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DETERMINANTS OF BANK BRANCH NETWORKS IN NIGERIA: AN EXPLORATORY ANALYSIS

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ABSTRACT

Bank branches are established by deposit money banks based on different criteria. This study examined the determinants of bank branch networks in Nigeria. Varied determinants from empirical results across financial sectors around the world with similar operating environments with Nigeria were examined to identify the determinants of bank branch networks in Nigeria using the log-linear regression model and the Vector Error Correction Model (VECM) for both long- and short-run examinations of data on study variables from 1990 to 2021. Research results showed that aggregate savings, self-employment, literacy level, urbanisation, GDP per capita, number of performing business entities, market size of DMBs in the Nigerian financial system, and the percentage of the working class to total population positively determine the bank branch network in Nigeria, while total population, internet penetration, size of deposits, level of non-performing loans and aggregate disposable income negatively influence bank branch network in Nigeria in the long-run. The VECM value of -96.2% shows that 96.2% of identified anomalies in the short-run are not reversed in the long-run. This result necessitates the introduction of structural socio-economic, monetary and financial inclusion policies correction policies to eliminate obstacles to growth in bank branch networks to achieve growth in financial inclusion and boost economic activities with spiral positive effects on credit growth, production capacity expansion, growth in self-employment, aggregate savings, bank deposits, and overall economic growth.

***Keywords*:** Branch banking, bank density, branch expansion, dmbs, digital banking, financial inclusion

JEL Code: E58, E64, G18, G21

1.0 INTRODUCTION

The banking sector plays an essential role in facilitating development and economic growth in an economy. It serves an intermediary between savers and lenders. To serve both adequately, in establishes branch networks to meet their needs. These branch networks has transformed the financial landscape with positive effect on financial inclusion and economic development. Branch banking is a system in which banking services are provided through a network of branch offices. This takes banking services (lending, safe keeping of deposits, account opening, deposit collection, fund transfer, and credit advancement) closer to current and potential customers resulting in a reduction in the cost of accessing banking services, and increasing financial inclusion. Increasing the number of bank branches increases a deposit money bank's (DMBs) presence which increases the bank's market share. Various factors have been identified as determinants of bank branching across developed and developing economies. These include the level of aggregate savings, employment, unemployment, total population, literacy level, urbanisation, GDP per capita,

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aggregate disposable personal income, number of performing business entities, internet penetration for online banking services, business regulation, number of banking staff, working class as a percentage of total population (system-specific determinants), and size of deposits, legal origin of the bank, location of the head office, market size, and non-performing loans (bank-specific determinants).

Economic thought posits that the higher the level of aggregate disposable personal income (DPI) and GDP per capita (GDPC) in a country, the higher is the level of consumption and savings activities. An increasing desire to save requires bank branches to carry out the savings activities (opening of bank accounts and depositing funds). The higher the rate of employment (EMPL) in a country, the higher will be national and personal income with resultant savings activities at bank branches with potential demand for bank branches. On the other hand, increasing level of unemployment (UNEMP) in a country has an opposite effect on both national and personal incomes. Increase in literacy (LD) level in a country increases knowledge of and benefits of banking, with resultant request for bank presence in localities increasing bank branches in a country. Bank credits (BC), a major service rendered by deposit money banks (DMBs) increases production and operational capacities of businesses with resultant positive effects on employment, national and personal incomes, and demand for increased branch networks to carry out savings and other banking activities. Non-performing loans (NPL) decreases bank incomes with resultant closure of bank branches. Bank branches also increases with increasing overflow of customer capacities at bank branches attributable to population growth. Percentage of loans by DMBs to total loans and advances is an indication of increased banking services with positive effect on bank branch growth.

Empirical evidences (Zhang & Sisira, 2021; Harimaya & Kondo, 2012; Hryckiewicz & Kowalewski (2008) show that bank branches are located in urban centres where banking services are needed with reduced per unit cost of operation. Thus, the higher the level of urbanisation (URB) in a nation, the higher will be the demand for more bank branches. Bank branch networks also require qualified staff for effective operation. Where available, banks will effortlessly expand their branch networks. In addition, the higher the proportion of the population in the working class bracket, population characteristic (PNC), the higher will be the national and disposable personal income (DPI) and GDP per capita (GDPC) with resultant positive effects on savings and demand for banking services and bank branch networks.

Research results by Kim and Vale (2001) from the study of banks in Norway showed that branch numbers are outcomes from strategic decisions and proposed actions of competitors. Zhang and Sisira (2021) argued that of bank networks can be grouped into factors unique to each bank and others unique to the states or regions. According to Hryckiewicz and Kowalewski (2008) and Harimaya and Kondo (2012), bank-specific factors influencing branch networks include the legal origin of the bank's home country, and the location of the bank's headquarters. On bank-specific factors, Harimaya and Kondo (2012) argued that the location of bank headquarters in a less-privileged area stirs increase in bank branches.

Ansong et al. (2015) and Castellanos et al. (2009) noted that factors within a state/region such as the levels of education, aggregate income and economic activities have more bank branches. For DMBs entering a new state/region, Kondo and Harimaya (2014), and Cohen and Mazzeo (2010) argued that the existence of high performing business entities, their market size and business regulations in these states/regions are major determinants of branch networks. Srinivas and Wadhwani (2019) noted that provision of person-to-person services is also an additional determinant of branch location. From their study of determinants of bank branches in Ghana,

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Ansong et al. (2015) identified literacy rate, percentage of workforce to total population, proportion of urban population, population size as determinants of branch networks. This assertion supports earlier findings by Dick (2007), Hong et al. (2008) and Tranfaglia (2018).

