents. The gender distribution of the respondents shows that 27 respondents (48.2%) were male while the remaining 29 respondents (51.4%) were Female. In terms of age, the majority of the respondents' age falls within 41- 50 years (25 respondents, 44.6%). This is followed by 18 respondents (32.1%) within 31-40 years; 20-30 years (8 respondents, 14.3%); and those above 51 years (5 respondents, 8.9%). Among these respondents, majority were married (45 respondents, 80.3%) while the remaining 19.7% (11 respondents) were still single as at the time of the survey.

Regarding the educational qualification of the respondent, the results show that majority of the respondents had a minimum of a first degree or its equivalent (94.6%) implying a high degree of educational exposure by the respondents with possession of PhD as the least (2 respondents, 3.6%). Similar to educational qualification is the acquisition of a professional certificate that would enhance the level of productivity of the employees. While the majority of the respondents

35(62.5%) had professional certifications in information security and other related fields, others had their professional roots embedded in accounting (ACA/FCA/FCCA).

Based on work experience, the majority of the respondents had worked for more than 10 years 43(76.8%) followed by less than 6 years 8(14.3%) with the least being those who have worked between 6 – 9 years 5(8.9%). Overall, most of the respondents are married males who fall between the age brackets of 41-50 years. These respondents also possess at least an MSc degree which was supported with one or more professional qualifications to underscore the depth of their exposure, knowledge and experience in the fields of cybersecurity and financial innovation.

Table 2 presents the outcome of responses received in respect of risk management. The responses provided by the sampled respondents indicate an aggregated mean of 2.97 indicating that on average, they agreed that deposit money banks have in place a formal information security program to guide their cybersecurity activities; risk assessment to protect customer information. The responses also indicate

that on average, the bank's regular cyber security testing is performed by a qualified third-party vendor and that there is a risk management and disaster recovery program in place in the institutions. However, on average, the majority of the respondents disagree that the selected deposit money banks have in place adequate frameworks for risk assessment, risk mitigation and cyber security planning.

Table 3 presents a highlight of the responses obtained in respect of the cybersecurity indicator of bank monitoring. The responses provided by the sampled respondents in respect of bank monitoring with an aggregated mean of 3.47 indicated that on average, they agreed that deposit money banks keep employees up-to-date on policy changes, new information security and associated best practices. The responses also indicate that on the average, the banks regularly educate customers about information security risks and best practices; manage and monitor system configurations effectively and obtain information on the latest cyber threats and vulnerabilities. Lastly, deposit money banks give prompt responses to customer requests by e-mail or other means.

Table 2. Cyber Security Indicator – Risk Management

S/N	Questions	Strongly Disagree	Disagree	Agree	Strongly Agree	Mean	Std. Deviation
1	The banks have a formal information security program in place	(0) 0.0%	(3) 5.4%	(27) 48.2%	(26) 46.4%	3.410	.5962
2	The banks program provides the framework for risk assessment, mitigation, and cyber security planning.	(25) 44.6%	(31) 55.4%	(0) 0.0%	(0) 0.0%	1.553	.5016
3	The banks cyber security testing are performed by a qualified third-party vendor	(3) 5.4%	(1) 1.8%	(20) 35.7%	(32) 57.1%	3.446	.7843
4	There is a risk management and disaster recovery program in the bank	(3) 5.4%	(1) 1.8%	(22) 39.3%	(30) 53.6%	3.410	.7810
5	The banks has a risk assessment to protect customers information	(2) 3.6%	(8) 14.3%	(31) 55.4%	(15) 26.8%	3.053	.7488
						2.975	0.682

Source: Researchers' Field Survey, 2021

Decision Scales; ≤ 1.49 = Strongly Disagree, 1.5 – 2.49 = Disagree, 2.5 – 3.49 = Agree, 3.5 – 4.49 = Strongly Agree

