

Impact of Financial Technology (Fintech) on Financial Inclusion in Nigeria

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Abstract

Financial inclusion is a major strategy of sustainable development while financial technology (Fintech) has been identified as a new innovation that can be employed to achieve financial inclusion. With growing influence of Fintech in Nigeria, gains associated with a large number of people who are financially included is enormous. However, a large proportion of its population do not have adequate access to physical and technological infrastructures; that could aid financial inclusion. The impact of financial technology on financial inclusion in Nigeria is the focus of this paper. ARDL method was employed to test the relationship between Fintech and financial inclusion on a quarterly time-series data from 2009 to 2019. The empirical result of the study shows that financial technology has significant and negative impact on financial inclusion; implying that the current state of the country's financial technology does not translate to improvement in financial inclusion in the short-run. In addition, it shows that economic growth significantly influenced financial inclusion in Nigeria on short-run and long-run basis respectively. Therefore, we recommend the need for radical collaboration among all stakeholders in Fintech industry, ministry of science, technology, National Communication Commission, and traditional saving institutions, to enhance the long-run positive impact of Fintech on financial inclusion in Nigeria.

Keywords: Financial Technology, Financial Inclusion, Technological Innovations, Technology Infrastructure, Development

I. INTRODUCTION

Technological innovations have been ushered into different aspects of human activities for centuries, but in recent times, the technological improvements go beyond past impressions in terms of data (gathering, process, and usage) and global connectivity, which has reduced the cost of economic transactions and brought the whole world into a unified system via the internet, thereby making 21st century different. Financial technology covers technology-enabling business models and digital innovations in the financial sector. Its impacts on human endeavors are on a global rise, therefore, making various economic agents adopt multiple financial and technological integration systems in line with its adaptability to business environment and its end users (United Nations, 2021).

With approximately over 200 million people, Nigeria (Africa's regional player) has the largest population of youths in the world (World Bank, 2020). The population advantage can create an enormous market for the provision of services especially in the financial industry if effectively managed by all stakeholders; however, the level of its financial inclusion is low (Demirgüç-Kunt, Klapper, Ansar, Hess, & Singer, 2018)). Financial inclusion in Nigeria is challenging because a large proportion of its population lives in areas where they do not have adequate access to physical and technological infrastructures, that could aid in promoting financial services such as online banking; therefore, making the populace from rural and remote areas financially vulnerable (Salampasis & Mention, 2018). In 2018, records from the Nigerian FinTech

association showed that 58% of those funds amounting to over 104 million dollars were received by FinTech start-ups, while in 2020 Nigeria had the second-highest cryptocurrency transaction estimated at 500 million dollars.

Despite these laudable feats, financial technology, though at its infancy has not performed to its full potentials in the financial industry, with over 48 percent of its adult being financially excluded, (adult literacy rate of 62 percent). FinTech is a major way to bridge the gap between financial services provided by financial institutions and people who are financially excluded. Emerging financial technologies (FinTech) such as online mobile banking, crowd funding, crypto currencies, and block chain-based transaction platforms have the potential to expand financial inclusion. There is evidence that fintech adoption was driven by increasing aggregate demand, and the adoption has expanded the reach of financial services (Frost, 2020). This can create access to banking services, investment possibilities, and endless opportunities for those currently underserved (Odinet, 2020). The low coverage of banking and credit in Nigeria implies that a substantial fraction of the population may not have access to credit and liquidity. As the literacy rate increased by eleven percent over ten years (2008-2018) to 62.02% and internet penetration through GSM data usage also increased, nevertheless, more than 30 million adult Nigerians do not have or use either formal or informal financial services products.

These constraints prevent relative prices from resolving disequilibria, amplifying the impact of shocks on employment, production, consumption, and causes inefficient intermediation of savings which reduce returns on real investment amongst others (Economic and Financial Review, 2013; Solomon, 2015). Different frameworks were also put in place by the central bank of Nigeria to foster inclusion, such as the Financial System Strategy 2020 (FSS 2020), which has financial inclusion as one of its major objectives, but the problem persists as the number of exclusion keeps increasing.

Financial inclusion is a huge challenge in Nigeria. The low coverage of banking and credit services in Nigeria implies that a substantial fraction of the population may not have access to credit and liquidity. Low internet penetration and low literacy rate; shocks on employment, production, consumption and inefficient intermediation of savings aggravate the return on real investment, which consequently increase poverty among the populace.

