

Deposit Money Banks-Based-Financial Inclusion and Economic Growth in Nigeria: The Role of a Dual Folded Proxy

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Abstract

Access to finance and financial services have made deposits money bank (DMBS)-enhanced financial inclusion a recent hotspot for either empirical or theoretical research explorations or both. Since FICn is basically designed to link the unbanked and 'misbanked' to DMB services and products, integrating DMB and FICn services to form comprehensive and composite index for FICn would not only improve the empirical validity or performance of the surrogates, but also enlarge the impact base of such metrics. Hence, this study innovatively introduced the non-scarcity of DMB services as mechanism through which FICn can be transmitted to the financially unreached and disadvantaged segment of the economy. This study seeks to explore the role and importance of DMBs in appropriately including the financially excluded economic agents in the trajectory of FICn; and to critically evaluate the potency of DMB-based FICn proxies and surrogates on growth. These surrogates are dual-folded proxies that integrated DMB services into the definition of FICn to reflect comprehensive dimensional indices such as DMBs- FICn service penetration, DMBs-FICn service non-scarcity, DMBs- FICn service usage, DMBs-FICn location and localisation of services and DMBs-FICn affordability of services. The study employed diverse estimation techniques in the validation of the models. Results that emerged from the analysis indicated that: GDPP(GDP per capita) is a determinant of ATM_p penetration, ownership, and usage in Nigeria in the short-run only; ATM_p penetration, ownership, and usage only Granger-caused GDPP in the long-term; ATM_p Granger-caused the spread of banks branches network in the long-run, while the spread of banks branches network Granger-caused ATM_p in the short-run(a confirmation of non-sustainable and ephemeral impact).

JEL Classification: C18, C22, G21, G28

Keywords: Financial inclusion, Deposit money banks, Economic Growth, Nigeria

1. Introduction

Nigeria is one of the most populous countries and one of the largest economies in both sub-Saharan Africa and Africa (IMF, 2021). With the continuous growth and

expansion of the population especially in the rural unbanked areas (that is, areas that are financially excluded or deprived) of the country, the role of deposit money banks in significantly enhancing the performance of financial inclusion (hereinafter FIn) has become a policy and research concern and issue. With deteriorating living and worsening economic conditions, most of the population that are living in poverty are 'financially disenfranchised' as access to financial services (such as access to mechanism for savings, consistent non-scarcity of credit/loans, insurance services, remittances and payments facilities, and pension) is difficult and uneasy and in most cases impossible. To boost the non-scarcity, access and affordability of credit and financial services; a functional and sustainable inclusive financial system is required not only as step to poverty eradication, but as a policy priority in countries that are late-comers to the inclusive financial development process (Ishioro, 2020b).

This study therefore, first, seeks to answer the following questions amongst others: what is the chore of deposit money banks (DMBs) in the advancement of FIn process in Nigeria? This is very important, given that Ahamed and Mallick (2019) only investigated the function performed by FIn in DMBs stability. In this regard, our foremost task is to unveil in reverse form the thematic query of Ahamed and Mallick (2019) for the Nigerian economy.

Second, it has been acknowledged in the literature especially by Wairimu (2020) that little attention has been focused on the channels through which DMBs affect FIn in the economy. Is it through the adoption of e-banking? is it through DMBs' branch network (BBR)? or is it through credit to the domestic economy? Hence, we have adopted the proxies of DMBs to include: Automated Teller Machines (per 100,000 adults), number of commercial banks' branches, and credit extended to the entire economy (as percentage of GDP) partially in consonance with Adesola and Ewa (2020). We have presented a highlight of the justification for adopting these surrogates in the appropriate section.

How has the statutory function of financial intermediation of DMBs facilitated the FIn policy of government in Nigeria? However, the specific questions include: How does the current distribution of the Automated Teller Machines (ATM_p) through the ATM_p penetration channel by DMBs significantly enhanced the degree of FIn in Nigeria? What is the associatability between non-scarcity of banks credit to either the non-public sector or the economy and level of FIn in Nigeria? What are the significant contributions of the number of banks branches to the growth of FIn in particular and the Nigerian economy in general?

Therefore, following the outcome of previous studies, the main objective of this study is to evaluate the significant contributions of deposit money banks to the FIn process in Nigeria. The presentation plan of this study is as follows: in addition to the introduction, literature review is presented in section two, the next section (three) focused on materials and methods, while section four presents the discussion of results obtained. The last section concludes the study with recommendations and summary of findings.