Table 3. Cyber Security Indicator – Bank Monitoring

S/N	Questions	Strongly Disagree	Disagree	Agree	Strongly Agree	Mean	Std. Deviation
1	The banks keep employees up-to-date on policy changes, new information security and best practice	(2) 3.6%	(2) 3.6%	(22) 39.3%	(30) 53.6%	3.429	.7350
2	The banks educate their customers regularly about information security risks and best practice	(3) 5.4%	(1) 1.8%	(20) 35.7%	(32) 57.1%	3.446	.7843
3	The banks are effectively managing and monitoring the system configurations	(1) 1.8%	(1) 1.8%	(18) 31.1%	(36) 57.1%	3.589	.6260
4	The banks get information on latest cyber threats and vulnerabilities	(0) 0.0%	(2) 3.6%	(27) 48.2%	(27) 48.2%	3.446	.5695
5	The bank gives prompt responses to customer requests by e-mail or other means	(1) 1.8%	(0) 0.0%	(27) 48.2%	(28) 50.0%	3.464	.6019
	Grand Mean					3.475	0.663

Sources: Researchers' Field Survey, 2021

Table 4. Financial Innovation Indicators

S/N	Questions	Strongly disagree	Disagree	Agree	Strongly agree	Mean	Std. Deviation
1	Using e-banking does not require a lot of effort	(0) 0.0%	(1) 1.8%	(23) 41.1%	(32) 57.1%	3.553	.5366
2	Card Products, POS, ATM, E-banking usage is always available for business	(1) 1.8%	(5) 8.9%	(31) 55.4%	(19) 33.9%	3.214	.6799
3	There is high level of confidentiality in Card Products, POS, ATM, E-banking usage	(1) 1.8%	(8) 14.3%	(31) 55.4%	(16) 28.6%	3.107	.7052
4	There is high level of integrity in banks Card Products, POS, ATM, E-banking usage	(2) 3.6%	(9) 16.1%	(24) 42.9%	(21) 37.5%	3.142	.8186
5	Implementation of POS enhance data security	(2) 3.6%	(0) 0.0%	(31) 55.4%	(12) 21.4%	2.982	.6739
6	Card Products, POS, ATM, E-banking usage enables user’s identification and confirmation before usage enhances its adoption	(0) 0.0%	(12) 21.4%	(29) 51.8%	(15) 26.8%	3.053	.6985
7	Card Products, POS, ATM, E-banking usage can be relied upon for financial transactions	(0) 0.0%	(22) 39.3%	(27) 48.2%	(7) 12.5%	2.732	.6739
8	Experience is an important influence in adoption of POS, ATM, E-banking usage.	(1) 1.8%	(12) 21.4%	(28) 50.0%	(15) 26.8%	3.017	.7505
9	The degree of innovativeness influences the adoption of Card Products, POS, ATM, E-banking usage in an organization	(2) 3.6%	(6) 10.7%	(27) 48.2%	(21) 37.5%	3.196	.7727
10	Customer motivations will enhance the adoption of Card Products, POS, ATM, E-banking usage	(2) 3.6%	(13) 23.2%	(29) 51.8%	(12) 21.4%	2.910	.7693
11	Information quality obtained from the use of Card Products, POS, ATM, E-banking usage will enhance its adoption	(1) 1.8%	(2) 3.6%	(32) 57.1%	(21) 37.5%	3.303	.6301
	Grand Mean					3.110	0.701

Sources: Researchers’ Field Survey, 2021

Table 4 presents an overview of the responses obtained in respect of selected indicators of financial innovation. The responses provided by the sampled respondents in respect of financial innovation with an aggregated mean of 3.11 indicated that on average, the respondents agreed that the levels of financial innovation are relatively high in the chosen deposit money banks. In particular, some of the highest indicators were that: using e-banking does not require a lot of effort ($\bar{x}=3.56$); information quality obtained from the use of Card Products, POS, ATM and other e-banking channels will enhance its adoption ($\bar{x}=3.30$); Card Products, POS, ATM, E-banking usage is always available for business ($\bar{x}=3.21$); degree of innovativeness influences the adoption of Card Products, POS, ATM and other E-Banking channels in deposit money banks ($\bar{x}=3.19$); sufficiently motivating customers will enhance the adoption of Card Products, POS, ATM and other E-Banking channels. Similarly, majority of respondents agree that the levels of confidentiality and integrity in the usage of POS, ATM and other E-Banking channels are high. However, nearly 40% of respondents (39.3%) disagree that Card Products, POS, ATM and other E-Banking channels can be relied upon to consummate financial transactions. Consequently, banks must put in place adequate measures to improve the levels of monitoring of these channels to minimize downtime and associated challenges that negatively impair the ability of customers to consummate their transactions.

