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NIGERIA'S BANKING SECTOR REFORMS AND COMMERCIAL BANKS' PERFORMANCE: A SIMPLE TEST OF THE MODIFIED PANTULA PRINCIPLE

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ABSTRACT

This study examined the achievement of organizational goals by deposit money banks following the period of banking sector reform. Annual time series data from the banking industry and the Nigerian economy for the period 1990 to 2020 were used to implement a simplified version of the modified Pantula Principle (an improved cointegrating technique). Three sets of reforms and bank performance measures, including bank-specific, industry-specific, and macroeconomic indicators, were identified and adopted. The empirical findings obtained from our analysis revealed that there are no long-run connections between selected performance measures and some bank-specific, industry-specific, and macroeconomic variables, implying that the reforms had no long-term impact on the statutory achievement of the banks' goals in Nigeria during and beyond the era.

Keywords: Pantula Principle; Banking Sector Reforms; Banks' Performance; Nigeria.

JEL Classification : C18,G21,G28

INTRODUCTION

Reforms (or re-engineering efforts) in the banking sector are not a recent occurrence; they can indeed be traced back to McKinnon (1973) and Shaw (1973) landmark research of the early 1970s. In recent years, the consequences and/or recurrence of banking sector reforms (henceforth reforms) undertaken across the globe's economies (for both developed, emerging, and underdeveloped economies) have triggered a lot of academic and policy interest (Dogarawa, 2011; Robin, Salim and Bloch, 2018). These research interests are divergent: as some studies relate reforms to economic growth; some evaluated the determinants of the performance and profitability of banks (such as Goldberg and Rai, 1996; Chirwa, 2003; Bonin, Hassan and Wachtel, 2005; Milla, 2005; Naceur and Goaid, 2001; Shih, Zhang and Liu, 2007) while the others are concerned with the implications of the reforms on the accomplishments of both the financial sector and the banking sub-sector (Andries, Apetri, and Cocris, 2012). The studies on the previous are more profound than those on the later. For instance, while there exists a handful of studies on reforms and economic growth in Nigeria (such as Ishioro, 2017; Fadare, 2010; and Balogun, 2007); to the best of our knowledge, there are no recent studies on the long-run impact of reforms on the performance of banks in Nigeria that adopted the Pantula principle.

Two frameworks of testing and monitoring banks stability and performance have been identified in the literature: qualitative-based analysis (using financial stability indicators) and scenario-based stress analytical framework. Both frameworks are fraught with seemingly intractable limitations. However, these limitations can be overcome by applying the quantitative-linked-analytical (QLA) framework of banks performance evaluation. The QLA has been advocated by the International Monetary Fund (IMF) in developing quantitative indicators that can facilitate the understanding of banks' performance during the era of reforms.

Although reforms have initiated a shift away from dwindling performance to significant long-run recovery path; the industry is still performing weakly in terms of many essential indicators. Hence, the main focus of this study is to investigate the long-run relationship of reforms on the performance of banks in Nigeria. The econometric testing technique adopted in this study is both innovative and unique.

THE NIGERIAN BANKING SYSTEM: OVERVIEW OF THE PHASES OF EMERGENCE

Phases of the Emergence of the Nigerian Banking Sector

Nnanna (2005a, 2005b) identified four (4) epoch-making distinct phases of the emergence of the Nigerian Banking Industry. The first phase that commenced in 1930 and ended in 1959 was regarded as the unguided and unsupervised (*laissez-faire*) phase. Most Nigerian banks failed during their early and formation years due to weak capital bases, poor and inefficient regulatory and supervisory framework and proven institutional weaknesses.

The second phase began in 1960 and terminated in 1985, and was referred to as the control regime where the central bank of Nigeria (CBN) ensured and enforced strict compliance with prescribed monetary authorities conditions (of minimum paid-up capital) for issuance of licenses.

Third stage which was regarded as the post-SAP or de-control regime started in 1986 and lasted until 2004. This phase 'mid-wifed' the birth of the neo-liberalization philosophy of

'hitch-free entry' into banking in Nigeria; and licenses were issued and granted on the basis of political affiliation and patronage. This phase was one of the most devastating stages ever witnessed in the Nigerian banking industry as the current regulatory authorities of the sector are still contending with the far-reaching sinister impacts of this phase.

The fourth phase (which started in 2004 and has continued to date) emphasized recapitalization, consolidation and consistent/proactive regulation of Banks (Kolawole, 2007; kama , 2006; Adedipe,2005; Adegbite,2005; Ajayi, 2005; Bello, 2005; Imala, 2005; Nnanna , 2005b; Ogunbunka, 2005; Uchendu, 2005).

Banking Sector Reforms in Nigeria: Historical Perspective

Studies in the banking and economic literature have identified 6 forms of reforms. These include but not limited to financial liberalization, globalization , deregulation, recapitalization ,consolidation and privatization. But of the six, recapitalization and consolidation are the most prominent and most implemented in Nigeria.

The first ordinance that governed the re-engineering processes in the Nigerian financial sector was introduced in 1952 (Dogarawa , 2011). The 1952 ordinance was enacted to effectively supervise and regulate the large number of banks that were registered in 1947 and 1952. In 1947, a total number of 145 banks were registered but only 40 retained their licenses as at 1952 (Ugwuanyi, 1997).

The ordinance was designed to overhaul the operational mechanism of existing and surviving banks. It introduced a minimum paid-up capital for expatriate banks (₦12,500) before the issuance of a valid license to practice banking. Furthermore, it required all existing banks to adhere strictly to the directives and laid down regulatory rules within three years. However, by 1954, all but four banks had failed. To save the entire sector from total collapse and subsidence, regional governments intervened (as regional government came to the aid of the 3 crisis-enmeshed banks).The government of Eastern region aided and rescued ACB Ltd; government of Western region (aided both ACB Ltd and Agbonmagbe Bank while government of the Northern region aided Bank of the North.

Following the 1952 reforms, other reforms backed with either statutes or regulation/legislations ensued. These include: CBN Act of 1958; Banking Act of 1969; Rural Banking Scheme introduced in 1977; Financial Sector Liberalization Act of 1986 under the Structural Adjustment Programme (SAP); Nigerian Deposit Insurance Corporation (NDIC) Act of 1988; Community Banking Scheme introduced in 1990; CBN Act of 1991 (this repealed the CBN Act of 1958); Banks and other Financial Institutions Act (BOFIA) of 1991(repealed the Banking Act of 1969); and Universal Banking introduced in 2000;and recently BOFIA 2020 amongst others.

Although, these reforms relatively strengthened the operational mechanism of the banking sector and the entire financial system, they couldn't forestall the systemic bank distresses of those era. The spotlights of the reforms that preceded the previous reforms were stated in four (4) major milestones: rejuvenating and enhancing the quality of banks; fostering and sustaining financial stability; evolving a sound and healthy financial sector; and ensuring that the financial sector significantly contribute to the development and growth of the real economy.

Sanusi (2012) noted that the Nigerian BS experienced critical structural setbacks in 2009 due to the widespread global financial melt-down; as a result many Nigerian banks were rescued

by the government. The CBN injected about ₦620 billion into the sector and replaced the management of eight (8) banks. This was done to restore confidence and stability to the banking sector (CBN,2015). The most recent in the gallery of reforms is the BOFIA 2020 (that repealed BOFIA, laws of the federation of 2004).This Act which commenced on the 12th of November, 2020 was enacted to supervise and regulate banking and other businesses of financial institutions in Nigeria.

Banking Sector Reforms in Nigeria : Necessitating Factors

Anyanwu (2010), in line with Balogun (2007), and Omoruyi (1991), identified liberalization of markets to facilitate efficient and effective allocation of resources; expansion of the saving and/or intermediation role of banks; investment and growth promotion through the institution of market-based interest rates; using the reforms as the pedestal for inflation control and surveillance in order to attain sustainable economic growth, etc as the unalloyed targets and objectives of the reforms in Nigeria. Also, Anyanwu (2010) enumerated five fundamental phases of reforms in Nigeria: the 1986 to 1993 phase when the sector was deregulated with banks (that emerged from the indigenization programme) as dominant institutions; the re-regulation phase of 1993-1998; the 1999 phase (the phase that witnessed the re-enactment of the liberalization and universal banking paradigm); and the 2004 phase, which was principally bank consolidation that focused on curtailing the wanton spread of the vestiges of the global financial meltdown.

Furthermore, Anyanwu (2010) outlined major components of the reforms in Nigeria to include: bank consolidation from 2004 to 2009; real sector rejuvenation initiatives within the ambit of the reforms of the 2000s (clearly required the establishment of N200 billion commercial Agricultural Credit Scheme, N500 billion development bond, N200 billion small and medium scale enterprise guarantee scheme, etc).