2. Literature Review

Deposits Money Banks-Based Financial Inclusion

The role of deposits money banks in the provision of financially inclusive services has been underscored by different studies including Emara and Said (2021), Kanungo and Gupta (2021); Siwela and Njaya (2021); Shen *et al.*,(2020), Yousef (2020); Ahamed and Mallick (2017), and Demirgüç-Kunt, Klapper, Singer and Van Oudheusden (2015).Hence FIn has been described as DMBs-inclusive financial inclusion in consonance to the role played by deposit money banks (DMBs) in the expansion of banking services to all economic agent, who hitherto were financially excluded (Ahamed and Mallick (2019) and other studies such as Chatterjee (2020), Ratnawati (2020), Hassan *et al.*,(2020), Kelikume (2020), Geng and He (2021), Kamal, Hussain & Khan (2021), Alabi and Olaoye (2022); and Khera *et al.*(2022).

Conceptual Issues

The thematic and policy objective of inclusive finance is to facilitate, encourage, promote and foster the non-scarcity of banking and financial services to the largest proportion of the economy at relatively affordable rates and/or terms in order to either reduce or eradicate financial exclusion (Ishioro, 2020b ,Ahamed & Mallick, 2017, Sarma & Pais, 2011; and Mohan, 2006). In relation to access and usage, FIn has been defined by Ahmed and Mallick (2017) as providing all economic agents (individuals, households and families, firms including informal small scale enterprises) access to formal financial services and products, and can use such services and products effectively (see also, Ditta & Saputra, 2020).

Inclusive finance promotes access to financial services, instruments, opportunities and products for the most financially disadvantaged or deprived proportion of the economy. Inclusive finance is important for the following reasons: Inclusive finance helps to remove socio-economic inhibitions and financial constraints and to curtail adverse shocks in order to assist economic agents to access the much needed external sources of funds in times of liquidity crunch; discourages the existence of widening financial inequality; acts as panacea against worsening

economic conditions by providing insurance and financial freedom from poverty (Collard *et al.*, 2001).

Iqbal and Sami (2017) frantically observed that FIn (represented by deposit-money-banks' proxy) embodies the apt delivery of financial and monetary (DMBs') services to the desired segment of the society (often made up of the less privileged and the privileged, the less-banked, unbanked who constitutes the 'yet- to-be-banked masses') at acceptable and affordable terms. In other words, FIn is the gradual, but sustained exclusion of financial exclusion from the economy (Ishioro, 2020b).

One of the best ways to describe or define a concept or phenomenon is to present in lucid picturesque what it is not. FIn which is the underdevelopment of financial exclusion can be best understood by describing its antonym 'financial exclusion'. 'Financial exclusion' is defined according to McKillop, Ward and Wilson (2007) as the " inability, difficulty and / or reluctance of particular group (s) to access or use mainstream financial services that are relevant and appropriate to their needs which would have allowed them to lead a normal life in the society they belong to" (see Collard *et al.*, 2001).

Theoretical Framework

The theory of intermediation is presented as a hybrid theory in which deposits money banks-based financial inclusion-engendered growth transmission mechanism adapted as the theoretical framework.

The mechanism through which DMBs engender or boost FIn is explicated using the schematic diagrams below. The transmission mechanism is initiated and starts with the establishment and spread of deposit-money-banks (DMBs).The DMBs in pursuance of the growth of inclusive finance programme extend their branch network (BrN) to the unbanked and underbanked areas that were previously excluded from the provision of financial services or the DMBs-engendered FIn transmission mechanism.

$$DMBs \Rightarrow \uparrow BrN \Rightarrow \uparrow ACS / AVA_{FinSvc} \Rightarrow \downarrow FE \Rightarrow \uparrow FI \Rightarrow \uparrow GRWT$$

Where: *DMBs* represents deposit-money-banks;

BrN represents DMBs branch network;

ACS represents access to DMBs services;

AVA_{FinSvc} represents availability of DMBs services;

FE represents Financial exclusion;

FI represents Financial Inclusion;

- $GRWT$ represents growth of the economy;
- \Rightarrow represents ' leads to ';
- \downarrow represents ' decreases or reduces or falls ';
- \uparrow represents ' increases '.

As the number of branch network of DMBs increases, access (ACS) to and availability (AVA) of banking and financial services (denoted as $FinSvc$) also increases leading to the reduction of financial exclusion (FE) and enhanced performance of financial inclusion (FIcn).

$$DMBs \Rightarrow \uparrow ACS / AVA_{FinSvc} \Rightarrow \uparrow ATM_{usage} \Rightarrow \downarrow FE \Rightarrow \uparrow FI \Rightarrow \uparrow GRWT$$

Where ATM_{usage} represents usage and non-scarcity of DMBs services while all other indicators are as previously defined.