In Japan, Kondo and Harimaya (2014) identified the existence of high performing business entities in area as a determinant of branch location. Feinburg (2009) identified growth and market size as determinants of bank location. Cohen and Mazzeo (2010) showed evidences that competition and large population influences bank location and network. Alessandrini et al. (2005) added that customer perception of bank services can easily be obtained from person-to-person interaction only available at bank branches. Findings by Srinivas and Wadhwani (2019) showed that customers still prefer the presence of physical branches to digital channels, especially in developing economies. Zhang and Sisira (2021) noted that maintenance of economic and financial stability, and deposit mobilisation has made operation of bank branches essential. Carlson and Mitchener (2006) observed that non-restriction of branch networks increases competition among banks, eliminating inefficiency in banks with positive effects on a country's financial stability.

In Nigeria, total bank branches increased from 3010 in 2002 to 3247 in 2003, and further to 3492 in 2004, 5809 in 2010, before declining to 5454 in 2011. It increased slightly to 5639 in 2013 before declining to 5526 in 2014, and further in 2015 to 5470.

Despite the essential roles of branch networks, there is dearth of empirical studies on determinants of bank branch networks in Nigeria. An understanding of determinants of bank branch networks is crucial for regulators, policy makers and deposit money banks seeking to promote financial inclusion, financial system stability and economic growth. What factors influence bank branch networks in Nigeria in both the short and long-runs? This study aims to identify and examine both the short and long-run determinants of bank branching in Nigeria to bridge the gap in literature.

2.0 THEORETICAL FRAMEWORK

This study is hinged on the competitive dynamics and prospect theories. The competitive dynamics theory posits that strategies adopted by a bank to increase bank branch network is a response to increase in bank branch network of competitors aimed at maintaining/increasing improve market share. Thus, as competing DMBs increase bank branch networks, others in the industry strive to increase their bank network to increase customer base, deposits and market share. The aim is to increase competitive edge (growth in market share) and match competitors' strategic expansion to maintain/increase market share. This positively influences size of bank branch networks. The prospect theory states that DMBs weigh their expected incomes from prospective bank branch expansion in deciding on establishing a branch. These weights differ among banks intending establishing branches with resultant different decisions on branch establishment. Thus, the prospect of access to new customers (increase in market size), additional gains and increased market share positively influences branch expansion. Diminished prospect negatively affects bank branch expansion.

2.1 Empirical Literature

Various determinants of bank branching have been identified in literature. On bank financial and market characteristics statistics, Boda and Cuderlikova (2020) examined the determinants of bank branch networks in districts in Slovakia based on bank profile, size and numbers using the bivariate and univariate Poisson regression, and identified technological, socio-economic, urbanisation, economic and branch market concentration as factors influencing bank networks in Slovakia. Boda and Cuderlikova (2020) concluded that significant determinants of bank branching in Slovakia are population size, population characteristics, economic development, existing branch concentration,

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and environmental factors. Hannan and Hanweck (2007) studied the effect of market characteristics on bank networks in the US using panel data made up of 2000 markets obtained from 1988-2004. Research results showed that bank branching is influenced by the rate of returns obtain on their "interest-bearing assets" of the bank. Additional results showed that branch networks have an inverse relationship with the policies restricting the establishment of branches and market concentration. Richards et al. (2008) argued that the existence of bank branches increases a bank's market share and power.

Exploring the effect of the global financial crisis on bank network expansion in Thailand, Rysman et al. (2023) concluded that in the absence of financial crisis, branch networks increased by 18.5%. where it occurs, Rysman et al. (2023) contended that it reduces branch expansion. Allen et al (2021), and Marin and Schwabe (2019) attributed improved access to financial services to growth in bank branch network. Spieker (2004) attributed growth in bank branches in the US to expected increase in operational performance, changes in demographic and economic conditions, and changes in laws governing bank branching. On the effect of bank market types on bank branch networks, Kuehn (2018) concluded that multi-market banks increases competition resulting in branch expansion compared with the single market banks, with resultant positive effects at lowering deposit rates. Damar (2007) studied the effect of bank consolidation on bank branch networks in Turkey using data on changes in market GDP, market population and market concentration from 2001-2003 and concluded that consolidation involving failed banks resulted in decline in the number of branches, and high branch networks for consolidation among healthy banks. Using the matching technique and panel regressors to examine the effects of mergers and acquisitions (M&As) on bank branch networks in the USA for the period 2000-2020, Calzada et al. (2021) concluded that M&A significantly reduced the number of bank branches in the US. Meesrichan and Fongsuwan (2014) observed that bank branch networks in Thailand is determined by economic variables influencing bank's return on investment.

Hadiyanto and Dwidienawati (2023) observed that increase in bank branches positively influence bank financial performance. In Nepal Gwachha (2022) noted that bank networks have an insignificant effect on banking sector growth. Using the regression model to examine the effect of bank networks on deposits, Dereli et al (2007) showed the effectiveness of the OLS model in predicting the volume of bank deposits in Turkey, and useful for bank branch policy decisions. Using the spatial econometric analysis to examine the effect of the number bank branches on economic activities and new business formations, Ho (2019) concluded that bank branches declines significantly result in declines in economic activities and business formations in a locality. Findings by Nam and Ellinger (2008) identified specialisation in lending activities, provision of banking and financial services to a large number of customers, and ability to attract quality managers as benefits of growth in bank branch network.

