UNPACKING THE IMPACT OF BANK-SPECIFIC FACTOR INTERACTIONS ON CAPITAL STRUCTURE

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Abstract

This study examines the joint effects of competition, efficiency, and stability on the capital asset ratio (CAR) of African commercial banks using a composite institutional measure—competition, efficiency, and stability index (CESINDEX). The analysis is based on an unbalanced panel of 792 bank-year observations from 66 commercial banks across 12 African countries. Panel estimation techniques are employed to account for heterogeneity and endogeneity. The findings indicate that CESINDEX has a positive and statistically significant effect on CAR, suggesting that stronger institutional conditions are associated with higher bank capitalization. Among the competition, efficiency, and stability components, financial stability, proxied by the Z-score, exhibits the strongest positive association with CAR, while technical efficiency and profitability display negative relationships with capital ratios. Overall, the results demonstrate that capital structure decisions in African banks are shaped by the joint interaction of competition, efficiency, and stability rather than isolated institutional effects. The study contributes to the banking and capital structure literature by providing integrated evidence from institutionally diverse and financially constrained African economies.

Keywords: Competition, Efficiency, Stability, CESINDEX

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1. INTRODUCTION

The African banking sector plays a pivotal role in financial intermediation, economic growth, and systemic stability by mobilizing savings, allocating credit, and supporting investment across diverse economic sectors (Badev et al., 2025). Strong banks facilitate efficient resource distribution and underpin broader economic development, particularly where capital markets remain underdeveloped and financial inclusion remains constrained (Martins, 2024). Recent research highlights that institutional quality, regulatory practices, and bank efficiency significantly influence banking stability and economic outcomes in African contexts, reinforcing the sector's foundational economic role (Demirgüç-Kunt et al., 2023).

Capital structure decisions are central to banks' financial health, resilience, and risk-bearing capacity, as they determine how banks balance equity and debt in financing operations and absorb losses (Le & Pham, 2021). In emerging markets, such as Africa, optimal capital composition directly affects regulatory compliance, lending capacity, and risk management, with regulatory frameworks like Basel III shaping banks' leverage choices (Akwaa-Sekyi, 2020). Competition, efficiency, and stability are not isolated phenomena but interact in shaping banks' capital strategies (Ciola et al., 2023). Competitive forces can stimulate operational innovation and efficiency but may also compress margins and incentivize risk-taking (Andrieş et al., 2022). Similarly, efficiency enhances profitability and internal capital generation, while stability buffers banks against shocks, reinforcing capital buffers (Dahal & Dhungana, 2025).

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This study investigates the joint influence of competition, efficiency, and stability on capital structure decisions in African banks through a CESINDEX. The research explores interaction effects among these dimensions and their impact on banks' capital asset ratios (CARs) across heterogeneous African contexts. The examination of these complex interactions provides a nuanced understanding of the factors driving capital structure decisions in African banks.

This study advances theory and generates empirical insights that inform prudential regulation and capital planning in African banking systems. The findings offer practical guidance for policymakers and regulators seeking to strengthen financial resilience and promote competitive and efficient banking markets in emerging economies.

The remainder of the paper is organized as follows. Section 2 reviews the theoretical and empirical literature. Section 3 outlines the data and methodology. Section 4 presents and discusses the empirical results. Section 5 concludes with policy implications and directions for future research.

2. LITERATURE REVIEW

The Modigliani and Miller's (1958) theory posits that a firm's value is unaffected by its capital structure under the assumptions of perfect markets, no taxes, and no transaction costs. While foundational, this framework is largely theoretical and lacks practical relevance, especially in complex, real-world settings like African banking systems. Its rigid assumptions overlook critical firm- and market-level dynamics—such as competition, efficiency, and financial stability—that have been shown to influence capital structure choices (Keshavamurthy et al., 2026). These omissions are particularly limiting in emerging markets, where institutional imperfections and systemic volatility are pronounced. As Myers (1984) highlights, there is a need for more context-sensitive models that reflect the realities of firm behavior and market conditions. In African banking environments, where strategic capital decisions are shaped by the interplay of regulatory pressures, operational efficiency, and competitive intensity, the Modigliani-Miller framework proves insufficient. This study responds to that gap by adopting a more integrated approach, capturing the joint effects of these institutional variables on capital structure.

