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Capital Buffer Dynamics and Risk-Taking Behaviour of Nigerian Commercial Banks in the Post-Reform Era

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ABSTRACT
This study examines the long-run determinants of capital buffer accumulation and risk-taking behaviour among listed Nigerian commercial banks in the post-reform era. Methodology Using an unbalanced panel of 11 listed commercial banks observed semi-annually from H1:2012 to H2:2023, the study applies a Panel Autoregressive Distributed Lag model estimated through the Pooled Mean Group technique. Robustness checks are conducted using fixed effects, random effects, instrumental variable estimation, and alternative proxies for capital adequacy and risk-taking. The findings reveal that capital buffers adjust slowly, while risk-taking responds more rapidly to long-run shocks. Rising non-performing loans erode capital buffers through the risk-weight channel, indicating moral hazard rather than proactive recapitalisation. Higher capital buffers reduce non-performing loans and earnings volatility, confirming a capital discipline effect. However, regulatory pressure increases risk-taking among undercapitalised banks, suggesting gambling-for-resurrection behaviour. The non-oil business cycle and oil revenue cycle jointly create compound procyclicality in bank capital and risk decisions.
This study extends the capital buffer and bank risk-taking literature by incorporating the oil revenue cycle as a distinct explanatory variable in a resource-dependent banking system. It also demonstrates the usefulness of the Panel ARDL-PMG approach in separating long-run equilibrium relationships from short-run dynamics. The results imply that recapitalisation policy should be supported by risk-sensitive supervision, countercyclical capital rules linked to both non-oil and oil cycles, dividend restrictions for vulnerable banks, and capital market reforms to reduce deleveraging-induced credit contraction.

Keywords: Capital Requirements, Bank Risk-Taking, Procyclicality, Oil Revenue Cycle, Panel ARDL-PMG

INTRODUCTION

The Nigerian banking sector has undergone a profound structural transformation over the past decade, shaped by a succession of regulatory overhauls, macroeconomic instabilities, and shifting monetary policy stances by the Central Bank of Nigeria (CBN). Among the most consequential regulatory interventions was the CBN's recapitalization directive issued in March 2022, mandating commercial banks to achieve substantially higher minimum capital thresholds within a 24-month compliance window a policy widely interpreted as the most aggressive capital adequacy reform since the landmark banking consolidation of 2005 (Adeola & Ikpesu, 2024). Simultaneously, the adoption of a modified Basel III-compliant framework, encapsulated in the CBN's Prudential Guidelines revisions of 2022, introduced more stringent risk-weighted capital requirements and expanded definitions of qualifying Tier 1 and Tier 2 instruments, compelling Nigerian banks to reassess their capital planning strategies (Brana et al., 2019).

These regulatory pressures have unfolded against a backdrop of severe macroeconomic turbulence. Following the unification of Nigeria's multiple exchange rate windows in June 2023, the naira experienced one of its most dramatic depreciations in decades, losing over 60 percent of its value against the United States dollar within a matter of months (Abbas, Yousaf, et al., 2021). This currency shock exposed banks with significant foreign currency-denominated liabilities to acute balance sheet vulnerabilities, eroding risk-weighted asset quality and compressing net interest margins. Concurrently, headline inflation accelerated sharply, surpassing 33 percent year-on-year by early 2023, prompting the CBN's Monetary Policy Committee to implement a series of aggressive benchmark rate hikes that cumulatively raised the Monetary Policy Rate from 11.5 percent in mid-2022 to 24.75 percent by May 2023. This monetary tightening cycle elevated borrowing costs across the credit spectrum, suppressed loan origination volumes, and amplified rollover risks

for borrowers in rate-sensitive sectors, thereby generating upward pressure on the non-performing loan ratios of Nigerian commercial banks (Moudud-Ul-Huq, 2021).

The nexus between capital requirements and bank risk-taking has attracted growing scholarly attention in the context of sub-Saharan Africa, yet the empirical literature focusing specifically on Nigeria remains both limited and methodologically constrained. Existing studies have predominantly relied upon static panel estimation frameworks fixed and random effects generalised least squares which, while useful for cross-sectional inference, are inadequate for capturing the intertemporal dynamics that characterise capital buffer and risk-taking adjustments over medium to long horizons (Pfeifer & Hodula, 2021). These approaches also remain vulnerable to estimation bias arising from non-stationarity in macroeconomic and bank-specific variables, a challenge that is particularly acute in the Nigerian context given the pronounced cyclical volatility of oil revenues, which directly impinges on fiscal positions, money market conditions, and bank credit supply (Reigl & Uusküla, 2021). Moreover, the simultaneous equation models dominant in the extant literature focus overwhelmingly on short-run causal dynamics, thereby overlooking the possibility that the fundamental drivers of capital buffer accumulation and risk-taking decisions operate through long-run adjustment mechanisms that are only identifiable when appropriate cointegration techniques are applied.

This paper responds to these gaps by investigating the long-run determinants of capital buffers and risk-taking behaviour among listed Nigerian commercial banks over the period spanning the post-2012 Basel III transition through the recapitalization cycle of 2022 to 2023. The empirical strategy departs from the prevailing literature in two substantive respects. First, we argue that bank-specific characteristics, macroeconomic cycle indicators, and regulatory pressure variables exert their most economically meaningful influence on capital and risk outcomes through long-run equilibrium relationships rather than through short-run contemporaneous effects. This assumption is particularly compelling in the Nigerian setting, where institutional inertia, shallow interbank and capital markets, and persistent information asymmetries between banks and supervisors create structural impediments to instantaneous capital adjustment (Nwankwo, Eze, & Obi, 2023). Second, we employ the Panel Autoregressive Distributed Lag estimator combined with the Pooled Mean Group technique originally developed by (Zribi & Boufateh, 2020) as our primary identification strategy. This approach permits estimation under mixed orders of integration, controls for cross-sectional heterogeneity in short-run dynamics while imposing long-run coefficient homogeneity, and mitigates endogeneity concerns arising from potential feedback between capital buffers and risk-taking through the inclusion of lagged terms for both endogenous and exogenous regressors (Erülgen et al., 2020).