Research results by Orlow et al. (1996) showed that provision of financial services via physical bank branches are more expensive. Thus, additional branches according to Hirtle (2005) increases operational costs which may not reduce profits if there exist economies of scale. Reduction in bank networks according to Sengupta and Dice (2019) reduced customers' access to bank services. Sengupta and Dice (2019) observed a significant decline in branch networks post-financial economic crisis in the US. This seems attributable to the increased regulation of the sector after the crisis. Jagtiani and Lemieux (2018) noted that increasing the number of Fintech firms and new array of services has significantly improved online bank services with negative effects on physical branch networks. In spite of these improved technologies in the financial sector, Sengupta and Dice (2019) argued that proximity of banks and banking services to customers is still very

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essential. Research results by Anenberg et al. (2018) showed that bank customers consistently used both online and in-branch services, contending that online banking is not a perfect substitute for physical banking services. Nguyen (2014) and Carbo et al. (2007) noted that non-availability of bank branches in localities with low-income households having low internet access and limited mobility results in financial exclusion. FDIC (2018) argued that the existence of physical bank branches assures financial stability and remains a reliable means of contact between the customers and the banks. Caldaza et al. (2021) argued that absence of bank branches limits access to financial services. Research results by Shiers (2002) revealed that increase in branch networks minimises bank risks. On the effect bank branch network on financial inclusion, Nwidobie (2019) posited that increased bank branch networks positively and significantly promotes financial inclusion in Nigeria.

Increased socio-economic development is also known to positively affect bank branch network which further improves the locality's socio-economic growth. Findings by Huysentruyt et al. (2012) from the study of determinants of bank network in Antwerp from 1991-2006 showed that socio-economic environment and market structure conditions were major determinants. This finding is supported by results by Stix (2020), and Chen and Strathearn (2020). Financial exclusion according Alama et al. (2015) and Ansong et al. (2015) is attributable to reduction in the number of bank branch networks. With the proliferation of Automated Teller Machines and online banking services (which would have served as substitutes to services provided at branches) bank branch networks in the US increased by 66% (Hannan & Hanweck, 2007).

Findings by Adams and Amel (2016) showed that bank branch networks were positively influenced by local demand. An examination of the finance-growth link by King and Levine (1992) showed that the existence of bank branch networks in a locality increases socio-economic activities in a locality; and reduces financial exclusion (Alama et al., 2013). On the effects of bank branch networks on economic activities and wellbeing, Burgess and Pande (2005), and Burgess, et al (2014) observed a 0.36% reduction in poverty, increase in output by 0.55% with resultant lower levels of mortality, with the opening of new bank branches in rural communities.

On population characteristics and deposit size, Zhang and Sisira (2021) conducted a panel data analysis of bank deposit and population size from data obtained from 25 states in India for the period 2006-2017, and concluded that bank deposits and population size are determinants of bank branch networks in India. Further evidences from the study revealed that the effects of bank deposits and population size on bank location differs across states depending on the state's business environment. Findings by Ansong et al. (2015) and Hendrickson et al (2014) suggests that deposit attraction makes bank branches necessary. Ansong et al. (2015) examined the patterns of bank branch networks across urban and rural Ghana and concluded that population size, workforce size, percentage of urban residents to total population and literacy levels were determinants of bank branch networks in Ghana. Research results by Sengupta and Dice (2019) showed that the effects of population, employment and income on bank branch network declined significantly post-global economic crisis. An examination of 2000 banking markets in the US for the period 1977-1988 by Amel and Liang (1997) showed that current profits of existing branches in the locality and population growth were determinants of branch networks. Research results by Alama et al. (2015) and Huysentruyt et al. (2012) showed evidences that population in a locality is a determinant for locating bank branches. Karjalouto et al. (2002) contended that population characteristic (age) of residents in a locality influence bank branch location, as locations with more of the elderly demand physical bank branches. Where banks imitate another to cite a branch in a

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sparsely populated an unattractive location, Barreto and Baden-Fuller (2006) noted that decline in bank profitability is usually the result.

On the influence of financial technology on branch networks, Harvey (2016), Buckley and Webster (2016), and Gulamhuseinwala et al. (2015) contended that changing customer needs and deployment of technology to meet these needs seems to have made bank branches less essential. Using rural household and community-based data from Ghana, Osei-Assibey (2009) showed evidences that the level of infrastructure (communication infrastructure and energy) market size and vibrancy of the market positively influence bank branch networks in Ghana. Insecurity Osei-Assibey (2009) added, negatively influence bank branching. Gardo and Klaus (2019) identified technological, bank size and demographic factors as determinants of branch networks which in turn addresses the problem of overcapacities. Sahu and Maity (2021) noted that with technological advancement, bank branches will reduce as customers will easily access banking services online. Hegerty (2021) referred to localities without physical branches as banking deserts. Using 850,000 anonymous transactions of individuals from commercial banks in the US, Zhou et al. (2020) concluded that there exists a symmetrical effect of bank networks on customer omnichannel behaviours. These branch networks according to Zhou et al. (2020) increases customer transactions. Further results by Zhou et al. (2020) revealed that on the opening of a new branch, complex transactions are migrated to the branch with a resultant decrease in online transactions. Increase in transactions at bank branches results in migration of banking transactions online. This according to Zhou et al. (2020) is attributable to spill over effect of learning about the existence of a new branch. Zhou et al. (2020) argued that the spill over effects moves from enquiries to complex banking transactions. On customer choice between branch banks and ATMs, Maity and Sahu (2023) showed evidences that bank customers in India prefer ATMs to bank branches which has culminated in a high growth in the number of ATMs compared to bank branch networks. Maity and Sahu (2023) attributed this growth to zero number of employees' requirement, low office space requirement, ease of commencement of ATM operation in a location with resultant lower operating cost. Pham et al. (2022) noted that existence of branches far from the headquarters, increases agency problems. To address this, Pham et al. (2022) recommended an optimal structure with a network of centralised branches with delegated powers combined with access point networks that are well diversified.