DMBs creates access or accessibility (ACS) and availability (AVA) of $FinSvc$ by adopting the instrumentality of the usage of ATM_p as the medium of under-developing FE, in order to develop or expand FIcn resulting in GRWT in the economy. In the transmission mechanism, DMBs are the channels through which FIcn is transmitted to the economy as they provide the openings and vents for FIcn to reach the unbanked and underbanked.

3. Materials and Methods

Sources, Nomenclature and Measurement of Variables

The annual time series data employed in this study are extracted from the World Bank World Development Indicators (WDI, 2022) and NCC (2021) which covered the period of 2011 to 2021.

Table 1: Measurement of Financial Inclusion Index

S/No	Financial Inclusion Index	Proxy of Financial Inclusion Index	Studies
1	Dimensional index: banking Service <i>penetration</i>	The number of bank accounts per 1000 adults or population with different financial institutions	Sarma (2004); Sarma and Pais (2008)

2	Dimensional index: <i>availability</i> of banking services	Number of bank branches and number of ATM's per 1000 adults; Number of ATMs per 1,00,000 population; Number of ATMs per 1,000 sq. km; Number of scheduled commercial banks per 1,000 sq. km	Sarma (2004); Sarma and Pais (2008)
3	Dimensional index: <i>usage</i> of banking services	Deposits plus credits as a percentage of GDP	Sarma (2004); Sarma and Pais (2008)
4	Measure of access	Percentage of people who had an account with banking institutions; Physical infrastructure for connectivity and information inclusive financial index	World Bank (2008); Sarma and Paris (2008)
5	Geographical Location Financial Inclusion index	The number of rural deposit accounts; bank credits for the unbanked rural population; Geographic branch penetration;	Mehrotra, Puhazhendi, Nair & Sahoo (2009)
6	Financial Inclusion Index	Credit income ratio; Deposit-income ratio; Life insurance premium volume/ GDP. Demographic ATM penetration, Demographic Branch penetration; Bank Cost-income ratio; Deposit accounts per capita; Credit account per capita.	Mehrotra, Puhazhendi, Nair & Sahoo (2009); Yorulmaz (2018)
7	Dimensional Index: <i>Affordability</i> of banking services	Ease and cost of transactions	Goel and Sharma (2018)

Source: Author's Compilation

The variables include: Automated Teller Machines per 100,000 Adults (ATM_p) adopted as DMB-FIcn service non-scarcity index or a DMB-augmented service non-scarcity FIcn; Number of Commercial Banks Branches (BBR): a DMB- FIcn service non-scarcity index or DMB-augmented service availability FIcn ; Domestic credit to the economy as percentage of GDP (DCE) adopted as DMB-augmented geographical location and FIcn localisation index; Gross Domestic Product per capita (GDPP at constant US Dollars) as both growth, and FIcn-users' welfare surrogate/ proxy; Commercial Banks credit to the private sector (CPS) as percentage of GDP defined as DMB-augmented geographical location and FIcn localisation index and Commercial Banks credit deposits ratio (CDR) defined as DMB- FIcn service usage index or DMB-augmented service usage FIcn. All the series are expressed in natural logarithm for the usual econometric and statistical reasons after the pragmatic practice of Ishioro (2018, 2019,2020a and 2020b).

BBR was adopted as a surrogate of DMBs, because it has been observed with empirical confirmation that as the distance between financial services providers (of which DMBs constitute a major gamut) and the demanders of such services widens, information asymmetry , moral hazards and the problem of adverse selection are fostered leading to ebbing efficacy of FIcn (Hauswald & Marquez, 2006; Mian, 2006 and Ahamed & Mallick, 2017).This implies that a reduction in the distance between the supply and demand for financial services increase the efficacy of FIcn.

Model Specification and Estimation Technique

Plethora of studies have investigated the role played by Deposit money banks in the FIcn process. We draw from the literature on the relationship between deposit money banks and FIcn to specify our econometric model denoting FIcn using the proxies of Deposit money banks versus economic growth.

The Estimation Procedures

The estimation procedure adopted in this study is in many phases and dimensions.

Unit Root Tests

First, the time series properties of the data used in the study were ascertained by testing for their unit root and stationarity properties following Ishioro (2015a, 2015b, 2016, and 2020b). The generalised model used for the *trio* unit roots and stationarity tests is stated as:

$$\Delta Y_t = \theta_0 + \Phi y_{t-1} + \theta_{2t} + \sum_{i=0}^{i=z} \Theta_j \Delta Y_{t-i-1} + e_t \quad (1)$$

In the equation stated above, y_{t-1} and y are the series in different time lagged values and dimensions; subscript t represents the time factor expressing time trend; θ_0 is the constant drift term; and e_t represents the error term. The Augmented Dickey Fuller (ADF), Phillips-Perron (PP) and the KPSS unit root tests were applied to evaluate the order of integration of the series while the Johansen long-run test was applied to ascertain the cointegrating relationship among the series. (Ishioro, 2017; 2018; 2017; 2015a).