The relevance of this inquiry is further underscored by the observation that the moral hazard consequences of deposit insurance and implicit government guarantees for systemically important banks well-documented in developed economies may manifest with particular intensity in Nigeria's banking landscape, where a small number of tier-one banks collectively hold a disproportionate share of system-wide assets and benefit from implicit too-big-to-fail protections (Srivastava et al., 2023). The procyclicality of lending behaviour in oil-dependent emerging economies such as Nigeria represents an additional dimension of systemic fragility that warrants empirical scrutiny. Evidence from comparable African banking systems suggests that banks operating in hydrocarbon-dependent macroeconomic environments tend to accumulate capital buffers during commodity boom periods and engage in rapid deleveraging during downturns, thereby amplifying rather than dampening the real economic cycle (Albulescu, 2022; Danisman & Demirel, 2019; Mateev et al., 2023). Whether a similar dynamic characterizes Nigerian banks' long-run capital adjustment remains an unresolved empirical question.

This study contributes to the existing literature in three ways. First, it provides to the best of our knowledge the first systematic long-run analysis of the determinants of capital buffers and risk-taking adjustment in the Nigerian banking system using a Panel ARDL-PMG framework calibrated to capture the post-Basel III regulatory cycle. Second, by using semi-annual data hand-collected from banks' audited financial statements and CBN supervisory returns, this study captures within-year variations in capital positions and asset quality that annual data would obscure a methodological refinement that is especially important during periods of rapid regulatory transition. Third, the findings offer timely and granular policy-relevant insights for the CBN as it implements its 2024 recapitalization mandate and works to strengthen the resilience of the Nigerian financial system against external shocks.

The remainder of this paper proceeds as follows. Section 2 synthesises the theoretical and empirical literature on how banks respond to capital requirements, with particular attention to evidence from emerging

market banking systems. Section 3 details the empirical methodology, variable construction, and data sources. Section 4 presents and interprets the estimation results, including robustness checks using alternative proxies for capital adequacy and risk-taking. Section 5 concludes with policy implications for the CBN and Nigerian bank supervisors.

EMPIRICAL METHODOLOGY and DATA

Variables and Hypotheses

The empirical framework developed in this section builds upon and extends the theoretical arguments advanced in Section 2 to construct a pair of testable specifications that capture the long-run determinants of capital buffer accumulation and risk-taking behaviour among Nigerian commercial banks (Dias, 2021; Mateev, Moudud-Ul-Huq, et al., 2022; Siddika & Haron, 2020). Consistent with the theoretical premise that the key drivers of capital and risk decisions operate primarily through long-run equilibrium mechanisms rather than contemporaneous short-run effects a premise that is particularly defensible in the Nigerian institutional context given the structural rigidities characterising the domestic capital market the following specifications adopt a long-run cointegration perspective rather than the simultaneous equation short-run causality framework that dominates the existing Nigerian banking literature (Lundtofte & Nielsen, 2019; Maghyereh & Abdoh, 2021).

Two dependent variables anchor the empirical analysis, each forming the basis of a separate but analytically related equation. The capital buffer equation treats the voluntary cushion maintained above the regulatory minimum as the outcome of interest, while the risk-taking equation examines the determinants of asset quality deterioration as proxied by the non-performing loan ratio (Ashraf et al., 2020; Mateev, Nasr, et al., 2022). Each equation incorporates a set of bank-specific variables, a macroeconomic cycle indicator, a regulatory pressure measure, and in recognition of the distinctive structural features of the Nigerian economy an oil revenue cycle variable that has no counterpart in banking studies conducted in non-commodity-dependent settings (Ding et al., 2023; Moudud-Ul-Huq, 2021).

Capital Buffer Equation

The capital buffer ratio (BUF) the strategic excess capital banks maintain above regulatory minimums to absorb losses, signal financial strength, and seize investments is shaped by a complex interplay of internal and external variables. Internally, BUF is expected to be negatively impacted by non-performing loans (RISK) due to moral hazard and by the loan-to-assets ratio (LTA) as banks prioritize deleveraging, while bank size (SIZE) yields competing predictions based on either too-big-to-fail reliance or charter-value protection (Begenau, 2020; Cappelletti et al., 2022; Wahinya et al., 2023). Externally, capital cushions face negative pressure from non-oil business cycles (CYCLE) reflecting procyclical drawdowns during economic expansions, but are positively driven by oil revenue upswings (OIL) that boost retained earnings, alongside strict regulatory pressure (REG) that firmly compels vulnerable institutions to rebuild their capital to avoid central bank sanctions.

Risk-Taking Equation

In the second equation, RISK the ratio of non-performing loans to total gross loans serves as the dependent variable. As a measure of ex-post credit risk materialisation that aggregates the cumulative consequences of prior lending decisions, non-performing loans constitute a natural and widely employed proxy for bank risk-taking in the empirical literature, particularly for emerging market banking systems where more forward-looking market-based risk measures are either unavailable or uninformative due to thin secondary markets (Bostandzic et al., 2022; Boufateh & Saadaoui, 2020; Hunjra et al., 2021).

The capital buffer ratio (BUF) enters the risk-taking equation as the primary explanatory variable of interest. Under the market discipline hypothesis, higher capital buffers align shareholder incentives with prudent risk management, inducing more conservative lending behaviour and lower non-performing loan ratios over the long run (Abbas, Masood, et al., 2021; Banna & Alam, 2021; Nasim & Downing, 2023). Alternatively, the asset substitution hypothesis suggests that banks that have successfully rebuilt capital cushions may exploit this headroom to engage in incrementally riskier investments. Loan loss provisions (LLP), measured as the flow of provisions for credit losses scaled by total gross loans, is included as a predictor of future risk-taking. The business cycle indicator (CYCLE) and oil revenue cycle variable (OIL) are expected to carry positive coefficients, reflecting procyclical risk accumulation. The regulatory pressure variable (REG) is expected to exert a negative long-run impact on RISK, consistent with tighter credit standards under

supervisory pressure, although the moral hazard hypothesis suggests the opposite (Degryse et al., 2021; Fraisse et al., 2020).