In their study of determinants of bank branch presence in North and South Italy using data from 2000-2016, Barbieri et al. (2021) concluded that economic, demographic and industrial variables explained observed dynamics in bank branch networks. Barbieri et al. (2021) argued that bank's proximity to customers ensures better services are provided, increasing competitive edge in the face of technological innovations which reduced the need for bank branches. Research results by Elyasiani and Golberg (2004) showed that relationship banking feasible at bank branch network increases bank deposits with enhancement of bank operations. Location of bank branches according to Barbieri et al (2021) strengthens a bank's presence in a locality. Barbieri et al. (2021) added that at bank branches, quality services are rendered to customers through physical interactions between bank staff and customers. Degryse et al. (2009), and Degrryse and Ongena (2005) noted that physical bank branches created closeness and creates favourable conditions for scouting for depositors and borrowers. Ho and Ishii (2011), and Agarwal and Hauswald (2010) argued that absence of close proximity through bank branches negatively affect the pricing of loans. Examining the distance between banks and their respective customers, Peterson and Rajan (2002) concluded that distance between customers and banks increased within the study period. On the effect of physical branch locations on banking and financial services in Thailand, Rysman

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et al. (2023) noted that physical branch locations reduce transportation costs to access financial and banking services, and the cost of obtaining information on loan facilities. Peterson and Rajan (2002) attributed this to the use of improved technology by banks with resultant improvement in bank productivity. Pham et al (2022) argued that high bank branch networks improve information collection.

On bank branching in China, He and Yeung (2011) concluded that small foreign banks in the country follow their customers (i.e. establish branches where their customers reside) while bigger banks locate their branches close to their competitors. Location of branches close to customers according to Kondo (2017) increases the total number of bills discounted and loans advanced as it increases customer contacts. Hannan and Hanweck (2007) also noted that traffic congestion positively influences bank branching. Using data from 1975-1995, Avery et al. (1999) concluded that bank mergers negatively influenced bank networks with the same zip code. No such relationship was found to exist for mergers outside common zip codes and out of market mergers.

3.0 METHODOLOGY

Data for this study were data on aggregate savings, population size, aggregate disposable income, formal unemployment, GDP per capita, market size, size of DMBs and non-performing loans obtained from the CBN Statistical Bulletin (2023); population characteristics, urbanisation, level of education obtained from the World Development Indicators, WDI (2023); and urbanisation and existence of high performing entities and internet penetration obtained from IMF Country Reports-Nigeria (2023). The data are annual values for macro socio-economic variables as employed in earlier studies. Earlier studies examined aggregate savings, SAV (Harimaya & Kondo, 2012; Hannan & Hanweck, 2007), population characteristics, PNC (Tranfaglia, 2018; Anson et al, 2015), population size, PNS (Ansong et al., 2015), aggregate disposable personal income, DRB (Ansong et al., 2015; Castellanos et al., 2009), urbanisation, URB (Boda & Cuderlikova, 2020), level of education/literacy level LD (Ansong et al., 2015; Castellanos et al., 2009), existence of high performing business entities, PET (Kondo & Harimaya, 2015; Cohen & Mazzeo, 2010; Kim & Vale, 2001), internet penetration, INP (Cohen & Mazzeo, 2010), formal unemployment, UNEMP, and GDP per capita, GDPC (Hryckiewicz and Kowalewski, 2008; Harimaya & Kondo, 2012), market size, MKS (Harimaya & Kondo, 2012; Feinburg, 2009; Hryckiewicz and Kowalewski, 2008), size of bank deposits, SDP (Zhang & Sisira, 2021), and non-performing loans, NPL (Zhang & Sisira, 2021; Avery et al., 1999; & Damar, 2007).

To identify the long-run determinants of bank branch network in Nigeria, this study employs the log-linear regression model using the E-view 11:

$$logNBR_t = \beta_0 + \beta_1 logSAV + \beta_2 logUNEMP + \beta_3 logPNS + \beta_4 logLD + \beta_5 logURB + \beta_6 logGDPC + \beta_7 logPET + \beta_8 logINP + \beta_9 logMKS + \beta_{10} logSDP + \beta_{11} logNPL + \beta_{12} logPNC + \beta_{13} logDRB + \mu_t \ldots\ldots(1)$$

Where $NBR = Number\ of\ Bank\ Branches$

This model is ideal for this study as it was used for earlier studies (Hannan and Hanweck, 2007; Gardo & Klaus, 2019). Short-run relationship between bank branch networks (number of branches) is examined using the Vector Error Correction Model (VECM) as it analyses relationships between multiple time series variables which allows for the inclusion of cointegrating relationships between the variables using the E-view 11:

$$\Delta x_t = \Pi x_{t-1} + \Sigma \boldsymbol{\Gamma}_1 \Delta \boldsymbol{x}_{t-1} + Cd_t + \varepsilon_t \ldots\ldots(2)$$

Where $\Delta x =$ the fixed difference between the variables in vector x

$P_i =$ is the coefficient matrix of cointegrating relationship

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Γ = is the coefficient matrix of lags of different variables of the vector x,
d =a vector of the deterministic terms
C = is the corresponding resultant coefficient matrix
P = the lag order of model in the VAR form
ε = is the error term with variance covariance and zero mean matrix Σ

4.0 Data presentation

Descriptive statistics:

Descriptive statistics of study variables are shown on Table 1(in the appendix).

Normality Test:

The Jarque-Bera statistic of 0.050889 (Fig.2) evidences the normality of the data set.