The objective of the study is to evaluate the impact of financial technology (FinTech) on financial inclusion in Nigeria. The rest of the study is organized as follows: the next section focuses on recent literature. Section 3 is on theoretical framework and methodology. Data analysis and discussions of results are reported in Section 4. Section 5 concludes and offers recommendations

II. RECENT LITERATURE

Financial technology (FINTECH) can be described as a process whereby firms combine financial services with modern, innovative technologies in order to distribute financial services in a more effective and less costly manner. (Dorfleitner, Hornuf, 2017; In AlMomani & Alomari, 2021). Financial inclusion, on the other hand is seen as a process where all members of an economy do not have difficulty in opening bank accounts; can access credit; and can conveniently, easily and consistently use financial system products and facilities without difficulty (Plymouth City Council, 2009). Many studies have examined the different connections between financial technology and financial inclusion; digital finance and economic growth (Shofawati, 2019; Igoni, Onwumere & Ogiri, 2020; Jiang, Wang, Ren & Xie, 2021), while others beam searchlight on Fintech and economic growth (Narayan, 2019; Sadigov, Vasilveva & Rubanov, 2020; Kammoun, Loukii & Loukii, 2020). However, there is no consensus in the findings of extant literature.

Kanga, Oughton, Harris and Murindea (2021) argued that fintech can positively impact financial inclusion and raise standard

of living in a nation, only if policy makers create an environment that can sustain standard settings of information and communication technology (ICT), and digital networks. ADB (2016) showed that low comprehension rate about financial education and channels reduced the rates of acceptance and adoption, because low-income earners working to meet basic needs have little or no motivation to learn or use the digital channels and infrastructures. Ene, Abba, and Fatokun (2019) showed that there was a strong and positive correlation between financial inclusion and the number of point-of-sale facilities available in Nigeria because the public found it easy to access and operate. It was further found out by Yaqub and Odeleye (2017), that the point-of-sale facilities significantly impacted financial inclusion while automated teller machines had insignificant impact on financial inclusion in Nigeria.

Employing the panel analysis for 49 Sub-Saharan countries for the period 2000-2012, Asongu and Le Roux (2017), reported that broadband and mobile phone penetration positively impacted inclusive growth, suggesting that growth was sustained over a period due to the penetration of broadband and mobile phones. In another study, Abor, Amidu and Issahaku (2018), confirmed that mobile ownership reduced the chance of individuals falling into poverty. Also, the result of Peruta (2018) on the pattern of mobile money adoption in emerging and developing countries, for the period 2011 to 2014, showed that it had a positive and significant influence on access to formal bank services. Similarly, Gosavi (2018) reported that mobile phones based on financial technology had positive influence on financial transactions. This suggests that the adoption of mobile money by firms can help them mitigate the problem of access to finance.

Findings of Asongu and Odhiambo (2019), on 48 African countries, showed that mobile, internet and broadband penetration impacted negatively on inequality in Africa for sustainable development. Employing the system Generalized Method of Moments

between 1996 and 2014, for 48 African countries, Tchamyu, Erreyger and Cassimon (2019), found that ICT reduced income inequality via formal financial sector and non-formal financial sector respectively.

Cross-country analyses were conducted by some authors (Ouma, Odongo, & Were, 2017; Tah, 2019; Enueshike & Okpebru, 2020; Wale-Awe, Alabi & Omoloye, 2020). They showed that technology increased savings among the poor; transfers of funds had significant effects on financial services, as well as increase in rural areas' deposits and loans availability to SMEs respectively. Anarfo, Abor, Osei and Gyeke-Dako (2019) investigated the relationship between monetary policy and financial inclusion in Sub-Saharan Africa and found the existence of a bi-directional relationship between financial inclusion and monetary policy. It contradicts Evans (2016) that found a unidirectional relationship from monetary policy effectiveness to financial inclusion.

However, the work of Bakari, Donga, Hedima, Babayo and Ibrahim (2019) showed that financial inclusion had a strong correlation on poverty reduction when examining the impact of financial inclusion on poverty alleviation in the sub-Saharan region between 1980 and 2017. It also showed that the causality flowed from monetary policy effectiveness to financial inclusion and not vice versa. In another study, Chinoda and Mashamba (2021) investigated the effects of financial technology, and financial inclusion on income inequality in 25 African countries using Foreign Financial Institution (FFI) model for the period 2011 to 2017. The result of the study shows that financial inclusion interacted with financial technology positively and significantly reduced income inequality in Africa. In addition, employing the provincial panel data over the period 2011 to 2018, Lv and Xiong (2022) reported that Fintech positively and significantly improved corporate investment efficiency in China. This suggests that the development of regional Fintech promotes corporate investment efficiency in China.

Recent studies on the subject matter are relatively few, especially in Nigeria. More so, existing literature employed annual data while ours is quarterly. Quarterly data are generally more detailed than annual data, as its data cover a longer period, hence, its findings can be forecasted for long-term goals. Our study therefore contributes to extant literature on the impact of financial technology on poverty reduction.