Model Specification

To empirically test the long-run determinants of capital buffers and risk-taking decisions for listed Nigerian commercial banks, this study employs the Panel Autoregressive Distributed Lag (Panel ARDL) technique in conjunction with the Pooled Mean Group (PMG) estimator developed by (Bardi & Hfaiedh, 2021; Jiang & Yuan, 2022). This methodological choice is motivated by three principal considerations: the non-stationarity of key variables, the dynamic heterogeneity of the adjustment process across Nigerian banks, and the endogeneity inherent in the capital–risk relationship. Building upon the theoretical specifications in Section 3.1, the two baseline long-run equations are:

$$\mathrm{BUF(it)} = \varphi_0 + \varphi_1\mathrm{RISK(it)} + \varphi_2\mathrm{LTA(it)} + \varphi_3\mathrm{SIZE(it)} + \varphi_4\mathrm{CYCLE(t)} + \varphi_5\mathrm{OIL(t)} + \varphi_6\mathrm{REG(it)} + \mu_i + \varepsilon(\mathrm{it}) \quad (1)$$

$$\mathrm{RISK(it)} = \psi_0 + \psi_1\mathrm{BUF(it)} + \psi_2\mathrm{LLP(it)} + \psi_3\mathrm{SIZE(it)} + \psi_4\mathrm{CYCLE(t)} + \psi_5\mathrm{OIL(t)} + \psi_6\mathrm{REG(it)} + \alpha_i + \omega(\mathrm{it}) \quad (2)$$

I and t indicate banks and semi-annual periods, respectively. μ_i and α_i are bank-specific fixed effects, and ε(it) and ω(it) are independently and identically distributed error terms (Abbas, Ali, et al., 2021; Elsayed et al., 2023; Ibrahim, 2019). The two equations are estimated separately to focus on long-run determinants rather than short-run simultaneous causality. The dynamic ARDL representations of Equations (1) and (2) incorporating one lag of each variable as selected by the Schwarz Information Criterion (SIC) are specified as follows:

$$\begin{aligned}\mathrm{BUF(it)} = {} & \lambda_i\mathrm{BUF(i,t-1)} + \delta_{10}\mathrm{RISK(it)} + \delta_{11}\mathrm{RISK(i,t-1)} + \delta_{20}\mathrm{LTA(it)} + \delta_{21}\mathrm{LTA(i,t-1)} \\ & + \delta_{30}\mathrm{SIZE(it)} + \delta_{31}\mathrm{SIZE(i,t-1)} + \delta_{40}\mathrm{CYCLE(t)} + \delta_{41}\mathrm{CYCLE(t-1)} + \delta_{50}\mathrm{OIL(t)} \\ & + \delta_{51}\mathrm{OIL(t-1)} + \delta_{60}\mathrm{REG(it)} + \delta_{61}\mathrm{REG(i,t-1)} + \varepsilon(\mathrm{it})\end{aligned} \quad (3)$$

$$\begin{aligned}\mathrm{RISK(it)} = {} & \gamma_i\mathrm{RISK(i,t-1)} + \rho_{10}\mathrm{BUF(it)} + \rho_{11}\mathrm{BUF(i,t-1)} + \rho_{20}\mathrm{LLP(it)} + \rho_{21}\mathrm{LLP(i,t-1)} \\ & + \rho_{30}\mathrm{SIZE(it)} + \rho_{31}\mathrm{SIZE(i,t-1)} + \rho_{40}\mathrm{CYCLE(t)} + \rho_{41}\mathrm{CYCLE(t-1)} + \rho_{50}\mathrm{OIL(t)} \\ & + \rho_{51}\mathrm{OIL(t-1)} + \rho_{60}\mathrm{REG(it)} + \rho_{61}\mathrm{REG(i,t-1)} + \omega(\mathrm{it})\end{aligned} \quad (4)$$

(3) and (4) are subsequently reparametrised in error correction form to explicitly separate the long-run equilibrium relationships from the short-run adjustment dynamics:

$$\begin{aligned}\Delta\mathrm{BUF(it)} = {} & \varphi_i[\mathrm{BUF(i,t-1)} - \varphi_{0i} - \varphi_{1i}\mathrm{RISK(it)} - \varphi_{2i}\mathrm{LTA(it)} - \varphi_{3i}\mathrm{SIZE(it)} - \varphi_{4i}\mathrm{CYCLE(t)} \\ & - \varphi_{5i}\mathrm{OIL(t)} - \varphi_{6i}\mathrm{REG(it)}] + \varphi_{11}\Delta\mathrm{RISK(it)} + \varphi_{21}\Delta\mathrm{LTA(it)} + \varphi_{31}\Delta\mathrm{SIZE(it)} \\ & + \varphi_{41}\Delta\mathrm{CYCLE(t)} + \varphi_{51}\Delta\mathrm{OIL(t)} + \varphi_{61}\Delta\mathrm{REG(it)} + \varepsilon(\mathrm{it})\end{aligned} \quad (5)$$

$$\begin{aligned}\Delta\mathrm{RISK(it)} = {} & \tau_i[\mathrm{RISK(i,t-1)} - \psi_{0i} - \psi_{1i}\mathrm{BUF(it)} - \psi_{2i}\mathrm{LLP(it)} - \psi_{3i}\mathrm{SIZE(it)} - \psi_{4i}\mathrm{CYCLE(t)} \\ & - \psi_{5i}\mathrm{OIL(t)} - \psi_{6i}\mathrm{REG(it)}] + \psi_{11}\Delta\mathrm{BUF(it)} + \psi_{21}\Delta\mathrm{LLP(it)} + \psi_{31}\Delta\mathrm{SIZE(it)} \\ & + \psi_{41}\Delta\mathrm{CYCLE(t)} + \psi_{51}\Delta\mathrm{OIL(t)} + \psi_{61}\Delta\mathrm{REG(it)} + \omega(\mathrm{it})\end{aligned} \quad (6)$$