The major criticism of the phases identified above is that the pre-1980 reforms, consolidation, and interventions were not mentioned. Balogun (2007) identified the following factors that forestalled the effectiveness of the reforms in Nigeria: inappropriate policy environment for the reforms; wrong prioritization of the reforms' agenda; unprecedented and abrupt reversals of reform policies; and interruption of reform programmes.

Sanusi (2012) observed that prior to the beginning of the last reforms that are still passively ongoing, the Nigerian banks couldn't and did not optimally facilitate economic growth and development due to inherent structural weaknesses and operational inadequacies. These deficiencies include a low capital base (undercapitalization), a large number of small banks with few branches (89 banks with 3,492 branches in 2005), which was reduced to 25 banks with approximately 5,809 branches following the 2004 reforms in 2010 (CBN, 2011; CBN, 2012; and CBN, 2015). The number of banks was reduced to 21 as at January 2022. The dominance of a few banks (where the top 10 banks controlled about 5% of aggregate assets, 52% of deposits and 45% of aggregate credits) was a major factor that prompted the reforms. Also, 62 banks were rated as largely unsound, while 25 were marginally sound. No Nigerian bank was rated very sound as of December 2004. This was evidenced by persistent boardroom squabbles, widespread frauds, gross insider abuses resulting in huge non-performance insider related credit, high turnover on the board, management, and staff; weak corporate governance (including inaccurate reporting and non-compliance with regulatory

requirements); and late or non-publication of annual accounts, thereby undermining the role of market discipline in ensuring banks' soundness.

According to CBN (2011), the overdependence on deposits sourced from the public sector led many banks to abandon their fundamental intermediary role of channeling funds from the surplus units to the deficit units of the economy. This made the banks weak, dysfunctional, and very volatile, thereby rendering their operations and survival highly dependent on government revenue that is usually susceptible to fluctuations.

Sanusi (2012) identified eight major interconnecting factors that led to the banking crisis as: weakness in the business and operational environment of the banks; macroeconomic instability caused by sudden inflows of huge capital; major failures in corporate governance at the bank level; critical gaps in the regulatory framework; uneven supervision and enforcement; unstructured governance and internal weaknesses within the regulatory institutions. Others include restricted disclosure of information and inadequate transparency about the financial positions of the banks, etc. Faced with the above situations, the CBN designed a 13-point reforms agenda. The major focus was to increase the bank's minimum required capital base as represented by shareholders' funds from N2 to N25 billion by December, 2005 (CBN, 2012 and CBN, 2015). Since then, there have been a series of mergers and acquisitions in the Nigerian banking industry.

Banking Sector Reforms in Nigeria: Successes and Outcomes

Reforms that started in the early 1950s in Nigeria and have been persistently consistent. A lot of successes and positive outcomes have been recorded as a result of these re-engineering processes. Sanusi (2012) keenly recounted the enormous impacts and dividends of reforms in Nigeria, including:

First, the reforms reduced the number of existing banks from 89 to 24 with more branches. 14 banks had their licenses revoked. Between 2007 and 2013 (post-reform period), the number of banks was 24, with a total of 5,606 branches. Sanusi (2012) noted that, as a result of the reforms, Nigerian banks are now among the major players in the African and global economic agendas as most banks fall within the top 20 banks in Africa and top 100 banks globally. As of 2017, 10 commercial banks had international authorization, 9 had national authorization and 2 had regional authorization. Second, the reforms compel banks to comply with the minimum capital requirement. With approximately N1.7 trillion injected into the system through the AMCON bonds issue, Nigerian banks have been empowered to extend credit to the private sector; as a result, credit has been made available to the power sector, SMEs, and the aviation sector at low interest rates. Third, the reforms have redirected and repositioned commercial banks for optimal profit maximization with the attendant transparency and best practices in financial position reporting. This is a hybrid of the restoration of good and high-degree corporate governance and public disclosure of transactions of the bank. Fourth, the reforms have designed, implemented and enforced a code of corporate governance that requires the CEO of a bank to serve a maximum of ten (10) years and handover to their successor. Finally, the re-engineering processes have instituted and increased the widespread of e-payment services among Nigerians, and they have restored greater confidence in the banking system with the premium within the international standard of 5.0 percent. These are a few of the tangible outcomes of the reforms in Nigeria.

METHODOLOGY

Sources, Nature and Description of Data.

Annual time series data for this study covered the period 1990 to 2020 and was sourced from and extracted from the International Monetary Fund (IMF) Financial Soundness Indicators for various years. This study's series are divided into two categories: performance indicators and banking-industry-specific indicators. A negative relationship is postulated between either ROA_b , ROE_b or $BNIM$ and $BNGL$ because, accumulated bad loans have the tendency to act as a drag on banks performance in the following ways : first, accumulated bad loans make banks to expend huge scarce resources on loans recovery and control resulting into very high operating costs; and second, the more exposed the banks are to greater loans' risks, the higher the level of accumulated bad loans, and the weaker the performance of the banks. This was one of the reasons given by the apex bank for implementing most of the reforms. Also, this explanation suffices for the relationship between $BPNL$ and either ROA_b , ROE_b or $BNIM$.

Table 1

Measures and Description of Variables

Variable	Symbol	Measure	Definition / Description
Return on Assets before tax	ROA_b	Banks Operational Performance	Total amount of net income generated annually by the bank divided by its total assets (depicted as a percentage).
Return on Equity before tax	ROE_b	Banks Performance (size of Banks)	Return on equity equals net income generated annually divided by total equity
Net Interest Margin	$BNIM$	Banks Performance (Cost of Intermediation)	Net interest margin equals interest income minus interest expense divided by total assets.
Ratio of Loan loss Provisions to non-performing loans	$BPNL$	Banks measure of credit risk	Ratio of Loan loss provisions to non-performing loans shows how much a bank is provisioning for bad loans annually relative to its total loans
Ratio of Bank credit to bank deposits	$BCBD$	Banks Liquidity	Measures assets to liability ratio
Ratio of Bank Capital to total Assets	$BCTA$	Banks capitalization or leverage / Capital ratio	Ratio of Bank Capital to total Assets equals total capital divided by total assets
Ratio of Bank Non-performing loans to gross loans	$BNGL$	Banks measure of credit risk / Assets quality	It measures the bank's credit risk exposure emanating from its loan book. The ratio is calculated as the bank impairment losses (or non-performing loans) as a percentage of its gross loans and advances.
Ratio of Bank non-interest income to total income	$BITI$	Bank Efficiency	This is a financial ratio that shows the percentage of the bank's non-interest income in relation to its total income. The ratio is calculated as the bank's non-interest income divided by its total income
Ratio of Bank overhead cost to total assets	$BOTA$	Banks Liquidity	This ratio compares banks overhead cost to their total assets.
Total Assets	BTA	Bank size	Total Assets is measured as the natural logarithm of the total assets, as deflated using GDP deflator.
Total Deposits	BTD	Banks Network embeddedness / ICT adaption	BTD is calculated as the log value of total deposits of the Banking sector.

Source: Author's Compilation.

In this study, BTA represents the size of the banks and banking sector, and it is a very reliable proxy for the evaluation of the cost advantages derivable from the economies of scale of the re-engineering process (Zhang and Daly, 2013; Shivagami and Prasad, 2016).

Estimation Technique

This study applied the unit root test, cointegration test and the modified Pantula Principle in the analysis of our models (Ishioro, 2015a and 2015b). These tests and estimation techniques are highlighted below.

Tests of Integration

Various tests of integration have been applied in the literature investigating the impacts of the reforms on banks' performance; these include Augmented Dickey Fuller (henceforth ADF) *à la* Dickey and Fuller (1979,1981); Ishioro (2022a, 2022b, 2022c, 2022d, 2016); Phillips-Perron (henceforth PP) popularized by Phillips and Perron (1988), and Ishioro (2020a, 2019, 2018, 2017); and Kwiatkowski-Phillips-Schmidt-Shin (henceforth KPSS) tests, *à la* Kwiatkowski, Phillips, Schmidt and Shin (1992).