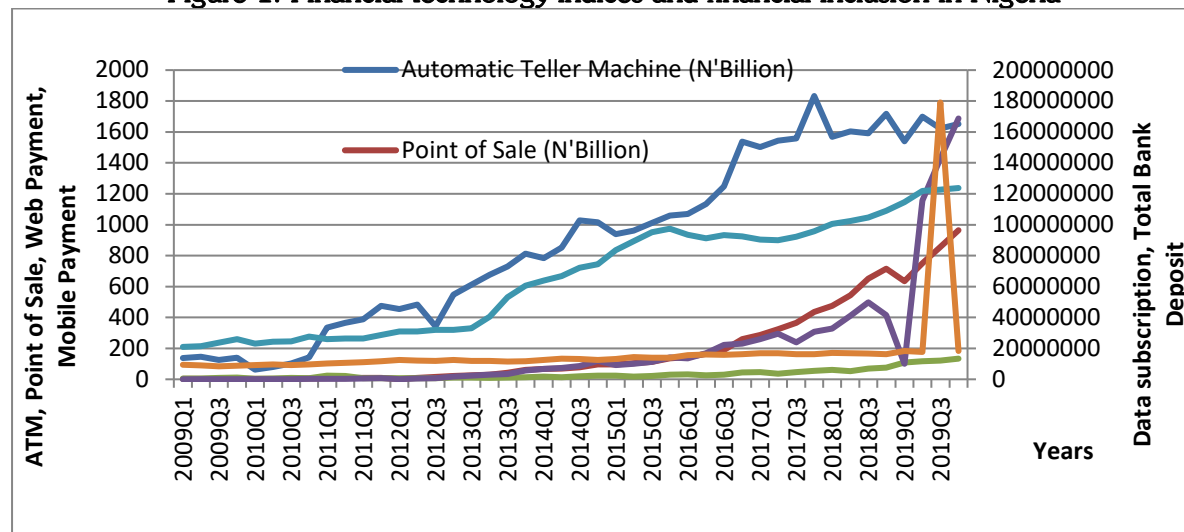
Trend Analysis of Financial Technology and Financial Inclusion in Nigeria

The trend movements of financial technology variables measured by automatic teller machine (ATM), point of sale (POS), web payment internet banking (WEB), mobile payment (MOB), data subscription (DSUB), and financial inclusion proxy by bank total deposit (BTD) are presented in Figure 1. From the chart, it shows that the trend of bank total deposit in a steep manner from 2009: Q1 to 2019: Q2 but witnessed a sharp growth in

2019: Q3 and later dropped to N179,088,017.82 billion in 2019: Q4 to N18,264,118.31 billion.

For indicators of financial inclusion, data subscription trends upward in the inception of the periods at 20,967,723 till 2015: Q4 at 97,458,319. It later dropped slightly to 91,285,372 in 2016: Q2 and subsequently rose till the end of the period. The trend movement of web payment sloped upwardly during the periods under study. As for mobile payment, its movement grows steadily to N497.63 billion in 2018: Q3 then dropped to N100.69 billion in the first quarter of 2019, later experienced rapid growth to N1,687.1 billion in 2019: Q4. The trend movement of point-of-sale sloped approximately in the same way as mobile payment. Meanwhile, the automatic teller machine experienced a wavelike trend at a steady growth rate during the whole period.

Figure 1: Financial technology indices and financial inclusion in Nigeria



Source: Authors' Computation, 2021

III. METHODOLOGY

Model Specification

Based on the empirical model of Nwafor (2018) whose focus was on the nexus between internet penetration and financial inclusion, this study adapts and modifies its theoretical model by incorporating other indices of financial technology (automatic teller machine transaction (*atm*), point of sale

transaction (*pos*), web payment transaction (*web*), mobile money payment transaction (*mob*), data subscription for GSM from network providers (*dsub*)) respectively. Functionally, incorporating real income growth measured by gross domestic product at 2010 constant price (*rgp*) and saving rate (*s*) as control variables, the empirical model of this study is specified as:

$$btd_t = f(atm_t, pos_t, web_t, mob_t, dsum_t, rgdp_t, r_t) \quad (1)$$

In mathematical form, it is specified as:

$$btd_t = \alpha_0 + \beta_1 atm_t + \beta_2 pos_t + \beta_3 web_t + \beta_4 mob_t + \beta_5 dsum_t + \beta_6 rgdp_t + \beta_7 r_t + \mu_t \quad (2)$$

where: *btd* being the financial inclusion measured by total private demand deposit is a function of automatic teller machine transaction (*atm*), point of sale transaction (*pos*), web payment transaction (*web*), mobile money payment transaction (*mob*), information and communication technology infrastructure measured by data subscription for GSM from network providers (*dsub*), and real income growth proxied by gross domestic product at 2010 constant price (*rgdp*). The parameters are represented by

α_0, β_{1-7} , while the disturbance term is denoted by μ , and t stands as time.