The parameters φ_i and τ_i represent the error-correcting speeds of adjustment to the long-run equilibrium for each bank i in the capital buffer and risk-taking equations, respectively. For the long-run equilibrium relationships to be valid, both parameters must take strictly negative values and be bounded within the unit circle, confirming mean reversion and cointegration (Haque, 2019; Lee & Lee, 2019; Maghyereh et al., 2022). The long-run slope coefficients are constrained to be homogeneous across banks under the PMG estimator, while short-run coefficients and error correction parameters are permitted to differ freely across i. As a robustness strategy, the two dependent variables BUF and RISK are subsequently replaced by the equity-to-assets ratio (EQUITY) and the standard deviation of return on assets (SD_ROA), respectively, measured using a six-period backward-looking rolling window.

Sample and Data

This empirical analysis utilizes an unbalanced panel dataset of 11 listed Nigerian commercial banks, observed semi-annually from the first half of 2012 to the second half of 2023. The year 2012 was specifically chosen as the starting point to align with the Central Bank of Nigeria's (CBN) phased implementation of Basel II and early Basel III prudential standards (Garcia & Ye, 2023; Killins & Mollick, 2020). The sample exclusively focuses on banks with national or international commercial licenses which collectively account for

approximately 88 percent of the Nigerian banking system's total assets as of December 2023 and intentionally excludes other types of financial institutions (such as microfinance or merchant banks) due to their fundamentally different capital structures and risk-taking incentives.

Data for this study were compiled from a variety of official sources. All bank-specific variables, including capital ratios, non-performing loans, and total assets, were hand-collected from audited annual reports, IFRS-compliant semi-annual financial statements, and mandatory disclosures required by the Nigerian Exchange Group (NGX). Additionally, regulatory data were sourced from CBN policy circulars and stability reports, while macroeconomic indicators were obtained from the National Bureau of Statistics (NBS) and CBN Statistical Bulletins.

Table 1. Variable Definitions, Measurement, And Expected Signs

Variable	Definition	Measurement	Sign in BUF	Sign in RISK	Source
BUF	Capital buffer	Total CAR minus CBN minimum requirement (%)	—	Negative	CBN / Bank reports
RISK	Credit risk / risk-taking	NPL/ otal gross loans (%)	Ambiguous	—	CBN / Bank reports
LTA	Loan intensity	Net loans/Total assets (%)	Negative	—	Bank reports
LLP	Loan loss provisions	LLP flow/Total gross loans (%)	—	Ambiguous	Bank reports
SIZE	Bank size	Ln(Total assets in ₦ billion)	Ambiguous	Negative	Bank reports
CYCLE	Non-oil business cycle	HP-filtered semi-annual non-oil real GDP growth	Negative	Positive	NBS / CBN
OIL	Oil revenue cycle	HP-filtered FGN oil revenues / GDP	Positive	Positive	NBS / CBN
REG	Regulatory pressure	Volatility-adjusted distance-to-minimum capital (5-yr rolling)	Positive	Negative / Ambiguous	CBN / Computed
EQUITY	Equity capital ratio (robustness)	Equity capital / Total assets (%)	—	—	Bank reports
SD_ROA	Return volatility (robustness)	6-period rolling std. dev. of pre-tax ROA (%)	—	—	Bank reports / Computed

Notes: CAR = Capital Adequacy Ratio. CBN = Central Bank of Nigeria. NBS = National Bureau of Statistics. FGN = Federal Government of Nigeria. HP = Hodrick-Prescott. All bank-level variables are computed from audited semi-annual financial statements. CYCLE and OIL are based on HP-filtered cyclical components. REG is constructed as described in Section Capital Buffer Equation.

Data Sources

To confirm the suitability of the Panel ARDL-PMG framework, the integration properties of all variables were first evaluated using four complementary unit root tests (LLC, IPS, Breitung, and Hadri LM), which successfully established that no variable exceeds an integration order of I(1). While bank size (SIZE) is strictly I(1) due to persistent nominal asset growth, the capital buffer (BUF) and non-performing loan (RISK) variables exhibit mixed I(0) and I(1) results driven by structural shocks from central bank recapitalization mandates and non-linear risk accumulation dynamics, respectively. Ultimately, this mixed but bounded integration order across all variables firmly satisfies the econometric preconditions and validates the use of the Panel ARDL-PMG estimation approach.

Table 2. Panel unit root test results

Variable	LLC Level	LLC 1st Diff	IPS Level	IPS 1st Diff	Breit. Level	Breit. 1st Diff	Hadri Level	Hadri 1st Diff
BUF	−4.18**	−7.23**	0.61	−4.52**	0.84	−7.31**	0.91	0.38**

RISK	−5.84**	−6.47**	−2.41**	−5.18**	1.62	−3.14**	0.68**	0.17**
SIZE	1.24	−3.09**	3.71	−7.14**	8.02	−5.83**	1.04	−0.31**
LLP	−3.14**	−8.42**	−4.88**	−9.03**	−6.11**	−7.28**	0.09**	−0.51**
LTA	−2.87**	−5.13**	−0.93	−7.88**	−0.61	−5.44**	0.81**	−0.19**
CYCLE	−16.72**	−13.98**	−2.71**	−4.36**	−6.04**	−5.21**	0.44**	0.28**
OIL	−14.33**	−12.61**	−3.18**	−5.02**	−5.88**	−4.97**	0.39**	0.22**
REG	−3.04**	−4.71**	−1.48*	−6.84**	0.79	—	0.47**	—

Notes: H_0: the variable follows a unit root process (except Hadri LM where H_0 is stationarity). *: H_0 rejected at 95% confidence. **: H_0 rejected at 99% confidence. All tests include intercept and time trend. IPS and Breitung are not computed for REG at first difference due to the indicator variable construction.