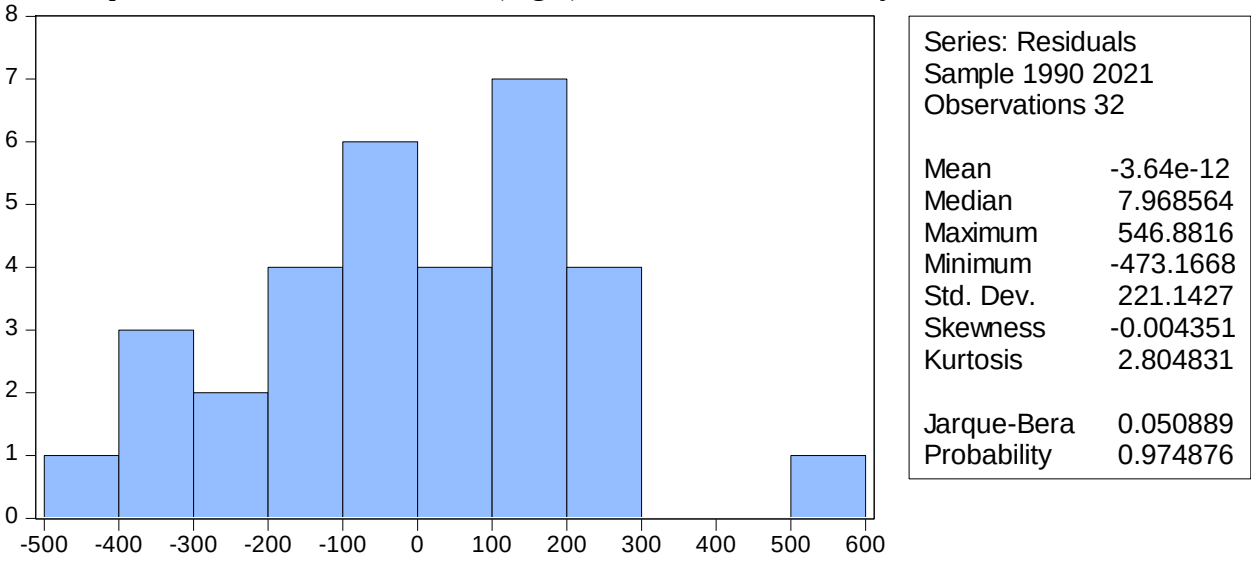

Fig 2: Jarque-Bera Normality Result

4.1 Data Analysis

Unit Root Test

To ascertain the stationarity of the series, we use the Augmented Dickey Fuller (ADF) statistic at 5% (2.960411). Test results are shown in Table 2 with stationarity at I(0) and I(1).

Table 2: Unit Root (ADF) Results

Variable	ADF Coefficient	T-statistic	p-value
logNBR(0)	0.002985	0.060895	0.9572
logSAV(1)	0.137493	-4.452860	0.0080
logUEMP(1)_	-0.100515	-8.643983	0.0000
logPNS(1)	-1.601035	-3.372862	0.0771
logLD(1)	-0.235875	-6.361446	0.0001
logURB(0)	-0.000776	-5.177123	0.0013
logGDPC(1)	-0.038981	-3.894098	0.0249
logPET(1)	0.094973	-4.879605	0.0025
logINP(1)	0.123258	-4.430527	0.0076
logMKS(0)	-0.272263	-2.062212	0.5371
logSDP(0)	0.199521	-3.828576	0.0318
logNPL(1)	0.570048	-6.855436	0.0000
logPNC(1)	0.019631	-2.500363	0.3247
logDRB(1)	0.037844	-6.182123	0.0001

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Table 3: Johannsen cointegration result

Sample (adjusted): 1992 2021
Included observations: 30 after adjustments
Trend assumption: Linear deterministic trend
Series: NBR SAV UNEMP PNS LD URB GDPC PET INP MKS SDP NPL PNC DRB
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.984418	318.8300	125.6154	0.0000
At most 1 *	0.886888	193.9816	95.75366	0.0000
At most 2 *	0.795847	128.6003	69.81889	0.0000
At most 3 *	0.719709	80.93367	47.85613	0.0000
At most 4 *	0.548947	42.77585	29.79707	0.0010
At most 5 *	0.454949	18.89077	15.49471	0.0148
At most 6	0.022558	0.684490	3.841466	0.4080

Trace test indicates 6 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.984418	124.8485	46.23142	0.0000
At most 1 *	0.886888	65.38128	40.07757	0.0000
At most 2 *	0.795847	47.66661	33.87687	0.0006
At most 3 *	0.719709	38.15783	27.58434	0.0015
At most 4 *	0.548947	23.88508	21.13162	0.0200
At most 5 *	0.454949	18.20628	14.26460	0.0113
At most 6	0.022558	0.684490	3.841466	0.4080

Max-eigenvalue test indicates 6 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The Johanssen cointegration Trace statistic of 318.8300 (Table 3) is higher than the critical value of 125.6154, and the Max-Eigen statistic of 124.8485 is greater than the critical value of 46.23142. Thus, cointegration exists suggesting that a long-run relationship exists between the study variables.

The long-run relationship between the number of bank branch network and the independent study variables is shown in the OLS regression result in Table 4.

Table 4: OLS Regression Result

Dependent Variable: LogNBR
Method: Least Squares
Sample: 1990 2021
Included observations: 32

Variable	Coefficient	Std. Error	t-Statistic	Prob.