Data Descriptions and Measurements

This study employs quantitative methods of analysis using a time series quarterly data from 2009 to 2019. The data was sourced from Central Bank of Nigeria (CBN) Statistical bulletin (2020) and World Bank Development Indicators (2020). Table 1 shows the measurements and descriptions of the variables used in the study.

Table 1: Data Sources and Measurements

Variables	Description	Measurement	Source
<i>btd</i>	Bank total deposit	Total deposit with bank (₦' Billion)	CBN Statistical Bulletin (2020)
<i>rgdp</i>	Real gross domestic product	Economic growth (₦' Billion)	CBN Statistical Bulletin (2020)
<i>r</i>	Interest rate	Interest rate (%)	CBN Statistical Bulletin (2020)
<i>atm</i>	Automatic Teller Machine	Financial Technology (₦' Billion)	CBN Statistical Bulletin (2020)
<i>pos</i>	Point of Sale	Financial Technology (₦' Billion)	CBN Statistical Bulletin (2020)
<i>web</i>	Web payment Internet banking	Financial technology (₦' Billion)	CBN Statistical Bulletin (2020)
<i>mob</i>	Mobile, payment	Financial technology (₦' Billion)	CBN Statistical Bulletin (2020)
<i>dsub</i>	Data subscription	Internet Users (Million)	World Bank Development Indicators (2020)

Source: Authors' Compilation (2021)

Estimation Methods

The study first tests the level of stationarity of all the time series regressors because this is vital in the process of estimation. This step is critical because non-stationary variables produce a misleading result and spurious conclusion. The Augmented Dickey Fuller technique by Dickey and Fuller (1979) was used to check the stationarity level of the variables. Afterwards, the study employs the autoregressive distributed lag (ARDL) model to test the cointegration as well as short-run and long-run estimates. The reasons for employing the estimators are due to the following inherent characteristics: (a) the estimator's application empiric is simple and

it brings the ordinary least square methods into play for the estimation of the cointegration relationship; (b) the test of cointegration (i.e. long-run relationships) existence among regressors can be conducted even if the unit root outcomes indicate stationarity at levels or first differences or the combination of both; (c) the method is found as a good and efficient estimator for empirical studies having small and finite samples; (d) it is more relevant for studies that have its regressors as an endogenous variable; (e) it allows dependent and independent variables to have unrestricted numbers of lags (Pesaran, Shin & Smith, 2001; Haug, 2002; Sakyi,

Commodore & Opoku, 2015; Ogbuji, Mesagan & Alimi, 2020).

Following the unrestricted error correction model, this study expresses the empirical model in ARDL bound form as:

$$\begin{aligned} \Delta btd_t = & \phi + \sum_{i=1}^p \varphi_i \Delta btd_{t-i} + \sum_{i=1}^p \gamma_i \Delta atm_{t-i} + \sum_{i=1}^p \eta_i pos_{t-i} + \sum_{i=1}^p \lambda_i web_{t-i} + \sum_{i=1}^p \pi_i mob_{t-i} \\ & + \sum_{i=1}^p \varpi_i dsum_{t-i} + \sum_{i=1}^p \theta_i rgdp_{t-i} + \sum_{i=1}^p \vartheta_i r_{t-i} + \sigma_1 btd_{t-1} + \sigma_2 atm_{t-1} + \sigma_3 pos_{t-1} + \sigma_4 web_{t-1} \\ & + \sigma_5 mob_{t-1} + \sigma_6 dsum_{t-1} + \sigma_7 rgdp_{t-1} + \sigma_8 r_{t-1} + v_t \end{aligned} \quad (3)$$

From the above equation, Δ being the change operator sign represents the first difference operator; σ_{1-8} stand as the coefficients of long-run multipliers for the long-run relationships; ϕ is the drift; $\varphi, \gamma, \eta, \lambda, \pi, \varpi, \theta, \vartheta$ represent the short-run dynamic parameters of the basic bound testing approach and v is the white noise

error. To verify if there is cointegration (i.e. long-run relationship) among the variables, the F-statistics is estimated in this regard and it is also used to test the non-acceptance of null hypotheses (no cointegration) against the alternative hypotheses (cointegration). Based on the above equation, the following null and alternative hypotheses are tested:

$H_0 : \varphi = 0, \gamma = 0, \eta = 0, \lambda = 0, \pi = 0, \varpi = 0, \theta = 0, \vartheta = 0$ [i.e. no cointegration], and

$H_1 : \varphi \neq 0, \gamma \neq 0, \eta \neq 0, \lambda \neq 0, \pi \neq 0, \varpi \neq 0, \theta \neq 0, \vartheta \neq 0$ [i.e. there is cointegration]

Thereafter, we compare the computed F-statistics with the tabulated upper and lower bounds as presented in Narayan (2004). The decision criterion is to accept the no cointegration hypothesis with rejection of cointegration, if calculated F-values fall below the tabular ones at the lower bound. If it

exceeds the upper bound, then we do not accept the null hypothesis of no cointegration. Lastly, if it is between the two critical bounds, the outcome becomes inconclusive (Mesagan, Ogbuji, Alimi & Odeleye, 2019).