Table 3 presents the descriptive statistics and pairwise correlation matrix for the full estimation sample of eleven listed Nigerian commercial banks observed between H1:2012 and H2:2023. The average capital buffer (BUF) across the sample stands at 3.2 percent, with a median of 2.8 percent, suggesting that Nigerian listed banks maintain positive excess capital cushions on average (Adeola & Ikpesu, 2024). However, the minimum value of −2.7 percent indicates that certain banks fell below their applicable regulatory minimum in specific periods. The non-performing loan ratio (RISK) exhibits a mean of 8.6 percent and a median of 6.4 percent, with an elevated standard deviation of 6.8 percent reflecting the pronounced time-series variation in asset quality associated with Nigeria's oil price-driven economic cycles. The sample maximum of 38.4 percent captures the deterioration experienced by state-linked institutions during the trough of the 2016–2017 recession, when the collapse of crude oil prices triggered a systemic wave of credit deterioration (Igbinosa, Sunday, & Babatunde, 2022). The loan-to-assets ratio (LTA) averages 48.6 percent notably lower than comparable banking systems reflecting the significant share of Nigerian bank assets held in government securities.

Table 3. Descriptive statistics and pairwise correlation matrix

	BUF	RISK	SIZE	LLP	LTA	CYCLE	OIL	REG
Mean	0.032	0.086	15.783	0.031	0.486	0.000	0.000	0.018
Median	0.028	0.064	15.864	0.024	0.498	0.002	0.001	0.000
Std. Dev.	0.041	0.068	0.814	0.028	0.112	0.021	0.038	0.042
Min	−0.027	0.018	13.912	−0.008	0.198	−0.048	−0.091	0.000
Max	0.194	0.384	17.218	0.114	0.781	0.053	0.088	0.261
Correlation Matrix								
BUF	1							
RISK	−0.388	1						
SIZE	−0.314	0.287	1					
LLP	−0.441	0.418	0.196	1				
LTA	−0.138	0.174	−0.121	0.083	1			
CYCLE	0.021	−0.038	0.004	−0.051	−0.074	1		
OIL	0.047	−0.029	0.011	−0.038	−0.062	0.412	1	
REG	−0.436	0.514	0.163	0.228	0.071	−0.044	−0.031	1

Notes: The sample comprises eleven listed Nigerian commercial banks observed at semi-annual frequency from H1:2012 to H2:2023. CYCLE is HP-filtered non-oil real GDP growth. OIL is HP-filtered FGN oil revenues/GDP. Correlations significant at the 5% level are indicated in bold.

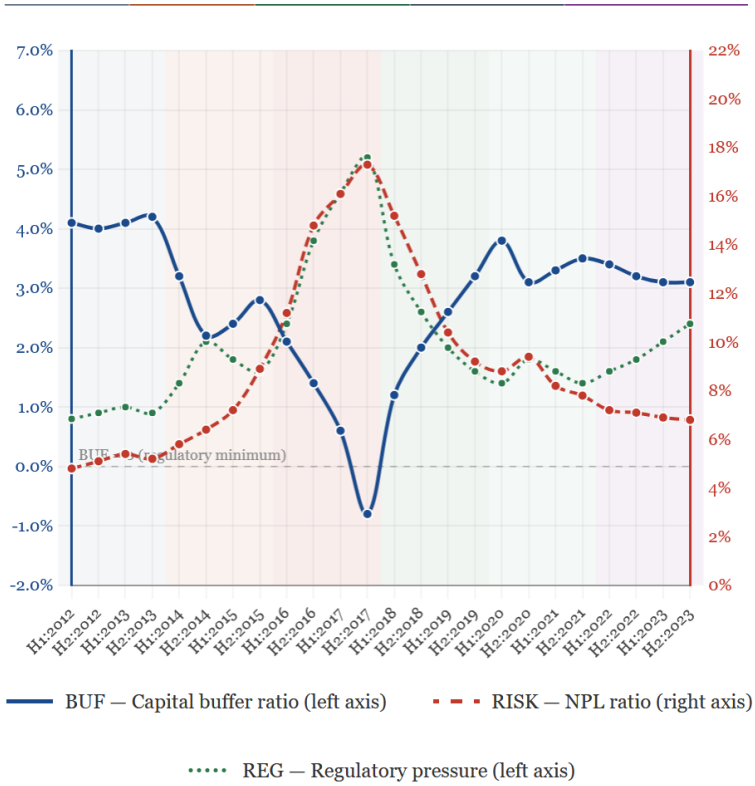

Figure 1. Co-Evolution Of Average Capital Buffers, Risk-Taking, And Regulatory Pressure Among Listed Nigerian Commercial Banks

Figure 1 traces the co-evolution of the average capital buffer ratio (BUF), the average non-performing loan ratio (RISK), and the average regulatory pressure indicator (REG) across the eleven sample banks from H1:2012 to H2:2023. The figure reveals several noteworthy patterns. Following the CBN's upward revision of the minimum capital adequacy ratio from 10 percent to 12.5 percent in 2014, average capital buffers experienced an initial compression. The subsequent oil price collapse that began in mid-2014 and accelerated through 2015–2016 triggered a pronounced simultaneous deterioration in both capital buffers and asset quality: average RISK climbed from approximately 4.8 percent in H1:2014 to a peak of 17.3 percent in H2:2017, while average BUF contracted sharply. The government's recapitalization support extended to two state-owned banks during 2017–2019, combined with an improvement in crude oil prices, facilitated a gradual recovery in average BUF to approximately 3.8 percent by H2:2020.