Models of the Cointegration Tests

Long-run Model: Deterministic Components

The major contribution of our study to the empirical evidence on reforms and bank performance is that we painstakingly investigated the different strands of the deterministic components of the Johansen cointegration models. These components are presented below as: Assuming model (1) below is Z-dimensional Vector Autoregressive Model (VECM) of the form:

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

In equation (1), Δ represents first difference operator; X_t is a $Z \times 1$ vector of the stochastic series of our model, α and β represent a $Z \times r$ matrices characterized by full rank, Θ 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. We rewrite equation(1) as:

$$\Delta X_t = \phi_1 \Delta X_{t-1} + \alpha \beta' X_{t-1} + \Theta + \delta_t + e_t \quad (2)$$

In equation (2), the linear time trend is represented as t while δ and Θ are decomposed into equation (3) and (4):

$$\delta = \ell \delta_1 + \ell_0 \delta_2 \mid \alpha = \ell \quad (3)$$

$$\Theta = \ell \Theta_1 + \ell_0 \Theta_2 \quad (4)$$

In equation (3), both δ_1 and δ_2 are r and $Z-r$ dimensional vectors of the linear and quadratic trend coefficients in the long-run relationship (henceforth long-run); in equation (4), Θ_1 and Θ_2 are r and $Z-r$ dimensional vectors of intercepts and linear trend slope coefficients in the long-run (Hansen and Juselius,1995). Five cases of cointegration are identified in the econometric literature and recently in Ishioro and Maku (2022) as:

Model One: No intercept and no trend cointegrating equation or VAR.

This is generally expressed as :

$$\Delta X_t = \sum_{i=1}^{z-1} \varphi_i \Delta X_{t-i} + \alpha \beta' X_{t-1} + \sigma D_t + e_t \quad (5)$$

From equation (3) and (4), the deterministic components (the intercept and the trend) can be estimated in five (5) ways (depending on the nature of restrictions imposed on $\hat{\partial}_1, \hat{\partial}_2, \Theta_1$ and Θ_2 in equation (3) and (4)). For model one, the restriction is imposed as:

$$\hat{\partial}_1 = \hat{\partial}_2 = \Theta_1 = \Theta_2 = 0$$

Model one is fraught with the problem of all series in the cointegrating vectors having the same or similar mean. Also, in the case of model one, it is assumed that the deterministic components are absent either in the data or cointegrating relations. But in reality, this assumption is somewhat fabulous, as the intercept is always needed when accounting for adjustments in the measurements of the X 's in equation (1), (2) and (5) above.

Model Two: Restricted Intercepts and No Trends.

Model (2) can be specified as shown in equation (6):

$$\Delta X_t = \sum_{i=1}^{z-1} \varphi_i \Delta X_{t-i} + \alpha[\beta', \beta_0][(X_{t-1}, 1)] + \sigma D_t + e_t \tag{6}$$

Following equation(3) and (4), the restrictions imposed on model two are shown as:

$$\hat{\partial}_1 = \hat{\partial}_2 = \Theta_2, \Theta_1 \neq 0$$

Model two is a less restricted model when compared to model one because it allows for inclusion of a constant term in the cointegrating vectors in the econometric model to be estimated. Only intercept (that is, no trend) is accommodated in the cointegrating equation while there is neither intercept nor trend in VAR. In the context of this model, it is assumed that there is no linear trends in the data (implying that the first differences of the series have a zero mean).The intercept is only applicable to the cointegrating equation(long-run model only).

Model Three: Unrestricted Intercepts and No Trends in the Cointegrating Equation or VAR.

$$\Delta X_t = \sum_{i=1}^{z-1} \varphi_i \Delta X_{t-i} + \alpha\beta' X_{t-1} + \mu_0 + \sigma D_t + e_t \tag{7}$$

Using equation(3) and (4), the restriction imposed on model three is stated as:

$$\hat{\partial}_1 = \hat{\partial}_2 = 0, \Theta_2 \neq 0, \Theta_1 \neq 0$$

In model three, the term (μ_0) is treated as unrestricted intercept in the econometric equation. 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.

Model Four: Unrestricted Intercepts and Restricted Trends.

Model 4 is designed to accommodate the constants and deterministic trends in the cointegrating vectors. Model four usually includes intercepts in both the cointegrating equation and the VAR, but only the linear trend is included in the cointegrating equation. The trend included in the cointegrating relations is akin to a trend stationary variable that is designed to take cognizance of exogenous growth in both performance and banking-industry-specific series. Also, it is worth noting that in the context of model four, there is no trend in the short-run. This is specified as:

$$\Delta X_t = \sum_{i=1}^{z-1} \varphi_i \Delta X_{t-i} + \alpha[\beta', \beta_1, \beta_0]'[X_{t-1}, t, 1] + \mu_0 + \sigma D_t + e_t \quad (8)$$

Following equation (3) and (4), the restrictions imposed on model four are shown as

$$\partial_1 = 0, \partial_2 \neq 0, \Theta_2 \neq 0, \Theta_1 \neq 0$$

Model Five: Unrestricted Intercepts and Unrestricted Trends.

Model five incorporates intercept and quadratic trend in the cointegrating equation and includes intercept and linear trend in the VAR system of equations. This has been confirmed by Asteriou and Hall (2007), who observed that model five essentially gives room for linear trends in the short-run model but allows for the inclusion of quadratic trends in the cointegrating equation. However, in the final model, both intercept and trends are unrestricted. This is why model 5 has been described as "the least restricted" of all the models of the cointegration test. The major weakness of this model is that it generates an unrealistic, ever-increasing or ever-decreasing, implausible rate of change. Model 5 is expressed as equation (9):

$$\Delta X_t = \sum_{i=1}^{z-1} \varphi_i \Delta X_{t-i} + \alpha[\beta', \beta_1, \beta_0]'[X_{t-1}, t, 1]X_{t-1} + \mu_0 + \mu_1 t + \sigma D_t + e_t \quad (9)$$

The restrictions imposed on model 5 are shown below:

$$\partial_1 \neq 0, \partial_2 \neq 0, \Theta_2 \neq 0, \Theta_1 \neq 0$$

Generally, of these five models stated above, model three that has the unrestricted constant is the basic, choicest and highly preferred for most empirical studies (Ishioro and Maku, 2022).

Modified Pantula Principle Estimation Technique

The modified Pantula Principle estimation technique involves either a bivariate cointegration model (in case of two variables) or multivariate cointegration model (in case of more than two variables). The bivariate (2 indicators or one-on-one) cointegration model was adopted in this study similar to Ishioro (2015c), Ishioro and Maku (2022) and, Akpobasa and Ishioro (2022) : using one dependent variable (selected from either *BNIM*, *ROE_b* or *ROA_b*) and one independent variable appropriately selected from *BTD*, *BTA*, *BOTA*, *BITI*, *BNGL*, *BCTA*, *BCBD* and *BPNL*, and included in different bivariate cointegration models. Beyond the traditional Johansen cointegration test *à la* Johansen (1995) adopted in this study, we also applied the modified Pantula Principle where the cointegration model has two trace-test statistic factors (implicitly implying that the trace-test statistics denoted as *Trace_{i,j}* consists of *i* which represents model *i* with *i* = 5 (representing model 1 to model 5 respectively)) and, *r* represents the number of cointegrating equations. The implementation of the modified Pantula Principle presented in table 4 is econometrically procedural: it usually starts from model one row one with *r* = 0 (using *Trace_{1,0}* as the starting point). If the *Trace_{1,0}* is greater than its 0.05 critical value, then proceed to the next trace-test statistics value (*Trace_{2,0}*) of model two using row one (where *r* = 0). If *Trace_{2,0}* is greater than its critical value, then we would proceed to model three (using *Trace_{3,0}* row one with *r* = 0) until you get to model five *Trace_{5,0}* row one (with *r* = 0).

The rule of thumb and selection criteria of the modified Pantula Principle is that: if $Trace_{i,j} < 0.05$ critical value of the model, then select the model. But if otherwise, reject it and proceed to the next model using its row one (first row). See table 2 for the procedural framework for the implementation of the modified Pantula Principle.

Table 2

Procedural Framework for Implementing the Modified Pantula Principle

Hypothesis	Five Models of Johansen Cointegration					
$H_0 : r$	k-r	Model 1	Model 2	Model 3	Model 4	Model 5
None	2	$Trace_{1,0}$	$Trace_{2,0}$	$Trace_{3,0}$	$Trace_{4,0}$	$Trace_{5,0}$
AtMost1	1	$\rightarrow Trace_{1,1}$	$\rightarrow Trace_{2,1}$	$\rightarrow Trace_{3,1}$	$\rightarrow Trace_{4,1}$	$\rightarrow Trace_{5,1}$

Source: Author's Construct

Results of Unit Root Test

All the series displayed in table 3 evinced the fact that only BNIM is integrated of order zero (I[0]); connoting that at levels, all the series except BNIM possess unit root and are non-stationary.