IV. ANALYSIS AND DISCUSSIONS OF RESULTS

Table 2: Descriptive Statistics of the Variables

	RGDP	R	ATM	POS	WEB	MOB	DSUB	BTD
Mean	16181941	3.02	891.42	199.57	32.13	201.75	65756584	17056202
Median	16130148	3.37	895.16	74.17	20.48	80.33	69509637	12882036
Maximum	19494114	4.22	1832.55	964.27	133.66	1687.10	1.24	1.79
Minimum	12583478	1.39	62.59	1.87	3.37	0.06	20967723	8398452
Std. Dev.	16850270	0.99	569.33	267.41	33.59	363.52	35213708	25163762
Skewness	-0.09	-0.46	0.06	1.41	1.66	2.88	0.050	6.27
Kurtosis	2.35	1.70	1.64	3.80	4.94	10.89	1.45	40.91
Jarque-Bera	0.83	4.69	3.42	15.78	27.23	175.29	4.40	2923.38
Probability	0.65	0.09	0.18	0.03	0.01	0.00	0.11	0.00
Observations	44	44	44	44	44	44	44	44

Source: Authors' Computation (2021)

Summary Statistics

The summary statistics presented in Table 2 shows the mean (average), standard deviation (degree of dispersion) minimum and maximum values of the variables as well as the skewness and Kurtosis. The results in the table provided some insights into the nature of the variables used in the study. The average value of the financial inclusion measured by total bank deposit is N17,056,202,000 billion, whereas the maximum and minimum values are N179,088,017,820 billion and N8,398,452,000 billion respectively. The standard deviation value is N25, 163,762,000 billion, which is highly dispersed. This is also indicated in the minimum and maximum values of the variables. On the part of the principal variables, the mean of automatic teller machine (ATM), point of sale (POS), web payment internet banking (WEB), mobile payment (MOB), and data subscription (DSUB) are N891.43 billion, N199.57 billion, N32.13 billion, N201.75 billion and N 65.78 billion. The variables have their minimum values as N62.59 billion, N1.87 billion, N3.37 billion, N0.06 billion, and N20.97 billion and their maximum values at N1,832.55 billion, N964.27 billion, N133.66 billion, N1,687.1 billion, and N123,728.53 during the period under study.

Regarding other key controlling variables given in Table 2, real GDP at 2010 constant price

and interest rate have their mean values at N16,181,941,000 billion and 3.02% during the period under study. The variables showed minimum values at N12,583,478, 000 billion and 1.39% and maximum values at N19,494,114,000 billion and 4.22% respectively. Their large standard deviation from the mean suggests that the variable is highly volatile. Also, all the variables are rightward skewed except real GDP and saving interest rate which are negatively skewed. In terms of peak, point of sale (POS), web payment internet banking (WEB), mobile payment (MOB), and bank total deposit (BTD) are leptokurtic while the remaining variables are platykurtic. This implies that the variables are not normally distributed.

Correlation Analysis

Correlation analysis shows the bi-variate relationship between the dependent and independent variables in the model. The result of the correlation matrix is reported in Table 3. The essence of the correlation analysis is to provide first-hand information about the degree of association between both variables. It also helps in analyzing the strength of relationship among the explanatory variables in order to avoid multicollinearity issues in the specified model.

Table 3: Correlation Analysis

	RGDP	R	ATM	POS	WEB	MOB	DSUB	BTD
RGDP	1							
R	0.6700	1						
ATM	0.7485	0.8026	1					
POS	0.6360	0.6738	0.7326	1				
WEB	0.5979	0.6204	0.7879	0.7690	1			
MOB	0.5556	0.4910	0.6336	0.7698	0.7800	1		
DSUB	0.7704	0.7486	0.7485	0.8277	0.7084	0.6742	1	
BTD	0.2818	0.2249	0.3057	0.4649	0.4884	0.5808	0.3518	1

Source: Authors' Computation (2021)

From the result, it can be deduced that all the indicators of financial technology have a positive correlation with financial inclusion indices measured as bank total deposits. It means that the developmental level of

technology in the financial industry has direct levels of association with the total deposit of bank in the sector. Similarly, the key controlling variables (i.e. real GDP and saving interest rate) have a positive correlation with

financial inclusion. It is also evident that the variables of financial technology have strong and positive correlation among themselves. The correlation coefficients are moderate, suggesting absence of possible multicollinearity problem in the estimation results. Hence, it can be concluded that the specified regression model for the study does not have multicollinearity problem.