Estimation Result

Table 4. Regression Analysis Results

Variables	Coefficient (β)	Std Error	T-Stat	p-value*
C	8.973	3.782	2.372	0.021
RMG	0.589	0.252	1.812	0.076
BMT	0.948	0.484	3.479	0.001
F-stat	23.274			
Prob (F-stat)	0.000			
Adjusted R-Squared	0.447			

Source: Researcher’s Field Survey, 2021

Note: *implies 5% significance level.

Interpretation and Discussion of Findings

$$FINT = \alpha_0 + \alpha_1 RMG + \alpha_2 BMT + \mu_1$$

$$FINT = 8.973 + \alpha_1 0.589 + \alpha_2 0.948 + \mu_1$$

The result of the pooled ordinary least squares regression test is as presented in Table 4 above. The regression result showed that all the proxies of Cyber Security (CYS) measured by Risk Management (α_1) and Bank Monitoring (α_2) have a positive effect on Financial Innovation (FINT) of deposit money banks. This is reflected by the signs of the coefficients, that is $\alpha_1 = +0.5894 > 0$; $\alpha_2 = +0.948 > 0$. This indicates that a unit

increase in RMG will bring about a 0.58 increase in FINT while a unit increase in BMT will cause a 0.94 increase in FINT. The value of the multiple coefficients of determination (Adjusted R^2) indicates that the aggregate variation in the explanatory variables could only account for 44.7% changes in the dependent variable while the balance of 55.3% could be explained by variables outside the study. With the F-statistics of 23.274 and the p -value of 0.000 which is less than the 5% level of significance adopted for the study, we rejected the null hypothesis and accepted the alternate which means that the entire model is significant.

The resulting aggregate model ($FINT = 8.973 + \alpha_1 0.589 + \alpha_2 0.948 + \mu_1$) and the study findings is consistent with the a priori expectation that a risk management framework (RMG) and bank monitoring (BMT) would exhibit a significant positive effect on financial innovation of deposit money banks. This finding is in alignment with the works of Njoroge [54]; Khalil et al [55] who concluded that cybersecurity actions are capable of influencing the development of innovative products and services in the banking industry. Additionally, findings from the study are in tandem with Ugwoja and Ekunwe [20] who found that cyber security preparedness measures have a significant effect on the use of electronic banking channels and by extension financial innovation products.

5. Conclusions and Recommendations

This study empirically examined the effect of cybersecurity on the financial innovation of deposit money banks in Nigeria. Risk management and Bank monitoring were employed as proxies for cybersecurity while electronic channels deployment such as ATMs, POS, Card products were used to measure financial innovation. Following the outcome of the regression analysis, the study reached a conclusion that cybersecurity had a positive and statistically significant impact on financial innovation of deposit money banks in Nigeria. In particular, the study found that putting in place effective disaster recovery plans and addressing cyber threats and vulnerabilities positively affected the financial innovation drive of deposit money banks.

Consequently, based on the findings of the study, it is therefore recommended as follows:

1. Deposit Money Banks should ensure regular review, revision and strengthening of their risk management framework to meet with emerging challenges from the deployment of financial innovative products and services.
2. Deposit Money Banks must strengthen existing systems configurations to ensure consistent protection of customers' information as well as addressing cyber threats and vulnerabilities to enhance uptake of financial innovative products.
3. Additionally, the study recommends that Deposit Money Banks should improve on the level of monitoring of the deployed e-banking channels (Card products, POS, ATMs and other channels) to facilitate greater reliance on them for the consummation of financial transactions.

As with most studies, notwithstanding the unique nature of this study as one of the first to explore the interconnection between cybersecurity deployments and driving financial innovation, it still has a few limitations. First, the study considered primary data elicited from current respondents which coincided with the most recent state of Deposit Money Banks in Nigeria. However, a widened timeline and inclusion of non-bank players such as financial technology firms may yield further insights and afford readers the opportunity to better establish trends in customer preferences and attractions to financial innovative products. Secondly, the research was done using a small sample size even though selected from all the major Deposit Money Banks listed in Nigeria. Future studies could therefore be undertaken to address these scope and sample size limitations identified to foster greater representativeness. Similarly, other cybersecurity indicators such as cybersecurity awareness, compliance attitude and openness to change may be brought to focus in future works. Also, future researchers could consider expanding the work to other underdeveloped or developing countries where financial innovation is still a challenge and an emerging issue.

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