ESTIMATION RESULTS

Long-Run Determinants of Capital Buffers

The estimation results for the capital buffer equation primarily rely on the Panel ARDL-PMG model, with Fixed Effects, Random Effects, and Instrumental Variable (IV) estimators serving as robustness benchmarks. The model's error correction term confirms a stable long-run cointegrating relationship but reveals a notably slow adjustment speed (12.4 percent per semester, taking approximately four years to fully recover from a shock), which reflects the high capital adjustment costs within Nigeria's shallow domestic equity market. Internally, non-performing loans (RISK) exert a negative long-run impact that strongly validates the moral hazard hypothesis, as banks prefer to let their buffers erode rather than undertake costly capital rebuilding that restricts dividends. This aligns with the negative effect of the loan-to-assets ratio (LTA), indicating that banks elevate their buffers primarily through loan contraction (deleveraging) rather than equity issuance, while bank size (SIZE) uniquely shows a positive effect, supporting the charter value hypothesis where large banks maintain higher capital to signal strength to international counterparties.

External macroeconomic and regulatory factors also dictate capital accumulation strategies. The business cycle (CYCLE) exhibits a significant negative long-run impact, confirming the procyclical nature of Nigerian banks that have yet to internalize the countercyclical capital behaviors prescribed by the Basel III framework. Conversely, the study introduces a novel finding that the oil revenue cycle (OIL) positively influences

capital buffers; commodity booms enhance long-run buffer capacities through expanded fiscal and credit channels, whereas revenue contractions lead to buffer erosion. Finally, regulatory pressure (REG) demonstrates the largest and most highly significant positive impact, cementing its role as the single strongest long-run mechanism compelling vulnerable institutions to rebuild their capital cushions to avoid central bank sanctions.

Table 4. Long-Run Determinants of Capital Buffers

	(1) PMG	(2) Fixed Effects	(3) Random Effects	(4) IV
RISK	−0.2841**	−0.1724***	−0.1483***	−0.3012***
	(0.018)	(0.000)	(0.002)	(0.000)
LTA	−0.4138**	−0.2214***	−0.1887***	−0.3521**
	(0.009)	(0.000)	(0.000)	(0.004)
SIZE	0.0143*	−0.0311***	−0.0298***	−0.0284**
	(0.062)	(0.001)	(0.000)	(0.011)
CYCLE	−0.5174*	−0.1082	−0.0914	−0.1236
	(0.071)	(0.382)	(0.471)	(0.544)
OIL	0.3816**	0.0947	0.0831	0.1624*
	(0.042)	(0.318)	(0.402)	(0.087)
REG	3.1482***	−0.1874**	−0.2013**	0.3147**
	(0.007)	(0.018)	(0.011)	(0.009)
Intercept	—	0.6724***	0.7218***	0.8041***
		(0.000)	(0.000)	(0.000)
Err. Correction	−0.1238***	—	—	—
	(0.004)			
# Observations	242	242	242	220
R^2 Within/Overall	—	0.268	0.241	—
Hausman Statistic	—	24.38	—	—
Hansen-Sargan p	—	—	—	0.812
F-statistic	—	—	—	17.64

Notes: The dependent variable is the capital buffer ratio (BUF). The sample of eleven listed Nigerian commercial banks is observed at semi-annual frequency from H1:2012 to H2:2023. Hausman statistic tests fixed vs. random effects consistency. Hansen-Sargan p-value tests over-identifying restrictions. F-statistic tests joint instrument relevance. P-values in parentheses. ***: significant at 1%. **: significant at 5%. *: significant at 10%.

Long-Run Determinants of Risk-Taking

Table 5 reveals that Nigerian banks adjust their risk-taking behavior (non-performing loans) approximately 2.5 times faster than their capital buffers, indicating that asset quality responds much more fluidly to fundamental changes than capital structure decisions. In the long run, higher capital buffers (BUF) significantly reduce risk, providing empirical support for the market discipline and shareholder alignment hypotheses. Similarly, larger bank size (SIZE) effectively lowers non-performing loans due to superior credit risk management and long-term diversification benefits. Notably, these crucial risk-reducing dynamics are exclusively detected by the PMG estimator, proving that they unfold primarily over the long term.

External macroeconomic and regulatory factors actively drive risk accumulation. Both the business cycle (CYCLE) and oil revenue booms (OIL) exert a positive impact on risk-taking, demonstrating a "compound procyclicality" where banks overextend credit to marginal borrowers during economic and commodity

upswings, which later defaults during contractions. Most strikingly, regulatory pressure (REG) robustly increases non-performing loans across all estimation methods. This indicates that banks facing strict capital scrutiny do not de-risk; instead, they engage in "gambling-for-resurrection" and moral hazard behaviors by taking on riskier loans, a finding that carries significant macro-prudential policy implications.

Table 5. Long-Run Determinants of Risk-Taking

	(5) PMG	**(6) Fixed Effects**	**(7) Random Effects**	**(8) IV**
BUF	−0.3138**	−0.2014	−0.1876	0.2241
	(0.024)	(0.188)	(0.213)	(0.374)
LLP	0.0841	1.7214**	1.9438**	2.8812
	(0.881)	(0.038)	(0.019)	(0.141)
SIZE	−0.0314***	−0.0198	−0.0147	0.0118
	(0.000)	(0.284)	(0.411)	(0.628)
CYCLE	0.2184**	0.1748	0.1812	0.1374
	(0.011)	(0.418)	(0.404)	(0.512)
OIL	0.3124**	0.1038	0.0972	0.1481
	(0.033)	(0.341)	(0.388)	(0.274)
REG	0.8441***	0.7824***	0.8017***	0.8613***
	(0.000)	(0.000)	(0.000)	(0.000)
Intercept	—	0.4418	0.3587	−0.0614
		(0.118)	(0.197)	(0.884)
Err. Correction	−0.3141***	—	—	—
	(0.000)			
# Observations	220	242	242	220
R^2 Within/Overall	—	0.2614	0.3418	—
Hausman Statistic	—	21.47	—	—
Hansen-Sargan p	—	—	—	0.341
F-statistic	—	—	—	58.74

Notes: The dependent variable is the non-performing loan ratio (RISK). P-values in parentheses. ***: 1%. **: 5%. *: 10%.