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C	-25538.88	6502.157	-3.927756	0.0009
LogSAV	0.000396	0.000327	1.209760	0.2412
LogUNEMP	17.77148	78.70451	0.225800	0.8238
LogPNS	-60.77910	70.51191	-0.861969	0.3995
LogLD	8.126715	11.59485	0.700890	0.4919
LogURB	407.5356	359.8652	1.132467	0.2715
LogGDPC	0.265650	0.328147	0.809547	0.4282
LogPET	0.000139	9.48E-05	1.470368	0.1578
LogINP	-170.7951	52.68235	-3.241980	0.0043
LogMKS	0.270970	16.87026	0.016062	0.9874
LogSDP	-2.58E-05	0.000111	-0.232540	0.8186
LogNPL	-7.069281	8.840841	-0.799616	0.4338
LogPNC	340.4922	86.63532	3.930178	0.0009
LogDRB	-0.000118	0.000102	-1.160487	0.2610

R-squared	0.980437	Mean dependent var	3926.188
Adjusted R-squared	0.968081	S.D. dependent var	1581.082
S.E. of regression	282.4728	Akaike info criterion	14.41624
Sum squared resid	1516026.	Schwarz criterion	15.01170
Log likelihood	-217.6599	Hannan-Quinn criter.	14.61362
F-statistic	79.35165	Durbin-Watson stat	2.047356
Prob(F-statistic)	0.000000		

The regression result on Table 4 gives the resultant regression equation:

$$logNBR = -25538.88 + 0.000396logSAV + 17.77148logUNEMP - 60.77910logPNS + 8.126715logLD + 407.5356logURB + 0.265650logGDPC + 0.000139logPET - 170.7951logINP + 0.270970logMKS - 2.58logSDP - 7.069281logNPL + 340.4922logPNC - 0.000118DRB + \mu_t \ldots\ldots 1$$

The R^2 value of 0.980437 (Table 3) indicates that equation 2 explains 98.04% of the variation in number of bank branches in Nigeria.

To examine the short-run relationship between bank branch network and identified determinants, we employ the Vector Error Correction Model (VECM) as the cointegration is a mixture of I(0) and I(1). The VECM result is shown on Table 5.

Table 5: Vector Error Correction Model Result

Dependent Variable: D(logNBR)
Method: Least Squares
Sample (adjusted): 1991 2021
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-223.2670	312.6449	-0.714123	0.4854
D(logSAV)	0.000190	0.000198	0.956868	0.3529
D(logUNEMP)	-6.838419	59.99105	-0.113991	0.9107
D(logPNS)	62.74050	74.72059	0.839668	0.4135
D(logLD)	3.219026	8.174727	0.393778	0.6989
D(logURB)	186.9021	410.3964	0.455419	0.6549
D(logGDPC)	0.435054	0.276868	1.571343	0.1357
D(logPET)	0.000168	6.13E-05	2.737339	0.0146
D(logINP)	-163.8317	46.93223	-3.490814	0.0030
D(logMKS)	4.178512	10.46818	0.399163	0.6951
D(logSDP)	-2.37E-05	7.00E-05	-0.338717	0.7392
D(logNPL)	-3.013893	6.321355	-0.476780	0.6400
D(logPNC)	210.6087	86.38430	2.438044	0.0268
D(logDRB)	-0.000104	6.49E-05	-1.604761	0.1281

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VECM(-1)	-0.962006	0.280490	-3.429729	0.0034

R-squared	0.790974	Mean dependent var	160.6129
Adjusted R-squared	0.608076	S.D. dependent var	406.0760
S.E. of regression	254.2190	Akaike info criterion	14.22061
Sum squared resid	1034037.	Schwarz criterion	14.91448
Log likelihood	-205.4195	Hannan-Quinn criter.	14.44680
F-statistic	4.324680	Durbin-Watson stat	1.610920
Prob(F-statistic)	0.003221		

The Vector Error Correction statistic of -96.2% (Table 5) indicates that 96.2% of anomalies identified in the short-run remain uncorrected in the long-run.

Serial Correlation L.M. Test:

Table 6: Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.272107	Prob. F(2,17)	0.7650
Obs*R-squared	0.992628	Prob. Chi-Square(2)	0.0088

The Breusch-Godfrey Serial Correlation L.M. Obs*R-square coefficient of 0.992628 (Table 6) shows the existence of serial correlation which necessitated the Vector Error Correction analysis.

Heteroscedasticity test:

The Breusch-Pagan-Godfrey heteroscedasticity Obs*R-square coefficient of 15.58256 (Table 7) shows the absence of heteroscedasticity in the study data set.

Table 7: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.502815	Prob. F(12,19)	0.2069
Obs*R-squared	15.58256	Prob. Chi-Square(12)	0.0111
Scaled explained SS	4.957382	Prob. Chi-Square(12)	0.9594

The CUSUM result (Fig. 3) indicates that the mean of the resultant regression is stable at 5%.