Johansen Long-Run Test

Second, the nature of the order of integration of the series would lead us to test for their cointegration properties. In this study, we carry out a bivariate (one-on-one) cointegration test as presented in table 3 to avoid over-bearing or generalised inferences on the nature and type of cointegration between our set of selected variables. We assume that our model expressed as equation (2) has unrestricted intercepts and no trends in the Cointegrating Equation (CE) or VAR.

$$\Delta X_t = \sum_{i=1}^{z-1} \varphi_i \Delta X_{t-i} + \alpha \beta' X_{t-1} + \mu_0 + \sigma D_t + e_t$$

(2)

In equation (2), Δ represents first difference operator; X_t is a $\mathbf{Z} \times \mathbf{1}$ vector of the stochastic series of our model, α and β represent a $\mathbf{Z} \times \mathbf{r}$ matrices characterized by full rank, φ is defined as the vector of constants and D_t is the vector of the deterministic series. e_t is the vector of error terms with the usual characteristics of normally, *i.i.d* with zero mean and constant variances. This includes both the deterministic trend in the X 's and constants in the cointegrating vectors. In the short-run model, it is assumed that the intercept included in the cointegrating equation is cancelled out by including the intercept in the VAR with only an intercept left in the model.

Granger Causality Tests

Third, we investigated (as in Ishioro, 2017, 2018, 2019, 2020a) and presented in table 4 and 5 the type of causality (categorized into long and short-run) of the series using the Granger causality tests. If two variables X and Y are cointegrated there are three possible or likely relationships: First, X determines Y , that is, X causes Y . Second, Y determines the status of X , that is, Y causes X ; and third, the series X and Y determines each other's performance (with a feedback effect). However, if the series are not cointegrated, then they are mutually exclusive in terms of performance (this is represented by our third schema). A simple Granger causality equation for the series X and Y can be specified as:

$$\Delta Y_t = \sum_{i=1}^{d_1} \Phi_{1i} \Delta Y_{t-i} + \sum_{j=1}^{h_1} \alpha_{1j} X_{t-j} + \mu_{1t} \quad (3a)$$

and

$$\Delta X_t = \sum_{i=1}^{d_2} \Phi_{2i} \Delta X_{t-i} + \sum_{j=1}^{h_2} \alpha_{2j} Y_{t-j} + \mu_{2t} \quad (3b)$$

In equation (3a) and (3b), d_1, d_2, h_1, h_2 are integer (positive) and μ_{1t} and μ_{2t} are white noise (iid).

These Granger causality test and / or relationships are denoted schematically in this study as either:

One-way causality Between ATM and GDPP

$ATM_p \rightarrow GDPP(GDPP \rightarrow ATM_p)$: We hypothesized a one-way causality between ATM_p and GDPP. The hypothesized causality between ATM_p and GDPP was tested at either 1 percent, 5 percent or 10 percent levels of significance respectively. $GDPP \rightarrow ATM_p$ connotes a unidirectional flow of causality from GDPP to ATM_p while $ATM_p \rightarrow GDPP$ connotes a unidirectional flow of causality from ATM_p to GDPP.

One-way causality Between BBR and GDPP

$BBR \rightarrow GDPP(GDPP \rightarrow BBR)$: We hypothesize the existence of a one-way causality between BBR and GDPP. The hypothesized causality existing between BBR and GDPP tested at either 1 percent, 5 percent or 10 percent levels of significance respectively. $BBR \rightarrow GDPP$ signifies the flow of causal linkage from BBR to GDPP at either 1 percent, 5 percent or 10 percent levels of significance, while $GDPP \rightarrow BBR$ exemplifies the movement of causality from GDPP to BBR at either 1 percent, 5 percent or 10 percent levels of significance.

One-way causality Between DCE and GDPP

$DCE \rightarrow GDPP(GDPP \rightarrow DCE)$: We hypothesize or propose the existence of a one-way causality between DCE and GDPP. The hypothesized causality existing between DCE and GDPP tested at either 1 percent, 5 percent or 10 percent levels of significance. In this causal relationship, $DCE \rightarrow GDPP$ represents the flow of causation from DCE to GDPP at either 1 percent, 5 percent or 10 percent levels of significance. $GDPP \rightarrow DCE$ represents the flow of causation from GDPP to DCE at either 1 percent, 5 percent or 10 percent levels of significance.