Stationarity Test

It has been demonstrated that if time series variables are non-stationary, regression results with these time series will differ from the conventional theory of regression with stationary series. That is, regression coefficients with non-stationary variables will be spurious and misleading. To overcome this

problem, a test for the level of stationarity of the time series is performed. Therefore, the analyses began by first estimating the order of integration of the study since studies have shown that in most time series studies, the constancy doctrine of OLS is violated. The consequence of this is that the classical t , f , and Durbin Watson statistic values based on such estimates may yield biased and inconsistent results, leading to the so-called spurious regression problem. As a result of this problem, the study begins by considering the characteristics of the time series data employed in the study through the order of integration of series using the Augmented Dickey Fuller (ADF) set of unit root test. The result is presented in Table 4.

Table 4: Augmented Dickey Fuller (ADF) Test (Trend and Intercept)

Variables	ADF value at Level	ADF value at 1st Difference	Order of Integration	Remark
RGDP	-3.3933 (8) [-3.5443]	-10.129 (1) [-3.5236]**	I(1)	Reject H_0
R	-1.8506 (0) [-3.5181]	-4.8240 (0) [-3.5208]**	I(1)	Reject H_0
ATM	-1.6667 (0) [-3.5181]	-6.4814 (0) [-3.5208]**	I(1)	Reject H_0
POS	-3.7816 (0) [-3.5181]**	-	I(0)	Reject H_0
WEB	-3.9454 (0) [-3.5181]**	-	I(0)	Reject H_0
MOB	-3.8186 (0) [-3.5181]**	-	I(0)	Reject H_0
DSUB	-1.4745 (1) [-3.5208]	-3.5540 (1) [-3.5236]**	I(1)	Reject H_0
BTD	-1.7375 (2) [-3.5236]	-13.268 (0) [-3.5208]**	I(1)	Reject H_0

Note: ** indicate level of significance at 5%

Source: Authors' computation (2021)

Table 4 reports the results of the stationarity tests at levels as well as the first difference for all the variables. A constant and trend term is included in the tests. The optimal lag length of each case for ADF tests is chosen using the Akaike Information Criteria (AIC) after testing for higher order serial correlation residuals. As shown in Table 4, the ADF values of point of sale (POS), web payment internet banking (WEB) and mobile payment (MOB) respectively are greater than the ADF critical values in absolute terms at levels. Thus, we do not reject the null hypothesis that the series contain a unit root in the process at level. It means that point of sale (POS), web payment internet banking (WEB) and mobile payment (MOB) are stationary at levels. More so, the

results shows that the ADF values of real Gross Domestic Product (RGDP), interest rate (R), automatic teller machine (ATM), data subscription (DSUB) and bank total deposit (BTD) are less than the ADF critical values in absolute terms at level, thereby, accepting the null hypothesis that the series contain a unit root in the process at level. After taking the first difference, each series appear to be stationary as the ADF value is more negative than the ADF critical value. Since the data appear to be stationary in first differences, no further tests are performed. Consequently, it can be concluded that the series (real gross domestic product, interest rate, automatic teller machine, data subscription and bank total deposit) are integrated of order one I(1).

Cointegration Test Result

The study tests the long-run relationship between financial technology variable, financial inclusion and other key controlling variables (such as income per capita and saving interest rate) using the autoregressive distributed lag (ARDL) bound cointegration tests in the stated hypotheses before estimating both the short-run and long-run parameters. For the models showing the

relationship between financial technology and its components, and other controlling variables (income per capita and saving interest rate), the ARDL bound test is employed because it is suitable for variables at different order of integration. The F-statistics estimate for testing the existence of long-run relationship between financial technology and financial inclusion in Nigeria is presented in Table 5.

Table 5: Cointegration Test of Financial Technology and Financial Inclusion

Test Statistic	Value	K
F-statistics (btd rgdp, r, atm, pos, web, mob, dsub)	19.707	7
Critical Value Bounds ARDL (1, 0, 0, 2, 2, 2, 2, 0)		
Significance	I ₀ Bound	I ₁ Bound
10%	1.92	2.89
5%	2.17	3.21
2.5%	2.43	3.51
1%	2.73	3.90

Source: Authors' Computation (2021)

From Table 5, the estimated F-statistics of the normalized equations are greater than the lower and upper critical bound at 1% significance level. This implies that the null hypotheses of no long-run relationship are rejected at 1% significance level. The implication of the above estimation is that financial technology indices, control variables (such as income per capita and saving interest rate) and financial inclusion, all have equilibrium conditions that keep them together in the long-run. Thus, there exists a long-run relationship between financial technology and financial inclusion in Nigeria.