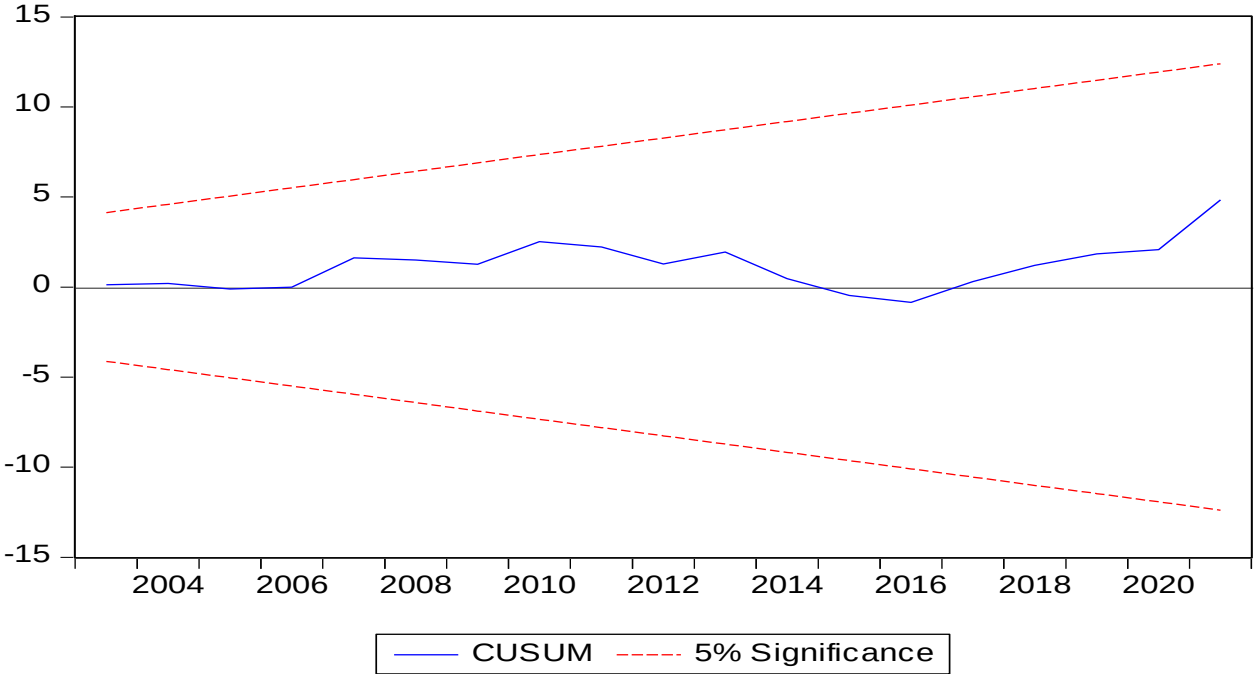

Fig 3: CUSUM result

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4.2 Discussion of results and policy implications of findings

The resultant regression equation indicates that there exists a positive relationship between aggregate savings (SAV), aggregate unemployment (UNEMP), national literacy rate (LD), growth rate in urbanisation in the country (URB), GDP per capita (GDPC), number of performing business entities (PET), market size of DMBs (MKS) measured by the percentage of loans and advances by DMBs to total loans and advances by all financial institutions in Nigeria, and population characteristic (PNS) measured by the population of the working class to total population in the long-run. Thus, as aggregate savings increases with resultant increase in demand for accessible bank branches, bank branches also increase. In addition, an increase in aggregate unemployment in the formal sector increases activities in the informal sector with increase in small scale businesses with resultant increase in personal income necessitating need for daily savings, and demand for and supply of bank branches. The positive relationship existing between bank branch network and national literacy rate shows that improved academic knowledge and financial literacy improves knowledge of the financial benefits of services rendered by DMBs resulting in demand and supply of bank services and branches. Similarly, urbanisation increases supply of formal employment, financial literacy level, and demand and supply of financial services with resultant increase in demand and supply of bank branches. Growth in GDP per capita improves personal financial resources with resultant increase in demand for and supply of bank branches. The positive relationship seen to exist between number of performing business entities and bank branch network indicates that increase in operational capacities of businesses with positive effects on formal employment, business and personal incomes increases demand for and supply of bank branches. Considering the size of DMBs comparative to other financial service providers, their market size necessitates the spread of their services to potential customers with resultant increase in bank branch network. The positive relationship between the bank branch networks and population characteristics measured by the percentage of the working class to total population indicates that the more persons being employed minimises financial burden on the working population with resultant increase in personal and aggregate savings, and demand for and supply of bank branches for cash deposit. This relationship is significant at 5% with a p-value of 0.0009.

Research results from Table 3 also show the existence of negative relationships between bank network and other study variables. The negative β value of -60.77910 between bank branches and total population (PNS) indicates that increases in the number of dependents has a negative effect on savings, and demand and supply of bank branch network. Thus, increase in population with attendant demand for child care and school fess negatively affect savings and demand for savings infrastructure available by bank branches, with negative demand for the network. Similarly, increase in internet penetration eases demand on physical bank branches with resultant increase in web and online banking. This may be attributable to ease and convenience of online baking among the youths and adult population below 70 years, with negative effect on demand on physical bank branch networks. This significantly results in the closure of some existing branches. Spate in non-performing loans negatively impact bank credit growth and financial performance and their ability to maintain existing branches, resulting in branch closures. Size of deposits similarly has an inverse relationship with bank branch network indicating that huge deposits are made online and not at physical bank branches. This may be attributable to insecurity in the country.

The above findings necessitate the introduction of monetary, fiscal, financial and social policies to improve aggregate savings, enhance growth in self-employment, level of academic and financial literacy, urbanisation, GDP per capita, profitability of existing firms and DMBs, and the percentage of the working class to total population; and reduce growth in total population, size of

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non-performing loans to improve growth in bank branches with significant effects on business financing, savings, production capacity expansion, employment, personal and aggregate income, aggregate savings, GDP, GDP per capita and consumption and overall economic growth.

Results on the short-run relationship between bank branch network and study variables indicates that number of bank branches (NBR) has a positive relationship with aggregate savings (SAV), population (PNS), literacy level (LD), level of urbanisation (URB), GDP per capita (GDPC), size of performing entities (PET), market size of DMBs (MKS), and population characteristics (PNC) with a coefficient of 0.000190, 62.74050, 3.219026, 186.9021, 0.435054, 0.000168, 4.178512 and 210.6087 respectively (Table 5). Number of bank branches in Nigeria were found to have an inverse relationship with the level of formal unemployment (UNEMP), internet penetration (INP), size of deposits (SDP), level of non-performing loans (NPL) and aggregate disposable income, DRB with beta coefficients of -6.838419, -163.8317, -2.37, -3.01389, and 0.000104 respectively (Table 5).