One-way causality Between CPS and GDPP

$CPS \rightarrow GDPP(GDPP \rightarrow CPS)$: The causality between CPS and GDPP was tested at either 1 percent, 5 percent or 10 percent levels of significance. In this bivariate causal regression, $CPS \rightarrow GDPP$ represents the movement of causal effects from CPS to GDPP at either 1 percent, 5 percent or 10 percent levels of significance while $GDPP \rightarrow CPS$ represents the movement / flow of causal impact from GDPP to CPS at either 1 percent, 5 percent or 10 percent (conservative) levels of significance.

Neutral Causality Hypothesis

In this study, four categories of neutral causality are hypothesized:

$ATM_p \rightarrow GDPP(GDPP \rightarrow ATM_p)$: In this hypothesized neutral relationship ($ATM_p \rightarrow GDPP$), neutral causality is expected to occur at either 1 percent, 5 percent or 10 percent levels of significance when ATM_p is adopted as the lead variable or in the causal relationship ($GDPP \rightarrow ATM_p$) when GDPP is adopted as the lead variable.

$BBR - GDPP(GDPP - BBR)$: In this hypothesized neutral relationship ($BBR - GDPP$), neutral causality is expected to occur at either 1 percent, 5 percent or 10 percent levels of significance when BBR is adopted as the lead indicator or in the causal relationship ($GDPP - BBR$) when GDPP is adopted as the lead indicator.

$DCE - GDPP(GDPP - DCE)$: In this posited neutral relationship ($DCE - GDPP$), neutral causality is expected to occur at either 1 percent, 5 percent or 10 percent levels of significance when DCE is adopted as the lead indicator or in the causal relationship ($GDPP - DCE$) when GDPP is adopted as the lead indicator.

$CPS - GDPP(GDPP - CPS)$: In this hypothesized neutral relationship ($CPS - GDPP$), neutral causality is expected to occur at either 1 percent, 5 percent or 10 percent levels of significance when CPS is adopted as the lead variable or in the causal relationship ($GDPP - CPS$) when GDPP is adopted as the lead variable.

Bi-Directional or Feedback Causality

We conducted a *one-on-one* Granger as a follow-up of the cointegration tests applied in this study.

4. Discussion of Results

The results of the ADF unit root test shown in table (1) confirmed that all the series except BBR, DCE and CPS were not stationary at levels.

Table 2: Results of Unit Root Tests

Type of Unit Root Tests	ADF Unit Root Test		Philips-Perron Unit Root Test		KPSS Unit Root Test		DECISION
	Level	1st Diff.	Level	1st Diff.	Level	1st Diff.	
D(ATM _p)	-2.902	-3.838*	-2.891	-5.927*	0.357**	0.313**	[I(1)]
D(BBR)	-	-	-	-	0.130***	0.132***	[I(1)]
	38.072*	20.988*	117.73*	37.226*			
D(DCE)	-5.686*	-	-5.617*	-8.860*	0.500*	0.458**	[I(1)]
		4.803**					
D(CPS)	-5.642*	-	-1.709	-	0.110	0.128***	[I(1)]
		3.457**		2.267**			
D(CDR)	-1.971	-	-1.161	-	0.019	0.119***	[I(1)]
		2.365**		2.382**			
D(GDPP)	-3.060	-	-3.060	-9.035*	0.099	0.351**	[I(1)]
		4.591**					

Source: Author's Computation

NOTE: ** indicates significant at the 0.05 level, *** indicates significant at the 0.1 level ATM: Automated Teller Machines (per 100,000 adults); BBR: Number of Commercial Bank Branches; CPS: Domestic credit to the Private Sector (% of GDP); DCE: Domestic credit to the Economy (% of GDP); GDPP: GDP per capita (constant \$ US).

However, they became stationary at first difference. Hence we do not reject the null hypothesis that ATM_p, GDPP and CDR contain unit roots at levels and therefore not stationary. But we rejected the null hypothesis that BBR, DCE and CPS possesses unit at levels. For all the series, we do not fail to reject the null hypothesis that all the indicators do not possesses unit root at levels and first difference.

Results of Johansen Co-integration Test

The results of the unrestricted cointegration rank test of GDPP and ATM_p disclose that there is no long-term association between them. Therefore, it can be inferred that the performance paths of ATM_p and GDPP are parallel (that is, they are tending to a non-converging end-point). The implication of this is that, their policies are mutually exclusive, that is, they lack cross-variable and cross-policy impacts. This seems to suggest that the spread and usage of ATM_p in Nigeria in the long-term is not for productive economic or growth-fostering activities.