Additional Estimations: Robustness Checks

To further validate the baseline results, two sets of robustness estimations are conducted. Table 6 presents results for the capital buffer equation when the equity-to-total-assets ratio (EQUITY) replaces BUF as the dependent variable, thereby eliminating the risk-weight denominator. The error correction term in Column (9) is negative and significant (−0.287), confirming cointegration. The RISK coefficient is statistically insignificant in the long run under the PMG estimator, suggesting that the significant negative relationship between RISK and BUF documented in Table 4 is predominantly driven by the risk-weight channel rising non-performing loans increased risk-weighted assets without a commensurate increase in regulatory capital, mechanically compressing the capital buffer ratio without reducing the book value of equity. The LTA coefficient becomes positive and significant under EQUITY (0.072), in sharp contrast to its negative sign in Table 4 revealing that expanding loan portfolios supports Nigerian bank equity capital accumulation through enhanced interest income and retained earnings, even as it simultaneously inflates risk-weighted assets.

Table 5. Robustness Checks

	(9) PMG	(10) Fixed Effects	(11) Random Effects	(12) IV
RISK	0.0614	−0.0847***	−0.0821***	−0.1714***
	(0.448)	(0.004)	(0.003)	(0.001)
LTA	0.0718**	−0.0241	−0.0208	−0.0784
	(0.031)	(0.418)	(0.481)	(0.108)
SIZE	0.0024	0.0071	0.0062	0.0114
	(0.698)	(0.214)	(0.274)	(0.118)
CYCLE	0.1984***	−0.0348	−0.0327	−0.0741
	(0.000)	(0.641)	(0.658)	(0.371)
OIL	0.2471***	0.0814	0.0762	0.1038
	(0.000)	(0.291)	(0.318)	(0.164)
REG	0.4218**	−0.1724***	−0.1681***	0.0714
	(0.028)	(0.000)	(0.000)	(0.341)
Err. Correction	−0.2871***	—	—	—
	(0.000)			
Observations	220	242	242	198
R^2 Within/Overall	—	0.194	0.181	—
Hansen-Sargan p	—	—	—	0.284
F-statistic	—	—	—	31.74

Notes: The dependent variable is the equity-to-total-assets ratio (EQUITY). P-values in parentheses. ***: 1%. **: 5%. *: 10%.

Table 7 reports the robustness estimation in which the standard deviation of return on assets (SD_ROA), measured using a six-period backward-looking rolling window, replaces the non-performing loan ratio as the dependent variable. The error correction term (−0.2418) is negative and significant, confirming a long-run equilibrium relationship between earnings volatility and its determinants. The BUF coefficient is negative and significant (−0.0194), consistent with the baseline RISK equation and reinforcing the conclusion that capital buffers exert a genuine long-run stabilizing influence on Nigerian bank risk profiles. The LLP coefficient is positive and significant in the long run (0.5124) consistent with Rajan's (1994) theoretical argument that banks use elevated provisioning as cover for investing in risky projects that inflate current earnings while creating latent future volatility. Notably, the OIL coefficient is negative and significant (−0.0081) for SD_ROA, contrasting with its positive sign for RISK in Table 5. This divergence reveals a time-layered vulnerability: oil booms stabilize short-run earnings volatility while building latent credit risk that crystalizes in subsequent downturns. The REG coefficient is positive and significant across all four estimation methods (0.2017), confirming that regulatory pressure drives higher earnings volatility in addition to higher non-performing loan accumulation.

Table 7. Long-run determinants of return on assets volatility

	(13) PMG	(14) Fixed Effects	(15) Random Effects	(16) IV
BUF	−0.0194***	−0.0091	−0.0074	−0.0081
	(0.004)	(0.218)	(0.281)	(0.571)
LLP	0.5124***	0.1284***	0.1271***	0.0841

	(0.000)	(0.001)	(0.002)	(0.442)
SIZE	0.0002	0.0011	0.0007	0.0002
	(0.811)	(0.268)	(0.321)	(0.918)
CYCLE	−0.0074*	−0.0058	−0.0054	0.0024
	(0.058)	(0.584)	(0.601)	(0.838)
OIL	−0.0081**	−0.0034	−0.0028	0.0018
	(0.041)	(0.471)	(0.512)	(0.781)
REG	0.2017***	0.0418***	0.0401***	0.0474***
	(0.000)	(0.000)	(0.000)	(0.000)
Err. Correction	−0.2418***	—	—	—
	(0.002)			
Observations	220	242	242	198
R^2 Within/Overall	—	0.341	0.318	—
Hansen-Sargan p	—	—	—	0.514
F-statistic	—	—	—	6.84

Notes: The dependent variable is the six-period rolling standard deviation of pre-tax return on assets (SD_ROA). P-values in parentheses. ***: 1%. **: 5%. *: 10%.

Synthesis of Findings

The empirical results presented in this section collectively yield a coherent and policy-relevant portrait of the long-run capital and risk-taking dynamics of listed Nigerian commercial banks. Table 8 provides a concise summary of the principal findings across the four estimated equations.