Table 3

Results of the Augmented Dickey-Fuller Unit Root Test

Series	Level	First Difference	Order of Integration
ROA _b	-3.1072	-4.7633***	I(1):ROA _b is integrated of order one at 1 percent level of significance
ROE _b	-2.1950	-4.8116***	I(1): ROE _b is integrated of order one at 1 percent level of significance
BNIM	-	-3.7462**	I(0):BNIM is integrated of order zero at 5 percent level of significance
BPNL	3.4150**	-42674**	I(1) : BPNL is integrated of order at one 5 percent level of significance
BCBD	-3.1156	-3.4218**	I(1) : BCBD is integrated of order one at 5 percent level of significance
BCTA	-1.7613	-3.6757**	I(1) : BCTA is integrated of order one at 5 percent level of significance
BNGL	-2.0984	-5.1420***	I(1) : BNGL is integrated of order one at 1 percent level of significance
BITI	-2.0410	-6.5813***	I(1) : BITI is integrated of order one at 1 percent level of significance
BOTA	-3.00763	-3.7372**	I(1) : BOTA is integrated of order one at 5 percent level of significance
BTA	-1.9230	-7.0467***	I(1) : BTA is integrated of order one at 1 percent level of significance
BTD	-3.1092	-4.0991*	I(1) : BTD is integrated of order one at 10 percent level of significance

Source: Author's Computation

NOTE:* connotes 10 percent;** connotes 5 percent, and *** connotes 1 percent level of significance

We rejected the null hypothesis of stationarity at levels for all series except BNIM. But after first differencing, all our selected series (ROA_b, ROE_b, BNIM, BPNL, BCBD, BCTA, BNGL, BITI, BOTA, BTA and BTD) were stationary (void of the presence of unit root). Therefore, we rejected the alternative hypothesis of non-stationarity after first differencing (You, 2014; Ishioro, 2022c).

Results of the Modified Pantula Principle

Using ROA_b as dependent or lead variable versus the other indicators such as BCTA, BCBD, BITI, BNGL, BTA, BOTA, BPNL, and BTD as independent variables. The results of the 8 bivariate cointegrating regression equations are presented in table 4.

Return on Assets Before Tax and Other Selected Banks Indicators

Return on Assets Before Tax and Ratio of Banks to Total Assets

The results of the first bivariate cointegrating regression of ROA_b versus BCTA presented in table 4 show that there is no long-run co-impact between ROA_b and BCTA. This implies that ROA_b does not tend to a common long-run equilibrium with BCTA. Furthermore, using the Pantula principle; models 1 to 5 are appropriate for the estimation of the model between ROA_b and BCTA because in all bivariate regressions, $Trace_{i,j} < 0.05$ critical value (that is, $5.632 < 12.320$ for model one when $r = 0$; and $0.385 < 4.130$ for model one when $r \leq 1$). This is applicable to all the other four models when the first and second rows are considered. Hence, the Pantula Principle holds for all the five models when estimating the long-run relationship between ROA_b and BCTA. The policy implication of this is that, reforms in the sector have not strengthened the long-run co-variation and / or co-change between return on assets before tax (ROA_b) and ratio of bank capital to total assets (BCTA) in Nigeria during the period under consideration. Furthermore, it means that any of the five models can be appropriately applied to the bivariate cointegration regression of ROA_b versus BCTA without producing misleading results and outcomes.

Table 4

Results of Return on Assets Before Tax and Other Indicators

Panel 4A: Return on Assets Before Tax (ROA_b) Versus Banks Capital to Total Assets Ratio (BCTA)										
Hypothesis	Model One		Model Two		Model Three		Model Four		Model Five	
$r = 0$	5.632	12.320	12.180	20.261	12.180	15.494	13.406	25.872	11.161	18.398
$r \leq 1$	0.385	4.130	3.370	9.164	3.370	3.841	4.045	12.518	1.805	3.841
Panel 4B: Return on Assets Before Tax (ROA_b) Versus Banks Credit to Deposits Ratio (BCBD)										
Hypothesis	Model One		Model Two		Model Three		Model Four		Model Five	
$r = 0$	12.324	12.320	15.741	20.261	15.725	15.494	23.662	25.872	23.331	18.398
$r \leq 1$	0.148	4.130	3.275	9.164	3.267	3.841	4.563	12.518	4.316	3.841
Panel 4C: Return on Assets Before Tax (ROA_b) Versus Banks Non-interest Income to Total Income Ratio (BITI)										
Hypothesis	Model One		Model Two		Model Three		Model Four		Model Five	
$r = 0$	10.350	12.320	17.737	20.261	17.225	15.494	30.220	25.872	29.926	18.398
$r \leq 1$	1.113	4.130	3.232	9.164	2.823	3.841	3.123	12.518	3.092	3.841
Panel 4D: Return on Assets Before Tax (ROA_b) Versus Banks Non-performing Loans to Gross Loans Ratio (BNGL)										
Hypothesis	Model One		Model Two		Model Three		Model Four		Model Five	
$r = 0$	9.755	12.320	11.669	20.261	11.566	15.494	15.042	25.872	13.092	18.398
$r \leq 1$	1.563	4.130	3.180	9.164	3.083	3.841	4.075	12.518	2.346	3.841
Panel 4E: Return on Assets Before Tax (ROA_b) Versus Banks Total Assets (BTA)										
Hypothesis	Model One		Model Two		Model Three		Model Four		Model Five	
$r = 0$	22.852	12.320	25.178	20.261	15.668	15.494	21.303	25.872	10.980	18.398
$r \leq 1$	6.358	4.130	6.668	9.164	3.535	3.841	9.154	12.518	0.931	3.841
Panel 4F: Return on Assets Before Tax (ROA_b) Versus Banks Overhead Costs to Total Assets Ratio (BOTA)										
Hypothesis	Model One		Model Two		Model Three		Model Four		Model Five	
$r = 0$	12.083	12.320	22.212	20.261	21.804	15.494	25.695	25.872	25.380	18.398
$r \leq 1$	1.180	4.130	5.381	9.164	5.149	3.841	5.734	12.518	5.434	3.841
Panel 4G: Return on Assets Before Tax (ROA_b) Versus Banks Provisions to Nonperforming Loans Ratio (BPNL)										
Hypothesis	Model One		Model Two		Model Three		Model Four		Model Five	
$r = 0$	8.428	12.320	14.767	20.261	14.702	15.494	16.966	25.872	16.600	18.398

$r \leq 1$	0.132	4.130	4.656	9.164	4.643	3.841	5.520	12.518	5.154	3.841
Panel 4H: Return on Assets Before Tax (ROA_b) Versus Banks Total Deposits (BTD)										
Hypothesis	Model One	Model Two	Model Three	Model Four	Model Five					
$r = 0$	14.635	12.320	16.390	20.261	13.971	15.494	26.295	25.872	17.289	18.398
$r \leq 1$	5.255	4.130	6.566	9.164	4.537	3.841	9.274	12.518	2.180	3.841

Source: Author's Computation

NOTE: Model one does not possess an intercept or trends. Model two has restricted intercepts but no trends. Model three contains no unrestricted intercepts or trends; Model four contains unrestricted intercepts and restricted trends; and Model five contains unrestricted intercepts and trends.

Return on Assets Before Tax and Banks Credit to Deposits Ratio

Furthermore, for ROA_b versus BCBD presented in Panel 4B of table 4; *long-run* co-variation is established only if models 1, 3 and 5 are applied with $r = 0$. However, for all $r \leq 1$ and for all the models (except model five); the Pantula Principle applies and is validated. This means that, for $r \leq 1$, and for all the models except model five are adjudged as appropriate for the estimation of the long-run cointegrating relationship between ROA_b versus BCBD. Therefore, models 1 to 4 are selected as appropriate for estimating the *long-run* between ROA_b and BCBD. This suggests that, the reforms have not improved the long-term liquidity of banks in Nigeria. This is why the sector is still experiencing a "persistent illiquidity crisis." The problem of illiquidity has been an obstinate challenge for the Nigerian banking industry. Hence, consolidation and recapitalization have been the major reform thrusts in Nigeria. Recall that one of the profound reasons why Afribank, Union, Intercontinental, Oceanic, Sky, and Diamond banks were taken over was a liquidity/credit risk crisis.

Return on Assets Before Tax and Banks Non-interest Income to Total Income Ratio

For ROA_b versus BITI presented in Panel 4C of table 4 with $r = 0$ and $Trace_{i,j} < 0.05$ critical value, a *long-run cointegration* was established based on variants 3, 4, and 5, but only variants 1 and 2 were selected as suitable for the estimation of their long-term interlink. However, using $r \leq 1$, all the variants of the cointegrating models are adjudged appropriate. The results suggest that the reforms have not tangibly strengthened the long-term co-performance of the operational performance of the banks and the efficiency of the banking industry in Nigeria.