Table 3: The Results of Johansen Co-integration test

Unrestricted Cointegration Rank Test of GDPP and ATM					
Hypothesized No. of CE(s)	Eigen Value	Trace Statistics	0.05 Critical Value	Max. Eigen Statistic	0.05 Critical Value
None	0.592	13.569	15.494	10.786	14.364
At most 1	0.207	2.783	3.841	2.783	3.841
Unrestricted Cointegration Rank Test of GDPP and BBR					
Hypothesized No. of CE(s)	Eigen Value	Trace Statistics	0.05 Critical Value	Max. Eigen Statistic	0.05 Critical Value
None	0.838	26.309	15.494	20.026	14.264
At most 1*	0.435	6.283	3.841	6.283	3.841

Unrestricted Cointegration Rank Test of GDPP and CDR					
Hypothesized No. of CE(s)	Eigen Value	Trace Statistics	0.05 Critical Value	Max. Eigen Statistic	0.05 Critical Value
None	0.574	14.826	15.494	10.251	14.264
At most 1*	0.316	4.574	3.841	4.574	3.841

Unrestricted Cointegration Rank Test of GDPP and DCE					
Hypothesized No. of CE(s)	Eigen Value	Trace Statistics	0.05 Critical Value	Max. Eigen Statistic	0.05 Critical Value
None	0.391	11.110	15.494	5.960	14.264
At most 1*	0.348	5.149	3.841	5.149	3.841

Unrestricted Cointegration Rank Test GDPP and CPS					
Hypothesized No. of CE(s)	Eigen Value	Trace Statistics	0.05 Critical Value	Max. Eigen Statistic	0.05 Critical Value
None	0.566	14.823	15.494	10.032	14.264
At most 1*	0.329	4.790	3.841	4.790	3.841

Source: Author's Computation

One cointegrating equation between GDPP and BBR, GDPP and CDR, GDPP and DCE, and GDPP and CPS was identified by our results. Generally, the confirmation of the existence of a cointegrating 'associatability' between or among any set of indicators (without recourse to the nature of the cointegrating relationship, whether negative or positive) means: first, the performance of the cointegrated indicators is mutually inclusive since they are tending to a common point of long-run balance; second, it means that the variables are determinants of each other (or one another in case of a non-bivariate model); and third, it means that any negative or conservative policy restraining the performance of one of the indicators would leading to the dwindling performance of the other indicator in the long-term.

Specifically, bivariate model between GDPP and BBR indicated and confirmed the existence of one cointegrating long-term association. The implication of this is that, as BBR expands, access to financial services is guaranteed thereby leading to improved performance of economic activities which in turn leads to improved performance of both DMBs and FICn in the long-term period. This implies that as DMBs expands their network, FICn also expands leading to increased economic growth in the long-term.

The bivariate cointegration model of GDPP and CDR established one long-term cointegrating association between them. CDR is used as a measure of the usage of banking services that correlate with the long-term dimensional expansion of FICn. This means that as banking services are widely used, the dimension of FICn becomes better thereby reducing the number of economic agents that were previously banking-services-unreached or denied. In the long-term, wide usage of the services of DMBs would mean widening FICn and better GDPP.

The long-term model of GDPP and DCE shows that both indicators are cointegrated. As the volume or quantum of DCE increases, the accessibility to banking credit facilities becomes more generalised and unrestricted (which is the definition of FICn according to Ishioro, 2020b). We therefore doubtlessly conclude that DMBs' DCE constitute a major determinant of FICn and growth of the economy. This explanation suffices for GDPP versus CPS bivariate model.

Results of the Short-Run Granger Causality Test

ATM_p usage does not Granger cause the performance of GDPP in Nigeria in the short-run. This result seems to indicate that the usage of ATM_p has not improved the income status and welfare of the FICn service seekers.

Table 4: Results of the Granger Causality Test

Granger Causality Between Deposit-Money Banks and Economic Growth			
Null Hypothesis	F-stat (Prob.)	Direction of Causality	Decision
ATM _p does not Granger Cause GDPP GDPP does not Granger Cause ATM _p	0.282 (0.867) 936.921 (0.004)	$ATM_p - GDPP$ $GDPP \rightarrow ATM_p$	No causality One-way Causality exist: flowing from GDPP to ATM _p
BBR does not Granger Cause GDPP GDPP does not Granger Cause BBR	171.085 (0.000) 1.048 (0.615)	$BBR \rightarrow GDPP$ $GDPP - BBR$	One-way Causality exist: flowing from BBR to GDPP No causality
CDR does not Granger Cause GDPP GDPP does not Granger Cause CDR	0.358 (0.829) 1.563 (0.531)	$CDR - GDPP$ $GDPP - CDR$	No causality No causality
DCE does not Granger Cause GDPP GDPP does not Granger Cause DCE	0.354 (0.831) 6.389 (0.037)	$DCE - GDPP$ $GDPP \rightarrow DCE$	No causality One-way Causality exist: flowing from GDPP to DCE