Table 8. Summary of Principal Long Run Findings

Variable	Effect on BUF	Effect on RISK	Effect on EQUITY	Effect on SD_ROA	Interpretation
RISK	Negative ✓	—	Not significant	—	Moral hazard: rising NPLs erode capital buffers through risk-weight channel
BUF	—	Negative ✓	—	Negative ✓	Capital discipline: higher buffers reduce long-run risk and earnings volatility
LTA	Negative ✓	—	Positive ✓	—	Deleveraging for buffer; lending sustains equity via earnings channel
LLP	—	Not significant	—	Positive ✓	Rajan effect: provisioning signals future earnings risk volatility
SIZE	Positive ✓	Negative ✓	Not sig.	Not sig.	Charter value (BUF); diversification benefits (RISK)
CYCLE	Negative ✓	Positive ✓	Positive ✓	Negative ✓	Compound procyclicality: buffers decline as credit risk builds in expansions
OIL	Positive ✓	Positive ✓	Positive ✓	Negative ✓	Oil booms support capital via earnings but build latent long-run credit risk

REG	Positive ✓	Positive ✓	Positive ✓	Positive ✓	Dual effect: rebuilds capital (discipline) but triggers moral hazard risk-taking

Notes: ✓ indicates statistical significance at least at the 10% level under the PMG estimator. Directional signs and significance levels are based on Tables 4, 5, 6, and 7 respectively.

Three overarching findings emerge from the synthesis. First, capital requirements operate as an effective prudential instrument in the Nigerian banking system through the capital discipline channel higher capital buffers significantly and robustly reduce risk-taking and earnings volatility in the long run but simultaneously generate moral hazard through the regulatory pressure channel, whereby undercapitalized banks respond to proximity-to-minimum capital conditions by increasing rather than reducing risk exposure. Second, the Nigerian banking system exhibits compound procyclicality driven by both the general non-oil business cycle and the oil revenue cycle, creating layered systemic vulnerabilities that are not captured by single-cycle models employed in earlier Nigerian banking studies. Third, the adjustment of capital buffers in Nigeria occurs primarily through the balance sheet liability side specifically through lending contraction and risk-weight compression rather than through equity issuance, revealing a structural dependence on the deleveraging channel that has potentially adverse consequences for private sector credit availability during regulatory tightening episodes.

LIMITATIONS AND FURTHER RESEARCH AGENDA

This study is subject to several limitations that future research should address. First, the sample is restricted to listed Nigerian commercial banks, which collectively represent the large-capitalized tier of the Nigerian banking system. The dynamics of capital buffer and risk-taking adjustment among unlisted banks which serve significant segments of the micro, small, and medium enterprise credit market may differ importantly from the patterns documented here. Second, the study does not explicitly model the simultaneous long-run relationship between capital buffers and risk-taking, treating the two equations as separate long-run specifications in order to focus on the equilibrium determinants of each variable independently. Future work employing a long-run simultaneous panel cointegration framework such as the panel Vector Error Correction Model could enrich the understanding of bidirectional long-run causality between capital and risk in the Nigerian banking system. Third, the sample period ends in H2:2023, prior to the full implementation of the CBN's 2024 recapitalization mandate. As the transition period unfolds, the real-time capital and risk dynamics of Nigerian banks will provide a uniquely rich natural experimental setting for evaluating the behavioral and systemic stability consequences of major capital threshold revisions in a resource-dependent emerging market economy a question that future research should actively pursue.

CONCLUSION AND POLICY IMPLICATIONS

This study leverages the Panel ARDL-PMG framework to uncover the long-run dynamics between capital buffers, risk-taking, and macroeconomic pressures in the Nigerian banking system from 2012 to 2023. It reveals that banks adjust their capital buffers very slowly taking about four years to fully recover from a shock due to the structural rigidities of a shallow domestic equity market that forces reliance on retained earnings. Consequently, rising non-performing loans erode capital buffers rather than prompting proactive recapitalization, confirming the moral hazard hypothesis. Furthermore, when banks are forced to rebuild capital, they primarily do so through deleveraging (contracting their loan portfolios) rather than issuing new equity. This strategy carries severe negative externalities, as regulatory-induced capital rebuilding simultaneously chokes off credit supply to the real economy, potentially amplifying economic downturns.

A central and highly original finding is the "compound procyclicality" unique to Nigeria's resource-dependent economy, driven jointly by non-oil business cycles and volatile oil revenues. While economic expansions and oil booms temporarily boost capital positions, they simultaneously mask latent credit risks that inevitably crystallize as bad loans during commodity price reversals. Crucially, the study exposes regulatory capital requirements as a double-edged sword. While maintaining high capital buffers successfully aligns shareholder interests and reduces long-term risk, imposing strict regulatory pressure on already undercapitalized banks triggers a perverse reaction. Instead of conservatively de-risking, these vulnerable

institutions engage in gambling-for-resurrection behavior, pursuing riskier lending strategies that ultimately increase earnings instability and systemic fragility.

Actionable Policy Recommendations for Nigerian Banking Regulators

Enhanced Supervision During Recapitalization: To prevent the risky gambling-for-resurrection behavior identified in undercapitalized banks, the CBN's 2024 recapitalization directive must be paired with strict oversight. This includes dividend restrictions, mandatory capital planning, and specialized stress testing for banks with low capital buffers. Customized Countercyclical Capital Buffers (CCyB): Standard CCyB frameworks are inadequate for Nigeria's unique economy. The CBN must develop a tailored CCyB activation rule that accounts for the country's dual procyclicality simultaneously factoring in both the non-oil output gap and deviations in the oil revenue cycle.

Domestic Equity Market Reforms: Because banks currently rely on restricting credit (deleveraging) rather than issuing shares to rebuild capital, structural reforms are urgently needed. The CBN, SEC, and NGX should collaborate to deepen secondary market liquidity and reduce the costs of raising equity, making it a viable alternative to cutting off credit to the real economy. Business Model Diversification: To insulate themselves from commodity-driven shocks, Nigerian banks must transition away from heavy reliance on oil-sector lending and government credit. Diversifying revenue streams toward fee-based, advisory, and transaction-banking services will stabilize their asset quality and capital buffers across the full economic cycle.

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