Return on Assets Before Tax and Banks Non-performing Loans to Gross Loans Ratio

For ROA_b versus BNGL, the bivariate model presented in Panel 4D of table 4; when $r = 0$ and $Trace_{i,j} < 0.05$ critical value, no cointegrating relationship was established implying that all the models (1 to 5) are appropriate for the estimation of the *long-run* cointegrating relationship based on the modified Pantula principle. But when $r \leq 1$, all the models are appropriate for the estimation of the long-run cointegrating relationship between ROA_b and BNGL. Therefore, models 1 to 5 are selected as appropriate for estimating the *long-run* cointegrating relationship between ROA_b and BNGL.

Return on Assets Before Tax and Banks Total Assets

For ROA_b versus BTA presented in Panel 4E of table 4, when $r = 0$ and $Trace_{i,j} < 0.05$ critical value, model one to three indicated one cointegrating equation while four and five indicated no cointegration. Therefore, we select model 4 and 5 as appropriate for estimating ROA_b versus BTA long-run model using $r = 0$ and $Trace_{i,j} < 0.05$ critical value. But for $r \leq 1$, only model one indicated one cointegrating. Hence, all the models except model one were

selected as appropriate based on the modified Pantula principle. One of the policy implications of this result is that, reforms in the sector have not strengthen the long-run co-variation and / or co-change between return on assets before tax (ROA_b) and banks total assets (BTA) in Nigeria during the period under consideration. Furthermore, it means that any of the selected models can be appropriately applied to the bivariate cointegration regression of ROA_b versus BTA without producing misleading results and outcomes.

Return on Assets Before Tax and Banks Overhead Costs to Total Assets Ratio

For ROA_b versus BOTA presented in Panel 4F of table 4; when $r = 0$ and $Trace_{i,j} < 0.05$ critical value; models 2, 3 and 5 show one cointegrating equation each while model 1 and 4 show no cointegration. Hence, adopting the rule of thumb of the modified Pantula Principle, we selected model 1 and 4 as appropriate for estimating the long-run cointegrating model of ROA_b versus BOTA using $r = 0$ and $Trace_{i,j} < 0.05$ critical value. However, for $r \leq 1$, only models 3 and 5 are cointegrated. Therefore, we selected models 1, 2 and 4 as appropriate in evaluating the *long-run* between ROA_b versus BOTA.

Return on Assets Before Tax and Banks Provisions to Non-Performing Loans Ratio

For the results of the bivariate regression of ROA_b versus BPNL presented in Panel 4G of table 4; when $r = 0$ and $Trace_{i,j} < 0.05$ critical value; all models except model 4 ($26.295 > 25.872$) are selected as appropriate. Using the benchmark of $r \leq 1$ show one cointegrating equation each; making models 1, 2 and 4 the appropriate models for estimating the long-run model of ROA_b versus BPNL.

Return on Assets Before Tax and Banks Total Deposits

For the results of ROA_b versus BTB presented in Panel 4H of table 4, when $r = 0$ and $Trace_{i,j} < 0.05$ critical value of the cointegrating statistics, model 1 and 4 are not selected because $14.635 > 12.320$ for model 1 while $26.295 > 25.872$ for model 4 implying that the two indicators are cointegrated but has no definite normalized cointegrating relationship; but models 2, 3, and 5 are selected based on the Pantula Principle because they satisfied the condition stated above. However, when $r \leq 1$, all the models are selected except model one whose trace statistic value is greater than the 0.05 critical value ($5.255 > 4.130$). The implication of our findings is that when $r = 0$ and $Trace_{i,j} < 0.05$ critical value of the cointegrating statistics, models 2, 3, and 5 are appropriate for estimating the *long-run cointegrating relationship* between ROA_b versus BTB while models 2, 3, 4, and 5 are appropriate when $r \leq 1$.

Return on Equity Before Tax and Other Selected Banks Indicators

Table 5

Results of Return on Equity Before Tax and Other Indicators

Panel 5A: Return on Equity Before Tax (ROE_b) and Bank Capital to Total Assets Ratio (BCTA)										
Hypothesis	Model One		Model Two		Model Three		Model Four		Model Five	
$r = 0$	15.290	12.340	26.960	20.262	25.667	15.494	25.718	25.872	22.191	18.397
$r \leq 1$	1.549	4.130	11.663	9.165	11.400	3.841	11.435	12.518	10.565	3.841

Panel 5B: Return on Equity Before Tax (ROE_b) and Bank Credit to Deposits Ratio (BCBD)										
Hypothesis	Model One		Model Two		Model Three		Model Four		Model Five	
$r = 0$	12.422	12.320	18.478	20.262	17.117	15.494	30.091	25.872	27.269	18.397
$r \leq 1$	0.666	4.130	3.726	9.165	3.711	3.841	5.000	12.518	4.991	3.841

Panel 5C : Return on Equity Before Tax (ROE_b) and Bank Non-interest Income to Total Income (BITI)

Hypothesis	Model One		Model Two		Model Three		Model Four		Model Five	
$r = 0$	11.396	12.320	11.396	20.262	19.910	15.494	18.347	25.872	20.671	18.397
$r \leq 1$	1.084	4.130	1.084	9.165	2.340	3.841	2.303	12.518	2.898	3.841

Panel 5D : Return on Equity Before Tax (ROE_b) and Bank Nonperforming Loans to Gross Loans (BNGL)

Hypothesis	Model One		Model Two		Model Three		Model Four		Model Five	
$r = 0$	14.413	12.320	21.991	20.262	20.400	15.494	25.021	25.872	20.353	18.397
$r \leq 1$	6.374	4.130	6.783	9.165	6.7342	3.841	8.269	12.518	8.061	3.841

Panel 5E: Return on Equity Before Tax (ROE_b) and Bank Total Assets (BTA)

Hypothesis	Model One		Model Two		Model Three		Model Four		Model Five	
$r = 0$	23.900	12.320	32.042	20.262	22.467	15.494	31.071	25.872	19.529	18.397
$r \leq 1$	10.962	4.130	11.233	9.165	2.323	3.841	10.726	12.518	5.414	3.841

Panel 5F : Return on Equity Before Tax(ROE_b) and Bank Overhead Costs to Total Assets Ratio (BOTA)

Hypothesis	Model One		Model Two		Model Three		Model Four		Model Five	
$r = 0$	14.158	12.320	22.748	20.262	21.280	15.494	22.594	25.872	18.172	18.397
$r \leq 1$	1.295	4.130	3.600	9.165	3.480	3.841	4.714	12.518	3.232	3.841

Panel 5G : Return on Equity Before Tax(ROE_b) and Bank Provisions for Non-performing Loans (BPNL)

Hypothesis	Model One		Model Two		Model Three		Model Four		Model Five	
$r = 0$	15.158	12.320	22.847	20.262	21.609	15.494	25.077	25.872	21.960	18.397
$r \leq 1$	1.441	4.130	8.900	9.165	8.671	3.841	12.012	12.518	9.759	3.841

Panel 5H : Return on Equity Before Tax(ROE_b) and Bank Total Deposits (BTD)

Hypothesis	Model One		Model Two		Model Three		Model Four		Model Five	
$r = 0$	19.067	12.320	25.397	20.262	20.728	15.494	25.872	25.872	18.964	18.397
$r \leq 1$	2.427	4.130	7.430	9.165	6.257	3.841	12.518	12.518	0.0022	3.841

Source: Author's Computation

NOTE: Model one has no intercept and trends; Model two has restricted intercepts but no trends; Model three has no unrestricted intercepts and trend; Model four has unrestricted intercepts and restricted trends; and Model Five has unrestricted intercepts and trends.

Using ROE_b as dependent or lead variable and the other indicators such as BCTA, BCBD, BITI, BNGL, BTA, BOTA, BPNL and BTD as independent variables. The results of the 8 bivariate cointegrating regression equations we tested are presented below.

Return on Equity Before Tax and Banks Capital to Total Assets Ratio

The bivariate cointegrating equation between ROE_b and BCTA presented in Panel 5A of table 5, when $r = 0$, and $Trace_{i,j} > 0.05$ are presented for models one, two, three, and five except model four. However, when $r \leq 1$, $Trace_{i,j} < 0.05$ for all the models except for model two, three and five where $Trace_{i,j} > 0.05$ at $r \leq 1$. Hence, only model one, and four are selected as appropriate for estimating the cointegrating relationship between ROE_b and BCTA. However, considering the weaknesses associated with model one as explained above, we selected only model 4 as the most appropriate cointegration model for estimating the long-run cointegration between ROE_b and BCTA. The policy implication of this is that, reforms in the sector have not strengthen the long-run co-variation and / or co-change between return on assets before tax (ROA_b) and ratio of bank capital to total assets (BCTA) in Nigeria during the period under consideration. Furthermore, it means that any of the five

models can be appropriately applied to the bivariate cointegration regression of ROE_b versus BCTA without producing misleading results and outcomes.