The pecking order theory by Myers and Majluf (1984) provides a valuable framework for understanding banks' preference for internal financing over external sources, especially under conditions of information asymmetry and high financing costs. Its relevance is notable in African banking contexts, where weak disclosure standards, regulatory inconsistencies, and underdeveloped financial markets can exacerbate asymmetries, making internal capital the most accessible and least costly option. This aligns well with the studies' findings that profitable and efficient banks tend to hold lower capital, relying more on internally generated funds. However, the theory's focus on financing hierarchy overlooks the institutional and structural complexities that shape capital structure in dynamic markets (Okyere et al., 2026). It does not fully account for how broader factors—like market competition, operational efficiency, and financial stability—interact to influence capital decisions. In this sense, while the theory offers a useful foundation, it lacks the integrative perspective necessary to capture the joint effects explored in this study through CESINDEX. Therefore, its explanatory power is limited when applied in isolation, underscoring the need for more comprehensive frameworks that consider institutional interplay in shaping capital structure in African banking systems.

Agency theory by Jensen and Meckling (1976) provides a strong foundation for understanding how capital structure can be strategically used to manage internal governance issues, particularly by using debt to curb managerial discretion and align interests with shareholders. This makes the theory relevant for examining how internal operational factors like efficiency interact with financial decisions. Its focus on agency costs is especially pertinent in African banking systems, where ownership structures, governance weaknesses, and transparency issues often intensify principal-agent problems (Amin et al., 2022). However, while agency theory offers valuable internal insight, it falls short in capturing how external institutional forces—such as competition intensity, regulatory environments, and systemic stability—affect managerial behavior and capital decisions. By assuming that managers

are primarily self-interested and by ignoring environmental contingencies, the theory lacks the nuance needed to address the broader institutional dynamics examined in this study. Thus, while agency theory enriches the understanding of internal decision-making mechanisms, it must be complemented by integrative approaches like the CESINDEX to fully reflect how competition, efficiency, and stability jointly influence capital structure in African banks.

Despite growing interest in the roles of competition, efficiency, and financial stability in shaping capital structure in emerging markets, existing literature remains fragmented, with most studies treating these institutional factors in isolation. For example, some studies examine competition, while others focus on stability or emphasize efficiency—yet none explore how these variables interact to influence capital decisions (Kismawadi, 2025; Liang et al., 2025; Thaker et al., 2022). Similarly, other research includes multiple institutional variables but models them independently, missing potential nonlinearities or synergistic effects (Asif et al., 2023). This study addresses that gap by introducing a composite metric capturing the joint dynamics of competition, efficiency, and stability, and testing for their interactive and threshold effects on capital structure in African banks. This approach offers a more holistic, system-based understanding of financing behavior in contexts shaped by institutional complexity.

Recent studies on capital structure increasingly employ diverse methodologies, but many suffer from methodological flaws that undermine their validity. Some studies apply cross-sectional regression to panel data without accounting for unobserved heterogeneity, leading to bias (Al-Azzam, 2026). Others use both qualitative and quantitative methods but fail to integrate their findings, resulting in fragmented insights (Liu, 2022). Some research relies on ordinary least squares (OLS) despite clear endogeneity between leverage and performance, omitting instrumental variables or two-stage least squares and weakening causal inference (Kyambade et al., 2026). In response, this study adopts a rigorous framework that integrates panel techniques, addresses endogeneity, and provides context-specific analysis suited to the complexities of African banking data.