Results of Short-run and Long-run Estimates

The discussion in this section answers the first null hypothesis that financial technology has no significant effect on financial inclusion in Nigeria. It examines both the short-run and long-run relationship estimates of financial technology indicators and other controlling variables in Nigeria using the estimated ARDL approach described extensively in the previous section. The estimated ARDL model is a composite of short-run and long-run estimates of the interrelationship among considered series in this study. The clear evidence of our empirical estimates from real gross domestic product, interest rate,

automatic teller machine, point of sale, web payment internet banking, mobile payment and data subscription are presented in Table 6.

The short-run estimation results show the error correction mechanism, which measures the speed or degree of adjustment. It is the rate of adjustment at which the dependent variable changes due to changes in the independent variables. The short run analysis shows the dynamic pattern in the model and ensures that dynamics of the model have not been constrained by inappropriate lag length specification. The ARDL test automatically chooses the lag length on all variables as the model was set at three to ensure sufficient degree of the freedom based on automatic selection of Akaike Information Criterion. The short-run estimates of the relationship between financial technology and financial inclusion are presented in Table 6. The coefficient of the ECT is found to be negative and statistically significant at the conventional level. The error correction term value of -0.1280 implied that the model corrects its short-run disequilibrium by 12.8% speed of adjustment in order to return to the long run equilibrium.

Table 6: Results of Estimated ARDL Model of Financial Technology and Financial Inclusion

Dependent Variable: Financial Inclusion (BTD)				
Selected Model: ARDL (1, 0, 0, 2, 2, 2, 2, 0)				
Sample: 2009-2019			Included observations: 35	
<i>Short-Run Estimates</i>				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D (BTD (-1))	-1.279770	0.137950	-9.277077	0.0000
D(RGDP)	-1.264742	0.685429	-1.845183	0.0769
D(R)	-0.281426	0.092308	-3.048771	0.0054
D(ATM)	-0.430589	0.156290	-2.755060	0.0108
D (ATM (-1))	-0.455554	0.160955	-2.830326	0.0090
D(POS)	-0.183559	0.092961	-1.974580	0.0595
D (POS (-1))	-0.564167	0.089463	-6.306152	0.0000
D(WEB)	0.330151	0.090115	3.663676	0.0012
D (WEB (-1))	-0.207554	0.086747	-2.392643	0.0246
D(MOB)	0.266391	0.057667	4.619430	0.0001
D (MOB (-1))	0.561691	0.053315	10.53534	0.0000
D(DSUB)	0.353553	0.401635	0.880284	0.3871
ECT (-1)	-0.127977	0.008364	-15.30110	0.0000
<i>Long-run Estimates</i>				
RGDP	-0.988257	0.596240	-1.657482	0.1099
R	-0.219904	0.073102	-3.008189	0.0059
ATM	0.090860	0.116892	0.777299	0.4443
POS	-0.238707	0.151366	-1.577022	0.1274
WEB	0.427508	0.111805	3.823697	0.0008
MOB	0.202328	0.112742	1.794609	0.0848
DSUB	0.276263	0.328156	0.841865	0.4078
C	26.90075	8.106690	3.318339	0.0028
R-squared	0.9041	F-stat	11.5907 (0.000)	
Adj. R-squared	0.8809	D-Watson	1.9768	

Source: Authors' Computation (2021)

The coefficient of the short-run lag one of change in banking total deposit growth has a negative and significant impact on the current changes in banking total deposit at 5%. This implies that the current level of banking total deposit is negatively influenced by the previous level of banking total deposit. The short-run parameter estimates of short-run current and lag one of change in automatic teller machine (ATM), point of sale (POS) were found to be negative and statistically significant at 5% indicating that they adversely affect changes in banking total deposit.

However, the current and first lag of mobile payment (MOB) positively and significantly influenced banking total deposit in the short-run. Meanwhile, the short-run coefficient of web payment internet banking (WEB) at

current level has positive effect on banking total deposit whereas its first lag influences banking total deposit negatively. As for data subscription (DSUB), its current level coefficient is negative and insignificant at 5% level.

The long-run estimates in Table 5 indicates that automatic teller machine (ATM), web payment internet banking (WEB), mobile payment (MOB) and data subscription (DSUB) have positive impact on banking total deposit in Nigeria. The result shows that the indicators are in tandem with the theoretical expectations but only web payment Internet banking (WEB) and mobile payment (MOB) were statistically significant at 5% and 10% level respectively. On magnitude basis, a 10% increase in automatic teller machine (ATM), web payment internet banking (WEB), mobile

payment (MOB) and data subscription (DSUB) cause banking total deposit (BTD) to increase by 0.91%, 4.28%, 2.02% and 2.76% respectively.