CPS does not Granger Cause GDPP GDPP does not Granger Cause CPS	50.808 (0.011) 0.729 (0.693)	$CPS \rightarrow GDPP$ $GDPP - CPS$	One-way Causality exist: flowing from CPS to GDPP No causality
BBR does not Granger Cause ATM _p ATM _p does not Granger Cause BBR	5.369 (0.311) 0.875 (0.654)	$BBR \rightarrow ATM_p$ $ATM_p - BBR$	One-way Causality exist: flowing from BBR to ATM _p No causality
CDR does not Granger Cause ATM _p ATM _p does not Granger Cause CDR	150.750(0.001) 354.024 (0.009)	$CDR \rightarrow ATM_p$ $ATM_p \rightarrow CDR$	One-way Causality exist: flowing from CDR to ATM _p . One-way Causality exist: flowing from ATM _p to CDR.
CDR does not Granger Cause BBR BBR does not Granger Cause CDR	1.056 (0.614) 2.038 (0.477)	$CDR - BBR$ $BBR - CDR$	No causality No causality
DCE does not Granger Cause ATM _p ATM _p does not Granger Cause DCE	1.895 (0.492) 0.551 (0.750)	$DCE - ATM_p$ $ATM_p - DCE$	No causality No causality
DCE does not Granger Cause BBR BBR does not Granger Cause DCE	23.051 (0.114) 0.273 (0.590)	$DCE \rightarrow BBR$ $BBR - DCE$	One-way Causality exist: flowing from DCE to BBR No causality
CPS does not Granger Cause ATM _p ATM _p does not Granger Cause CPS	2.403 (0.445) 0.401 (0.810)	$CPS - ATM_p$ $ATM_p - CPS$	No causality No causality

Source: Author's Compilation

NOTE: (–) represents no direction (directionless arrow); and (←) or (→) represents one-way direction (direction arrow)

Otherwise, the results suggest that ATM_p usage has not been for welfare-enhancing transactions and activities. But when GDPP is adopted as the lead variable in the bivariate Granger causality regression model, a uni-directional causal relationship was established between GDPP and ATM_p (with causality moving from GDPP to ATM_p). This implies that, as the income and welfare of economic agents improve through the enhancement of GDPP, the degree and pace of ATM_p usage would increase. This suggests that in the short-run GDP per capita is a determinant of ATM_p usage in Nigeria.

In the short-run, there is neutral causality between CPS and ATM_p, DCE and BBR, CDR and BBR, and between CDR and GDPP. This means the indicators have mutually exclusive performance, that is, none of them determines the short-run performance of the other. This confirms the existence of bi-directional neutrality, and bi-variable neutrality between them. Furthermore, this suggests that policies designed and implemented for one of the variables in the bivariate regression model won't have adverse effects on the other variable.

There is a one-sided 'no-causality' supposedly flowing from ATM_p to GDPP, GDPP to BBR, DCE to GDPP, GDPP to CPS, ATM_p to BBR, and from BBR to DCE.

There is one-way causality observed for the following sets of bivariate regressions flowing from ATM_p to GDPP; from BBR to GDPP; from GDPP to DCE; from CPS to GDPP; from BBR to ATM_p and from DCE to BBR. In these causal relationships ATM_p is a determinant of GDPP; BBR is a determinant of GDPP; GDPP is a determinant of DCE; CPS is a determinant of GDPP; BBR is a determinant of ATM_p; and DCE is a determinant of BBR. Our results imply that increase in ATM_p, BBR, and CPS in the short-run tend to trail the path of the increase in GDPP in Nigeria. Conversely, the poor performance of ATM_p, BBR, and CPS accounted or would account for the poor performance of GDPP: as the economy goes the way these indicators go. A one-sidedly-dependent causality of GDPP on each of these variables implies that GDPP is performing well because of the one-sided-inter-variable effects or impacts of the performance of these variables in the model.

There is bi-directional causal link between ATM_p and CDR (portending each variable as a determinant of the other).

Results of the Long-Run Granger Causality Test

The results of the long-run associativity indicated a one-way causality flowing from ATM_p to GDPP; implying that ATM_p Granger causes GDPP at the conservative 10 percent level of significance without a reverse causation.