The growing literature on capital structure has improved understanding of its drivers and outcomes, yet many recent studies suffer from hypothesis misalignment—where propositions lack strong theoretical grounding or contradict existing evidence. Some studies claim leverage boosts innovation but ignore how debt can heighten financial risk, conflicting with established theories. Others dismiss capital structure's impact on firm performance in emerging markets, despite substantial contrary evidence. Some assume a linear link between competition, efficiency, stability, and capital structure, overlooking the potential nonlinear dynamics of the interactions among these variables.

3. METHODOLOGY

This study adopts a positivist paradigm. This approach assumes an objective and measurable economic reality and supports theory-driven hypothesis testing using observable data (Mehra, 2025). It employs bank-level panel data obtained from the IRES database to ensure replicability, cross-country comparability, and generalisability within Africa's institutionally fragmented banking systems. Panel data methods integrate cross-sectional and time-series variation, enabling control for unobserved heterogeneity, dynamic effects, and institutional asymmetries, while supporting mediation, interaction, nonlinearity, and causal analysis (Mili et al., 2025). The population comprises African commercial banks, from which a stratified sample of 66 banks across twelve countries is selected based on regional affiliation and bank size to reduce sampling bias and enhance internal and external validity. Capital structure is proxied by the CAR (Julianto & Arie, 2025)

Competition is proxied by the Lerner index, calculated as a ratio of price minus markup, all divided by price (Subedi et al., 2026). Its use improves the study's methodological precision and supports deeper analysis of how competition affects capital structure decisions.

The Lerner index is calculated using the following formula:

$$Lerner\ index_{it} = \frac{Price_{it} - Marginal\ cost_{it}}{Price_{it}} \quad (1)$$

This formula measures a firm's market power by calculating the difference between the price it sets and its marginal cost, relative to the price. A higher Lerner index value indicates greater market power and potential for supernormal profits (Tien, 2025).

Technical efficiency is computed by input- and output-oriented constant-returns-to-scale using data envelopment analysis (DEA). An input-oriented model under constant returns to scale is applied, using deposits, labour costs, and interest expenses as inputs; outputs include loans, assets, and non-interest income (Hakuduwal & Nayabhari, 2025). DEA's linear programming foundation also enables robust cross-country comparability, reinforcing the efficiency dimension within the CESINDEX framework.

- Input-oriented DEA model: minimize θ, subject to $\theta x_0 - X\lambda \geq 0$, $Y\lambda \geq y_0$, and $\lambda \geq 0$.
- Output-oriented DEA model: maximize φ, subject to $x_0 - X\lambda \geq 0$, $\varphi y_0 - Y\lambda \leq 0$, and $\lambda \geq 0$, where, θ (or φ) is the efficiency score and they range from 0–1, x_0 and y_0 are the input and output vectors for the decision-making unit (DMU) being evaluated, X and Y are the input and output matrices for all DMUs, and λ is a vector of weights.

Stability is measured by the Z-score capturing insolvency risk (Sattar et al., 2025). It is calculated as follows:

$$Z - score_{it} = \frac{X_{it} - u_{it}}{\sigma_{it}} \quad (2)$$

where, X is the individual return on assets (ROA), u_{it} is the population ROA mean, and σ is the population standard deviation. This formula calculates the number of standard deviations an observation (X) is away from the mean (u_{it}).

This study includes key control variables to isolate the effects of competition, efficiency, and

stability on capital structure. ROA, defined as profit after tax relative to total assets, captures bank-level operational and managerial efficiency, reflecting earnings generation and asset productivity (Akter, 2025). ROA is normalized using min-max scaling and categorized as low (< 1%), moderate (1–2%), or high (> 2%) (World Bank, 2022) to ensure comparability across heterogeneous banks. Inflation, measured by the annual consumer price index (CPI), accounts for macroeconomic price pressures affecting bank costs, loan performance, and capital buffers (Munir et al., 2025). The CPI is classified as low (< 5%), moderate (5–10%), or high (> 10%) (World Bank, 2022). Gross domestic product (GDP) growth serves as an economic activity control, capturing effects on credit demand, borrower capacity, and profitability (Magaji & Musa, 2023). The thresholds are set at low (< 3%), moderate (3–6%), and high (> 6%) (World Bank, 2022). Together, these controls improve model precision by accounting for firm- and macro-level factors influencing capital structure in African banking systems.