Return on Equity Before Tax and Banks Credit to Deposits Ratio

The results of the bivariate cointegrating equation between ROE_b and BCBD presented in Panel 5B of table 5, when $r=0$, shows that $Trace_{i,j} > 0.05$ for models one, three, four and five except model two. However, when $r \leq 1$, and $Trace_{i,j} < 0.05$; all the models except for model five satisfied the selection criteria for the Modified Pantula Principle. Thus, we selected only model 2 as the most appropriate for estimating the *long-run* cointegration between ROE_b and BCBD for Nigeria during the period under consideration.

Return on Equity Before Tax and Bank Nonperforming Loans to Gross Loans

Furthermore, considering the results of the bivariate cointegrating equation between ROE_b and BNGL presented in Panel 5D of table 5, when $r=0$ and $Trace_{i,j} > 0.05$, it was indicated that all the models except model 4 satisfied the condition for selecting appropriate equation. But when $r \leq 1$ and $Trace_{i,j} < 0.05$, only models two and four can be selected. Conservatively therefore, only model four should be selected as appropriate using the harmonized condition of $r=0$ and $r \leq 1$ when $Trace_{i,j} < 0.05$. This implies that, the reforms in the Nigerian banking sector have not strengthen the long-run co-variation and / or co-change between return on equity before tax (ROE_b) and bank non-performing loans to gross loans (BNGL) in Nigeria during the period under consideration. Furthermore, it means that any of the selected models can be applied to the bivariate cointegration regression of ROE_b versus BNGL without producing misleading and spurious outcomes.

Return on Equity Before Tax and Banks Overhead Costs to Total Assets Ratio

The bivariate cointegrating equation between ROE_b and BOTA presented in Panel 5F of table 5 when $r=0$ and $Trace_{i,j} > 0.05$, it was indicated that all the models except model 4 satisfied the condition for selecting appropriate equation. But when $r \leq 1$ and $Trace_{i,j} < 0.05$, only models two and four can be selected. Conservatively therefore, only model 4 was selected as appropriate using the harmonized condition of $r=0$ and $r \leq 1$ when $Trace_{i,j} < 0.05$.

Return on Equity Before Tax and Banks Total Assets

The bivariate cointegrating equation between ROE_b versus BTA when $r=0$ and $Trace_{i,j} > 0.05$, it was indicated that all the models except model 4 satisfied the condition for selecting the appropriate and suitable equation. On the other hand, only models 3 and 4 satisfied the selection criteria of the modified Pantula Principle for the evaluation of the cointegrating relationship between ROE_b versus BTA when $r=0$ and $r \leq 1$ with $Trace_{i,j} < 0.05$. However, considering the weaknesses associated with and implicit in model 1, we selected only model 4 as the most appropriate cointegration model for estimating the *long-run* equilibrium relationship between ROE_b and BTA.

Return on Equity Before Tax and Banks Non-interest Income to Total Income

For ROE_b versus BITI cointegrating bivariate model presented in Panel 5C of table 5, and using both $r=0$ and $r \leq 1, Trace_{i,j} < 0.05$ as the selection criteria. We selected all the models except models 3 and 5. But for the reasons given for not selecting model one, we

selected only model 2 and 4 as appropriate for estimating the *long-run* co-influence and co-performance between ROE_b versus BITI. The empirical and econometric connotation of this is that, without the appropriate application of the Pantula principle, cointegration would have been reported based on the application of any other model when indeed there isn't any empirically-based cointegration; implying that in the context of the Pantula principle only models 2 or 4 would be appropriately applied to the bivariate cointegration regression between ROE_b and BITI without producing misleading results and outcomes.

Return on Equity Before Tax and Banks Provisions for Non-Performing Loans

The bivariate cointegrating equation between ROE_b and BPNL presented in Panel 5G of table 5, and when $r = 0$, $Trace_{i,j} > 0.05$ for models one, two, three, and five except for model four. However, when $r \leq 1$, $Trace_{i,j} < 0.05$ for all the models except model three and five where $Trace_{i,j} > 0.05$ at $r \leq 1$. Hence, only model 1, 2, and 4 are selected as appropriate for estimating the cointegrating relationship between ROE_b and BPNL. But, considering the weaknesses associated with model one as explained above, we select models two and four as the appropriate cointegration models for estimating the *long-run* cointegrating relationship between ROE_b and BPNL.

Return on Equity Before Tax and Banks Total Deposits

The bivariate cointegrating equation between ROE_b and BTD presented in Panel 5H of table 5, and when $r = 0$, $Trace_{i,j} > 0.05$ for models 1, 2, 3, 4, and 5. But for $r \leq 1$, $Trace_{i,j} < 0.05$ for all the models except model 3 where $Trace_{i,j} > 0.05$ at $r \leq 1$. Therefore, only model 1, 2, 4, and 5 are selected as appropriate for estimating the cointegrating relationship between ROE_b and BTD. However, considering the weaknesses associated with model 1 and 5 as explained above, we selected models 2 and 4 as the appropriate cointegration models for estimating the *long-run* cointegrating relationship between ROE_b and BTD.

Bank Net Interest Margin and Other Selected Banks Indicators

Table 6

Bank Net Interest Margin and Other Bank Indicators

Panel 6A: Bank Net Interest Margin (BNIM) versus Bank Capital to Total Assets(BCTA)										
Hypothesis	Model One		Model Two		Model Three		Model Four		Model Five	
$r = 0$	9.471	12.320	20.790	20.262	20.468	15.494	20.558	25.872	19.864	18.397
$r \leq 1$	1.322	4.130	7.864	9.164	7.730	3.841	7.767	12.517	7.077	3.841
Panel 6B: Bank Net Interest Margin (BNIM) versus Ratio of Bank Credit to Deposits(BCBD)										
Hypothesis	Model One		Model Two		Model Three		Model Four		Model Five	
$r = 0$	7.587	12.320	13.060	20.262	12.762	15.494	17.645	25.872	17.376	18.398
$r \leq 1$	0.506	4.130	3.008	9.165	2.842	3.841	4.109	12.518	3.850	3.841
Panel 6C: Bank Net Interest Margin Versus Bank Non-interest Income to Total Income										
Hypothesis	Model One		Model Two		Model Three		Model Four		Model Five	
$r = 0$	5.817	12.321	14.673	20.262	14.193	15.494	15.474	25.872	15.376	18.398
$r \leq 1$	0.992	4.130	3.350	9.165	3.233	3.841	3.666	12.518	3.645	3.841
Panel 6D: Bank Net Interest Margin Versus Bank Nonperforming Loans to Gross Loans										
Hypothesis	Model One		Model Two		Model Three		Model Four		Model Five	
$r = 0$	8.157	12.321	15.025	20.262	14.225	15.494	17.497	25.872	15.787	18.398
$r \leq 1$	1.664	4.130	4.530	9.165	3.855	3.841	6.343	12.518	4.682	3.841
Panel 6E: Bank Net Interest Margin Versus Bank Total Assets (BTA)										
Hypothesis	Model One		Model Two		Model Three		Model Four		Model Five	
$r = 0$	15.268	12.321	22.277	20.262	13.552	15.494	22.916	25.872	14.752	18.398

$r \leq 1$	1.881	4.130	8.664	9.165	4.566	3.841	8.920	12.518	3.082	3.841
Panel 6F: Bank Net Interest Margin Versus Bank Overhead Costs to Total Assets										
Hypothesis	Model One	Model Two		Model Three	Model Four	Model Five				
$r = 0$	3.732	12.321	14.207	20.262	13.820	15.494	15.378	25.872	14.583	18.398
$r \leq 1$	1.189	4.130	2.332	9.165	2.276	3.841	3.149	12.518	2.356	3.841
Panel 6G: Bank Net Interest Margin Versus Bank Provisions to Nonperforming Loans										
Hypothesis	Model One	Model Two		Model Three	Model Four	Model Five				
$r = 0$	10.565	12.321	13.562	20.262	13.338	15.494	15.508	25.872	15.247	18.398
$r \leq 1$	0.257	4.130	2.643	9.165	2.560	3.841	4.588	12.518	4.329	3.841
Panel 6H: Bank Net Interest Margin Versus Bank Total Deposits (BTD)										
Hypothesis	Model One	Model Two		Model Three	Model Four	Model Five				
$r = 0$	8.581	12.321	16.488	20.262	14.229	15.494	24.641	25.872	15.294	18.398
$r \leq 1$	0.298	4.130	7.225	9.165	5.498	3.841	7.581	12.518	0.723	3.841

NOTE: Model one has no intercept and trends; Model two has restricted intercepts but no trends; Model three has no unrestricted intercepts and trends; Model four has unrestricted intercepts and restricted trends; and Model Five has unrestricted intercepts and trends.