The VECM value of -96.2% (Table 5) shows that identified anomalies in the short-run are not reversed in the long-run necessitating the introduction of structural correction policies to eliminate obstacles to growth in bank branch networks from the Central Bank of Nigeria's monetary and financial inclusion policies through branch expansion to achieve stated objectives. This will significantly reverse a high percentage of anomalies identified in the short-run in the long-run.

The negative relationship existing between the number of bank branches in Nigeria and formal unemployment and size of bank deposits reverses in the long-run. Similarly, the positive relationship between the bank branch network and population in the short-run in addition reverses in the long-run.

5.0 CONCLUSION AND RECOMMENDATIONS

From this study, we conclude that in the long-run, aggregate savings, self-employment, literacy level, urbanisation, GDP per capita, number of performing business entities, market size of DMBs in the Nigerian financial system and the percentage of the working class to total population positively influences bank branch network in Nigeria. On the other hand, total population, internet penetration, size of deposits, level of non-performing loans and aggregate disposable income, DRB negatively influence bank branch network in Nigeria. In the short-run, bank branch network (NBR) is found to be positively influenced by aggregate savings (SAV), population (PNS), literacy level (LD), level of urbanisation (URB), GDP per capita (GDPC), number of performing business entities (PET), market size of DMBs (MKS), and population characteristics (PNC), while the number of bank branches in Nigeria were found to have an inverse relationship with the level of formal unemployment (UNEMP), internet penetration (INP), size of deposits (SDP), level of non-performing loans (NPL) and aggregate disposable income, DRB.

To improve bank branching in Nigeria with spiral positive effect on financial inclusion, the government should:

(i) Increase the level of literacy and financial literacy to increase use of bank branches and demand for branch networks.

(ii) Promote self-employment and SME growth to increase demand for bank branch services with positive effect on branch network growth.

(iii) Sustain policies that increase per capita income which in turn will increase demand for financial services and bank branches.

(iv) Leverage urbanisation and planned settlement growth to rationalise branch establishment.

Limitations of the study and areas for further research

This study has the following limitations:

(i) The study relied on aggregate financial and macroeconomic indicators which may shield regional disparities in branch performance and distributions.
(ii) The study examined the relationship between study variables and branch networks, but did not consider the direction of causality.
(iii) Qualitative variables such as political factors, cultural banking habits and trust in banking institutions were not brought under study.
(iv) Internet penetration was considered as a variable which could have been considered under mobile money, impact of fintech and digital innovations.
(v) The role of the Central Bank of Nigeria in bank branch network distribution, expansion and contraction was not examined.

Further research in the following areas are recommended:

(i) The effect of micro-level and regional effects on branch networks.
(ii) Application of panel data techniques or structural models to better ascertain causality.
(iii) Inclusion of digital finance as an explanatory variable.
(iv) Assessment of sectoral impacts of branch networks.

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Table 1: Descriptive Statistics of Variables

	NBR	SAV	UNEMP	PNS	LD	URB	GDPC	PET	INP	MKS	SDP	NPL	PNC
Mean	3926.1875	5736360	4.72	147.077875	62.4103125	40.1509375	1439.5	8414790.3125	12.316875	97.4815625	8393835	11.4965625	58.733125
Median	3418.5	1528300	3.995	142.4095	58.725	39.50499999999999	1451	2064505	4.55	100	2640620	7.8	60.28
Maximum	6918	25648260	9.789999999999998	218.541	77.62	52.75	3201	32868490	55.36	100	37613040	37.3	60.67
Minimum	1939	29650	0	95.214	48.66	29.68	270	33550	0	78.81	38780	0	53.44
Std. Dev.	1581.0823658433	7302773.443563267	2.090540908550364	36.45255130037474	9.028360507178514	7.305840950634482	933.1637826026525	10131719.02666061	16.60107039640672	4.300300146595 17	10186091.83826811	9.356698690407026	2.589268719156048
Skewness	0.1490045644991988	1.204316535231514	1.100335409554246	0.3113937537680815	0.2301805042012616	0.2015009065926021	0.2247421140173067	0.9430290900847842	1.297684514508245	-2.726650758319948	1.197926658252857	0.7290836435135302	-0.9568565122715706
Kurtosis	1.4129166755517205	3.396308330683 6	4.193679828717862	1.9023827032844 56	1.5158294313108 41	1.7101617588205 28	1.5763785701808 42	2.5765941786620 37	3.524249700644 1	12.07597536160746	3.669632473805867	2.796947870396693	2.077205880486923
Jarque-Bera	3.476857226423661	7.944764748129832	8.357098116751 4	2.123504012789658	3.219592713360653	2.434790993980576	2.971645395589 62	4.981983931369892	9.347704193871235	149.4824349278568	8.251361018915731	2.889976005723062	6.018462036418 63
Probability	0.1757964278715727	0.0188285230750 5689	0.0153207209193 8574	0.3458493489520689	0.1999283239974476	0.2960000969896814	0.2263160743312366	0.0828277635114 3995	0.009336236082998162	0	0.0161524989189793	0.2357489048511532	0.0493295977414957
Sum	125638	183563520	151.04	4706.492	1997.13	1284.83	46064	269273290	394.1400000000001	3119.41	268602720	367.89	1879.46
Sum Sq. Dev.	77494464.875	165324549 9008400	135.4812	41192.4433855	2526.8500 96875001	1654.6346 71875	26994634	318220364 3491096	8543.4616875	573.2700218749995	321645047 5066600	2713.982121875001	207.8336875000001
Observations	32	32	32	32	32	32	32	32	32	32	32	32	32