On the contrary, the table reported that real Gross Domestic Product (RGDP), saving interest rate (R) and point of sale (POS) have an indirect effect on banking total deposit (BTD) in Nigeria. Among the variables, only saving interest rate conforms to a priori expectations. A 10% decline in real Gross Domestic Product (RGDP), saving interest rate (R) and point of sale (POS) increase banking total deposit (BTD) by 9.88%, 2.2% and 2.39% correspondingly.

The coefficient of determination (Adjusted- R^2) is high (88.09%) indicating that about 88.09% of the total variations in banking total deposit was explained by the variables in the model. It simply indicated that the variation of changes in banking total deposit was explained by 88.09% variations in financial technology indicators and other controlling variables. The overall test using the F-statistic (11.591) is statistically significant at 5% level of significance showing that the model is well specified and statistically significant. The Durbin Watson statistic (1.9768) shows that there is absence of serial autocorrelation in the model.

Discussion of Findings

This study investigates the impact of financial technology (measured by automatic teller machine, web payment internet banking, mobile payment and point of sale) on financial inclusion in Nigeria. The empirical result shows that the relationship between economic growth and financial inclusion in Nigeria both at short-run and long-run is insignificant. This corroborates Okoye, Adetiloye, Erin and Modebe (2017). Also, the result shows that financial technology has significant and negative impact on financial inclusion. It means that the current state of the country's financial technology does not translate to improvement in financial inclusion in the short-run. This indicates the high prevalence of market-specific vulnerability in Nigeria where large numbers

of her citizens are still unbanked, implying lack of access to bank products and services. The financial excluded residents in the country have limited or no access to basic financial services which resulted from low access to technology like smart phones, poor internet connection etc. Statistics showed that more than 30 million adult Nigerians do not have or use either formal or informal financial services products or solutions despite the increase in literacy rate and internet penetration through GSM data.

Comparing the results with existing literature, it negates the findings of Ene, Abba and Fatokun (2019), which depicted a positive relationship between financial inclusion and the number of POS facilities. The short-run negative impact of ATM on financial inclusion reveals the true picture of the Nigerian banks' customers' experiences in regard of usage of automated teller machines both in the urban and rural areas. In the long run, the result shows that financial technology mainly through mobile payment and web payment internet banking has some potentials of ensuring financial inclusion in the country if the metrics are effectively managed and utilized. This is similar to the study of Abiola, Emmanuel, Adedoyin and Aregban (2020), which concluded that financial technology had the potential to drive financial inclusion. Furthermore, the finding that internet penetration does not significantly impact financial inclusion negates the results of Nwafor (2018).

V. CONCLUSION AND RECOMMENDATIONS

According to the empirical findings of the study, the following conclusion is drawn:

There is an increase in the services provided by Fintech in recent time and this will continue to increase as technological innovation increases across the world and especially in Nigeria. Also, the impact of economic growth in financial inclusion cannot be overestimated, there exists a positive correlation between economic growth and financial inclusion. Furthermore, internet penetration in Nigeria is not showing

its real value as computed by the National Communication Commission because internet penetration in top cities like Lagos, Ibadan, Abuja, Port-Harcourt, and Kano does not tell the real story of internet penetration in the whole country.

Based on our empirical findings, the following are recommended:

Nigerian Fintech and technology ecosystem need massive improvement. This improvement can be achieved when there is an enabling macro-economic environment for business to thrive, hereby attracting more local and foreign investors into the sector.

Also, there is a need for collaboration between the fiscal and monetary authorities to formulate localized measures to enhance economic growth, through infrastructural development, this will relatively reduce the number of people who are financially excluded.

Nigeria's technology infrastructure and education facilities should be massively overhauled while a top-notch collaboration between the fiscal and monetary stakeholders should be in place to reduce the Nigerian financial exclusion gap.

Furthermore, there should be widespread regional development across Nigeria. The governments at all levels, the ministry of science, technology and digital economy, and the National Communication Commission should work together, focusing on even spread of technological development, especially in rural areas. This can be achieved via policies that can drive rural area innovation and make rural areas, hubs for technologies.

Lastly, it is recommended that there is a need for radical collaboration among all stakeholders, such as Fintech industry, ministry of science, technology, National Communication Commission, and traditional saving institutions, to enhance the long-run positive impacts of Fintech on financial inclusion in Nigeria. Banks may not be physically present in all areas of the country,

but available technology can bridge the financial exclusion gaps.

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