Using BNIM as the performance indicator and dependent or lead variable versus the others as independent variables in the cointegration regression model, we tested 8 bivariate cointegrating regression equations. The results are presented below.

Bank Net Interest Margin and Banks Capital To Total Assets

The first bivariate cointegrating equation involves BNIM and BCTA. The results indicated that for model two, three and five, $Trace_{i,j} > 0.05$. Therefore, only model one and four are selected as appropriate for estimating the cointegrating relationship between BNIM and BCTA. However, considering the weaknesses associated with model one as explained previously, we select model four as the appropriate cointegration model for estimating the long-run co-movement between BNIM and BCTA. The empirical connotation of this is that, without the appropriate application of the Pantula principle, cointegration would have been reported based on the application of either model 2, 3 or 5 when indeed there isn't any; implying that in the context of the Pantula principle only models 2, 3 or 5 should be appropriately applied to the bivariate cointegration regression between BNIM and BCTA without producing misleading results and outcomes.

Banks Net Interest Margin and Ratio of Banks Credit To Deposits

The bivariate cointegrating regression equations consist of BNIM versus BCBD. For model 1, 2, 3, 4, and 5, $Trace_{i,j} < 0.05$ for $r = 0$. But for $r \leq 1$, only model 1 to 4 satisfied the selection criteria of the modified Pantula Principle. However, considering the weaknesses of model one, we selected model 2, 3, and 4 as most appropriate for estimating the long-term co-existence between BNIM and BCBD. From this finding/ result, we conclude that, reforms in the sector have not strengthen the long-run co-variation, co-performance and / or co-change between bank net interest margin BNIM and ratio of banks credit to deposits (BCBD) in Nigeria during the period under consideration. Furthermore, it means that any of the three models can be applied to the bivariate cointegration regression between bank net interest margin BNIM and ratio of banks credit to deposits (BCBD) without producing misleading results and outcomes.

Banks Net Interest Margin and Banks Provisions to Non-Performing Loans

The bivariate cointegrating regression equations consist of BNIM versus BPNL. For model 1, 2, 3, 4, and 5, $Trace_{i,j} < 0.05$ for $r = 0$. But for $r \leq 1$, only model 1 to 4 satisfied the selection criteria of the modified Pantula Principle. However, considering the weaknesses of

model one, we selected model 2, 3, and 4 as most appropriate for estimating the long-term co-existence and co-change between BNIM and BPNL. The econometric implication of the selection of the three models (2,3 and 4) out of five is that there were two chances of just selecting a model that wouldn't have been appropriate in the estimation of the bivariate cointegrating regression between BNIM and BPNL. Therefore, we conclude that, reforms in the sector have not strengthen the long-run co-variation, co-performance and / or co-change between bank net interest margin BNIM and ratio of banks provisions to non-performing loans (BPNL) in Nigeria during the period under consideration.

Banks Net Interest Margin and Banks Non-Performing Loans To Gross Loans

The fourth bivariate cointegrating regression between BNIM and BNGL, and using $Trace_{i,j} < 0.05$ for $r = 0$, using the selection conditionality of the Pantula principle we select model 1, 2, 3, 4 and 5 as appropriate. But when the selection was based on $r \leq 1$; only model 1, 2 and 4 were chosen as appropriate. However, due to the inherent weakness associated with model 1, we sustained the selection of models 2 and 4 only. The econometric implication of the selection of the two models (2 and 4) out of five is that there were three chances of just selecting a model that wouldn't have been appropriate in the estimation of the bivariate cointegrating regression between BNIM and BNGL.

Banks Net Interest Margin and Banks Non Interest Income To Total Income

The bivariate cointegrating equations between BNIM and BITI suggest that all the models (1 to 5) are appropriate in estimating the long-run cointegrating equation when $r = 0$ and $Trace_{i,j} < 0.05$. But using the $r \leq 1$ selection benchmark, all the models are deemed as appropriate. But, since models 1 and 5 are fraught with some fundamental weaknesses, we selected models 2, 3, and 4 as the appropriate cointegration models. Therefore, the implication of selecting three models (2, 3, and 4) out of five is that there were two chances of selecting a model that wouldn't have been appropriate in the estimation of the bivariate cointegrating regression between BNIM and BITI.

Banks Net Interest Margin and Banks Overhead To Total Assets

The bivariate cointegrating equations between BNIM and BOTA, suggest that all the models (1 to 5) are appropriate in estimating the long-run cointegrating equation when $r = 0$ and $Trace_{i,j} < 0.05$. But using the $r \leq 1$ selection benchmark, all the models are deemed as appropriate. But, since models 1 and 5 are fraught with some fundamental weaknesses, we selected models 2, 3, and 4 as the appropriate cointegration models. Therefore, the implication of selecting three models (2, 3, and 4) out of five is that there were two chances of selecting a model that wouldn't have been appropriate in the estimation of the bivariate cointegrating regression between BNIM and BOTA.

Banks Net Interest Margin and Banks Total Assets

For the cointegration model of BNIM versus BTA with $r = 0$, the results indicated that $Trace_{i,j} > 0.05$ for model 1 and 2, portending that only models 3, 4, and 5 are appropriate for estimating the long-run co-performance and co-movement of BNIM and BTA as an outcome of the re-engineering process in the industry. However, applying the $r \leq 1$ model selection criteria, $Trace_{i,j} < 0.05$ for all the models except for model 3 only. Therefore, harmonizing the outcomes of both $r = 0$ and $r \leq 1$, we selected models 4 and 5 as appropriate. But, as a result of the weaknesses implicit in model 5, only model 4 is chosen as appropriate for

estimating the long-run co-performance between BNIM and BTA. Hence, the econometric implication of selecting only model 4 out of 5 is that there are four chances of selecting a model that won't have been appropriate in the estimation of the bivariate cointegrating regression between BNIM and BTA.

Banks Net Interest Margin and Total Deposits of Banks

Finally, for the bivariate cointegrating regression equation involving BNIM versus BTD, and applying the $r=0$ and $r \leq 1$ model selection criteria, the findings show that using $Trace_{i,j} < 0.05$ all the versions of the cointegration models except model 3 are selected as appropriate. However, for the reasons advanced above for not selecting model 1 and 5, we choose model 2 and 4 as appropriate for estimating the long-run co-existence between BNIM and BTD. The econometric implication of the selection of the two models (2 and 4) out of five is that there were three chances of selecting a model that wouldn't have been appropriate in the estimation of the bivariate cointegrating regression between BNIM and BTD. However, our findings suggest that despite the reforms, there is no long-run co-impact between BNIM and BTD (that is, net interest rate margin does not affect the quantum and significance of the total deposits generated in the banking industry and vice versa).

CONCLUSION AND RECOMMENDATIONS

This study has painstakingly investigated the implications of the appropriate or inappropriate implementation of the Johansen cointegration test on the results obtained from annual time series data using bank performance and reforms indicators from the Nigerian economy for the period 1990 to 2020 as a case in point. The modified Pantula principle was applied in a bivariate cointegrating regression framework using any of ROA_b , ROE_b and BNIM as banks performance indicators versus other reforms, bank and industry-specific indicators such as: BCTA, BCBD, BITI, BNGL, BTA, BOTA, BPNL and BTD. The insightful results obtained from our econometric estimates indicated that not all the models of the Johansen cointegration test should be applied to the bivariate cointegration regression between ROA_b and other selected indicators; between ROE_b and other indicators; and between BNIM and other indicators. One of our prime findings is that the policy-oriented reorganizations and reforms going on in the sector to date have not enhanced the long-run interdependence between banks' performance and selected reforms, bank and industry-specific indicators in which ROA_b and BCTA in Nigeria are not excluded during the period considered.

Reforms should strictly target the compliance with the global practices including BASEL III liquidity standard (specifically the net stable funding ratio (NSFR) and the liquidity coverage ratio (LCR)). The regulatory authorities and management of banks should ensure that they are highly liquid and appropriately recapitalized. They should increase the loan awarding capacity of banks without increasing their proportion of bad and non-performing loans to ensure a functionally viable sector.

References

- Adedipe, A. (2005). Post-consolidation challenges. *Bullion (A Publication of the Central Bank of Nigeria)*, 29(2), 38-46, April/June.
- Adegbite, E.O. (2005). Financial sector reforms and economic development in Nigeria: The Role of Management. Paper presented at the First National Conference of the Academy of Management, Abuja, 22-23rd, November, 2005.