Table 5: Results of the Long-Run Granger Causality Test

Long-run Granger Causality Between Deposit-Money Banks and Economic Growth			
Long run Null Hypothesis	F-stat (Prob.)	Direction of Causality	Decision
ATM_p does not Granger Cause GDPP in the long-run GDPP does not Granger Cause ATM_p in the long-run	3.025 (0.081) 0.090 (0.763)	$ATM_p \rightarrow GDPP$ $GDPP - ATM_p$	One-way Causality exist: flowing from ATM_p to GDPP
BBR does not Granger Cause GDPP in the long-run GDPP does not Granger Cause BBR in the long-run	4.724 (0.029) 0.010 (0.918)	$BBR \rightarrow GDPP$ $GDPP - BBR$	One-way Causality exist: flowing from BBR to GDPP
CDR does not Granger Cause GDPP in the long-run GDPP does not Granger Cause CDR in the long-run	0.725 (0.394) 0.182 (0.669)	$CDR - GDPP$ $GDPP - CDR$	No causality No causality
DCE does not Granger Cause GDPP in the long-run GDPP does not Granger Cause DCE in the long-run	0.421 (0.516) 0.043 (0.834)	$DCE - GDPP$ $GDPP - DCE$	No causality No causality
CPS does not Granger Cause GDPP in the long-run GDPP does not Granger Cause CPS in the long-run	1.015 (0.313) 0.103 (0.748)	$CPS - GDPP$ $GDPP - CPS$	No causality No causality

BBR does not Granger Cause ATM_p in the long-run ATM_p does not Granger Cause BBR in the long-run	2.102 (0.147) 2.886 (0.089)	$BBR - ATM_p$ $ATM_p \rightarrow BBR$	No causality One-way Causality exist: flowing from ATM_p to BBR
CDR does not Granger Cause ATM_p in the long-run ATM_p does not Granger Cause CDR in the long-run	2.008 (0.156) 0.148 (0.700)	$CDR - ATM_p$ $ATM_p - CDR$	No causality No causality
CDR does not Granger Cause BBR in the long-run BBR does not Granger Cause CDR in the long-run	0.952 (0.329) 0.002 (0.962)	$CDR - BBR$ $BBR - CDR$	No causality No causality
DCE does not Granger Cause ATM_p in the long-run ATM_p does not Granger Cause DCE in the long-run	5.463 (0.019) 0.040 (0.840)	$DCE \rightarrow ATM_p$ $ATM_p - DCE$	One-way Causality exist: flowing from DCE to ATM_p
DCE does not Granger Cause BBR in the long-run BBR does not Granger Cause DCE in the long-run	8.147(0.004) 0.009 (0.922)	$DCE \rightarrow BBR$ $BBR - DCE$	One-way Causality exist: flowing from DCE to BBR
CPS does not Granger Cause ATM_p in the long-run ATM_p does not Granger Cause CPS in the long-run	5.408 (0.020) 1.440 (0.230)	$CPS \rightarrow ATM_p$ $ATM_p - CPS$	One-way Causality exist: flowing from CPS to ATM_p

Source: Author's Compilation

NOTE: (-) represents no direction (directionless arrow); and (\leftarrow) or (\rightarrow) represents one-way direction (direction arrow).

Since ATM_p penetration fosters access, it shows that ATM_p penetration is a mechanism of access that both DMBs and FI use to stimulate the growth of GDP in Nigeria; but only in the long-term. The results seem to suggest that ATM_p usage facilitates income-generating transactions that contribute to the growth of economic activities and eventually economic growth.

Furthermore, our results suggest that ATM_p-facilitated-cash withdrawals and transactions are directly or indirectly used for growth-boosting activities. However, the results additionally, give a clue that GDP-related activities, and performance and growth of income-earning activities in Nigeria do not Granger *causes* ATM_p penetration, usage or ownership. This seems to suggest that the growth experienced in Nigeria in the long-term is either ATM_p-usage and penetration neutral or it is too insignificantly significant to promote banking and inclusive financial activities.

5. Conclusion and Recommendations

This current exploratory study was interested in examining the multi-dimensional role of DMBs-defined-FIcn in facilitating the growth and performance of the economy. The major empirical innovation and analytical hallmark of this current study is that, it adopted the DMBs services-based surrogates for FIcn. These surrogates are dual-folded proxies that integrated bank services into the definition of FIcn to reflect comprehensive and dimensional indices such as DMBs-FIcn service penetration, DMBs-FIcn service availability, DMBs- FIcn service usage, DMBs-FIcn geographical, location and localisation of services, and DMBs-FIcn affordability of services. The integration of these proxies of DMBs services into FIcn paradigm made the performance of FIcn in this study very robust and insightful in both short and long-term periods. The results generated from our study are unique as they combined both short and long-run dimensions in the econometric investigation of our models.

The study recommends that for the purpose of utmost efficiency, policies of DMB-complemented FIcn should be well-designed and implemented for optimal FIcn-boosting (or FE-underdeveloping) service availability, penetration, usage and location / localisation both in the short and long-term.

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