This study implements a comprehensive suite of data diagnostics and econometric tests to ensure robustness, reliability, and validity in analyzing the effects of competition, efficiency, and stability on African banks' capital structure. Data preparation involved min–max normalization to standardize scales and compress outliers within ±2 standard deviations, preserving representativeness while limiting estimation bias (Saunders et al., 2023). Data properties were evaluated via Jarque-Bera tests for residual normality, panel unit root tests (Levin-Lin-Chu [LLC], Im-Pesaran-Shin [IPS], augmented Dickey-Fuller [ADF], Phillips-Perron [PP], Pesaran's cross-sectionally augmented Dickey-Fuller [CADF], cross-sectionally augmented IPS [CIPS], panel analysis of nonstationarity in idiosyncratic and common components [PANIC]) for stationarity, and cross-sectional dependence diagnostics (Pesaran cross-sectional dependence [CD], Breusch-Pagan Lagrange multiplier [LM], Frees', Friedman) to account for common shocks and latent correlations (Baltagi, 2021). Relationship and assumption tests included Pearson correlation matrices to detect multicollinearity, Kao panel cointegration tests to identify long-run equilibria, and two-step system generalized method of moments (GMM) with internal lagged instruments to address endogeneity, dynamic feedback, and measurement error (Bascle, 2008). Heteroscedasticity and serial correlation were assessed using Breusch-Pagan, White, and Arellano-Bond AR(2) tests, with robust standard errors applied to mitigate variance inconsistencies and autocorrelation, ensuring efficient and unbiased parameter estimation (Gujarati, 2015).

This study examines the impact of institutional interactions on bank capital structure in Africa through the CESINDEX, a composite measure of competition, efficiency, and stability, grounded in trade-off and pecking order theories. CESINDEX captures systemic institutional dynamics, where high values signal strong governance, operational effectiveness, and financial resilience, reducing distress risk and potentially supporting higher leverage, while low values reflect weak institutions, encouraging reliance on internal financing. A two-tailed hypothesis framework is adopted, reflecting theoretical ambiguity: competition, efficiency, and stability can either increase or decrease the CAR, depending on bank behaviour, internal financing, and macroeconomic context, while ROA, inflation, and GDP growth act as controls influencing leverage through profitability, cost of funds, and credit demand. CESINDEX is modeled in both linear and quadratic forms to detect nonlinear and threshold effects. Empirical analysis is conducted using EViews 12, which integrates fixed effect (FE) and random effects (RE), least squares dummy variable, generalized least squares (GLS), and two-step system GMM estimators, providing robust treatment of endogeneity, dynamic feedback, and unobserved heterogeneity.

The general form of the RE/FE model is specified following the methodology by Baltagi (2021), which provides a comprehensive framework for panel data analysis that accounts for unobserved heterogeneity across cross-sectional units:

$$Y_{it} = \beta_0 + \beta_k X_{it} + \mu_i + \varepsilon_{it} \tag{3}$$

where,

- Y_{it} is the dependent variable for bank i at time t;
- β_0 is the intercept or constant term;
- X_{it} is a vector of independent variables for bank i at time t;
- β_k is a vector of coefficients for the independent variables where k ranges from 1 to infinity;
- μ_i is the individual-specific effect (time-invariant) for bank i;
- ε_{it} is the error term for bank i at time t.