- Ajayi, M. (2005). Banking sector reforms and bank consolidation: Conceptual Framework, *Bullion (Publication of the Central Bank of Nigeria)*, 29(2), 3-11, April/June.
- Akpobasa, R.A., & Ishioro, B.O. (2022). Investments of multinational corporations and telecommunication output in Nigeria: a leapfrogging experience? *Himalayan Economics and Business Management*, 3(6), 12-19.
- Andries, A.M., Apetri, A.N., & Cocris, V. (2012). The impact of the banking system reform on banks performance. *African Journal of Business Management*, 6(6), 2278-2284 (February). DOI:10.5897/AJBM 11.1953
- Anyanwu, C. M. (2010). An overview of current banking sector reforms and the real sector of the Nigerian economy. *Central Bank of Nigeria Economic and Financial Review*, 48(4), 31-56.
- Asteriou, D., & Hall, S.G. (2007). *Applied econometrics-a modern approach*. New York, PALGRAVE MACMILLAN
- Balogun, E.D. (2007). Banking sector reforms and the nigerian economy: performance, pitfalls and future options, *Munich Personal RePEc Archive (MPRA)*, Paper NO.3804 available at: <https://mpra.ub.uni-muenchen.de/3804/>
- Bello, Y. A. (2005). Banking system consolidation in Nigeria and some regional experiences: challenges and prospects. *Bullion (A Publication of the Central Bank of Nigeria)*, 29(2), 47-54, April/June.
- Bonin, J.P., Hassan, I., & Wachtel, P. (2005) Bank Performance, Efficiency, and Ownership in Transition Economies. *Journal of Banking and Finance*, 29, 1-53.
- Central Bank of Nigeria [CBN](2011). Understanding Monetary Policy: Banking Sector Reforms in Nigeria (Vol. Series 7). Abuja: CBN. Retrieved February 8, 2018, from <https://www.cbn.gov.ng/out/2015/mpd/understanding%20monetary%20policy%20series%207.pdf>
- Central Bank of Nigeria [CBN](2012). Banking reform and its impact on the Nigerian Economy: Being a Lecture Delivered By Sanusi Lamido Sanusi, Governor, Central Bank of Nigeria at University of Warwick's Economic Summit, United Kingdom.
- Central Bank of Nigeria [CBN](2015). Consolidated Banking Supervision Annual Reports (2009 - 2014).
- Chirwa, E.W. (2003). Determinants of commercial banks' profitability in Malawi: a cointegration approach. *Applied Financial Economics*, 13(8), 565-577.
- Dickey, D.A., & Fuller, W.A. (1981). Likelihood ratio statistics for autoregressive time series with unit root, *Econometrica*, 49(4), 1057-1072.
- Dogarawa, A.H. (2011). Chronology of banking reforms in Nigeria: a survey of past and present theoretical and empirical literature. *Journal of Financial Regulation and Compliance*, 19(4), 370-382. <http://dx.doi.org/10.1108/13581981111182965>
- Fadare, S. O. (2010). Recent banking sector reforms and economic growth in Nigeria. *Middle Eastern Finance and Economics*, 8, 146 - 160.
- Goldberg, L.G., & Rai, A. (1996). The structure-performance relationship for european banking. *Journal of Banking and Finance*, 20, 745-771.
- Hansen, H., & Juselius, K. (1995). CATS in RATS. *Estima*, United States.

- Imala, O.I. (2005). Challenges of Banking Sector Reforms and Bank Consolidation in Nigeria. *Bullion (A Publication of the Central Bank of Nigeria)*, 29(2), 26-36, April/June.
- Ishioro, B. O. (2022a). dynamic effects of health expenditure shocks on HIV Prevalence in sub-Saharan Africa. *Journal of Academic Research in Economics*. 14 (3), November.
- Ishioro, B. O. (2022b). Deposit money bank-based financial inclusion and economic growth in Nigeria: the role of a dual folded proxy. *Gusau International Journal of Management and Social Sciences*, 5(3), 1-23.
- Ishioro, B. O. (2022c). Unit root and stationarity tests in expenditure on health and economic growth series: maximizing the power of breakpoints. *Himalayan Journal of Community Medicine and Public Health*, 3(6), 14-21.
- Ishioro, B.O. (2022d). The long-run macroeconomic determinants of banks' performance in Nigeria. *KIU Journal of Social Sciences*, 8(4), 25-37.
- Ishioro, B.O., & Maku, O.A. (2022). Health care expenditure-GDP Nexus in Sub-Saharan Africa, *Journal of Positive School Psychology*, 6(12), 1649-1664.
- Ishioro, B. O. (2020a). Crude oil and economic growth in Nigeria: a simplified pair-wise causality test. *Journal of Academic Research in Economics*, 12(2), 224-246
- Ishioro, B. O. (2019). Energy consumption and economic growth in Nigeria: an augmented neoclassical growth model perspective. *Journal of Environmental Management and Tourism*, 7(39), 1637-1657: Winter
- Ishioro, B.O. (2018). Energy consumption and performance of sectoral outputs: evidence from an energy-impooverished economy. *Journal of Environmental Management and Tourism*, 7(31), 1539-1558
- Ishioro, B.O. (2016). HIV/AIDS and macroeconomic performance :empirical evidence from Kenya. *Scientific Papers of the University of Pardubice, Series D*, XXIII(36), 102-117
- Ishioro, B.O. (2015a). Intertemporal optimization of the consumption of petroleum stock: empirical evidence from Nigeria. *Journal of Academic Research in Economics*, 7(2), 232-255
- Ishioro, B.O. (2015b). The long-run relationship between foreign reserves inflows and domestic credit: evidence from a small open economy, *Oeconomica*, 11(2), 18-41.
- Johansen, S. (1995). *Likelihood-based inference in cointegrated vector autoregressive models*. Oxford, Great Britain.
- Kama, U. (2006). Recent reforms in the Nigerian banking industry: issues and challenges, *Central Bank of Nigeria (CBN) Bullion*, 30(3), 65-74.
- Kolawole, S. (2007). Appraising the Banking Sector Reforms in (eds) Saliu, H., Amali, E & R. Olawepo: Nigeria's Reform Programmes: Issues and Challenges.
- McKinnon, R. I. (1973). *Money and capital in economic development*. Washington D.C.: Brookings Institution.
- Milla, L. (2005). The measurement and Determinants of UK Banks' Performance, Cass Business School Past Dissertation, available from the Cyril Kleinwort Learning Resource Centre, Cass Business School.
- Naceur, S.B., & Goaid, M. (2001) The determinants of the Tunisian deposit banks' performance. *Applied Financial Economics*, 11(3), 317-319.

- Nnanna, O. J. (2005a). Central banking and financial sector management in Nigeria: An Insider View in Fakiyesi, O. O. & S. O. Akano (eds): Issues in Money, Finance and Economic Management in Nigeria. Essays in Honour of Professor Obasanmi Olakankpo, Pp. 99-120.
- Nnanna, O. J. (2005b). Beyond bank consolidation: impact on society. CBN 4th Monetary Policy Conference, Published by CBN, Abuja.
- Ogubunka, U.M. (2005). Banking sector reforms and banks consolidation: the experience of Turkey, *Bullion (A Publication of the Central Bank of Nigeria)*, 29(2), 17-25, April/June.
- Omoruyi, S. E. (1991). The financial sector in Africa: overview and reforms in economic adjustment programmes. *CBN Economic and Financial Review*, 29(2), 110-124.
- Phillips, P.C.B., & Perron, P. (1988). Testing for unit root in time series regression, *Biometrika*, 75(2), 335-346.
- Robin, I., Salim, I., & Bloch, H. (2018). Financial Performance of Commercial Banks in the Post-Reform Era: Further Evidence from Bangladesh, *Economic Analysis and Policy*, 58, 43-54.
- Sanusi, S. L. (2012). Global Financial Meltdown and the Reforms in the Nigerian Banking Sector. *CBN Journal of Applied Statistics*, 2(1), 93.
- Shaw, E. S. (1973). *Financial Deepening in Economic Development*, New York: Oxford University Press.
- Shih, V., Zhang, Q., & Liu, M. (2007). Comparing the performance of Chinese banks: a Principal Component Approach. *China Economic Review*, 18(1), 15-34.
- Shivagami, G., & Prasad, T.R. (2016). Impact of banking sector reforms-an analysis. *Shanlax International Journal of Economics*, 4(3), 1-9
- Uchendu, O.A. (2005). Banking sector reforms and bank consolidation: conceptual framework. *Bullion (A Publication of the Central Bank of Nigeria)*, 29(2), 12-16, April/June.
- Ugwuanyi, P. (1997). *The Nigerian financial system*. Enugu: Marvelous Publishers.
- You, V. (2014). The linkage between bank net interest margins and non-interest income: the case of the Cambodian Banking Industry. *Munich Personal RePEc Archive (MPRA)* Paper No.58230:Posted 09 September 2014 05:29 UTC
- Zhang and Daly (2013). The impact of bank specific and macroeconomic factors on China's Bank Performance, *Global Economy and Financial Journal*.