This study modifies the FE/RE equation to examine the impact of CESINDEX on capital structure decisions.

$$CAR_{it} = \beta_1 + \beta_2 LERNER\ INDEX_{it} + \beta_3 TEFF_{it} + \beta_4 ZSCORE_{it} + \beta_5 CESINDEX_{it} + \beta_6 CESINDEXSQ_{it} + \beta_7 ROA_{it} + \beta_8 INFL_{it} + \beta_9 GDP_{it} + \varepsilon_{it} \tag{4}$$

The study assessed the influence of CESINDEX on bank capital structure using panel data techniques. FE and RE models were applied, with Hausman tests guiding selection to control for unobserved heterogeneity. To address endogeneity, simultaneity, and dynamic persistence in CAR, a two-step system GMM was employed with lagged instruments in levels and differences, validated via Hansen J-tests and AR(1)/AR(2) diagnostics. Statistical significance of CESINDEX, its components, ROA, inflation, and GDP, was assessed using t-values and p-values, with consistency across models confirming robustness. Dynamic GMM accounted for temporal dependence and potential reverse causality, while model diagnostics ensured instrument validity, coefficient reliability, and unbiased estimation, producing consistent and policy-relevant insights into the institutional determinants of African banks' capital structure. The general form of the equation is specified as follows:

$$Y_{it} = \beta_0 + \beta_1 Y_{i,t-1} + \beta_2 X_{it} + U_{it} \tag{5}$$

where, Y is the dependent variable, $\beta_0$is the intercept term, β_1 is the vector of the coefficients of the lagged dependent variable, β_2 is the vector of the coefficients of the explanatory variables, $Y_{i,t-1}$ is a vector of the lagged dependent variables, X_{it} is a vector of independent variables, and U_{it} are the error term consisting of the unobserved individual-specific effect U_{it} and the idiosyncratic error v_{it}. To explore robustness tests, the study specifies the equation as follows:

$$CAR_{it} = \beta_0 + \beta_1 CAR_{i,t-1} + \beta_2 CAR_{i,t-2} + \beta_3 LERNER\ INDEX_{it} + \beta_4 TEFF_{it} + \beta_5 ZSCORE_{it} + \beta_6 CESINDEX_{it} + \beta_7 CESINDEXSQ_{it} + \beta_8 ROA_{it} + \beta_9 INFL_{it} + \beta_{10} GDP_{it} + U_{it} \quad (6)$$

where, β_0 denotes the intercept; β_1 and β_2 capture short- and long-run autoregressive effects on the CAR, reflecting adjustment persistence; β_3 measures bank market power via the Lerner index, consistent with competition-capital structure theory. β_4 and β_5 capture technical efficiency and stability (Z-score) effects, respectively; β_6 estimates linear institutional interactions through CESINDEX, while β_7 models nonlinear threshold effects via competition, efficiency, stability index squared (CESINDEXSQ); β_8 reflects profitability's influence, grounded in pecking order and trade-off theories; β_9 and β_{10} quantify inflation and GDP growth's macroeconomic impacts; U_{it} accounts for unobserved heterogeneity. This model integrates dynamic, institutional, firm-level, and macroeconomic factors shaping African bank capitalisation.

4. RESULTS AND DISCUSSION

A descriptive analysis (see Table A.1 in Appendix) of African banks reveals substantial heterogeneity across key financial and institutional variables, with implications for robust estimation methods. The *CAR* averages 0.219 and exhibits right-skewness (0.378) with a wide range (0.070–1.000), while the *LERNER INDEX* shows left-skewness (-0.457) and high kurtosis (3.290), indicating both competitive concentration and potential outliers. Technical efficiency (*TEFF*) is negatively skewed (-0.503) with leptokurtosis (3.053), suggesting most banks operate efficiently, but a few underperform. The Z-score's (*ZSCORE*) near-symmetric distribution (skewness 0.102, kurtosis 2.581) indicates more stable financial resilience, whereas *CESINDEX* and its squared term (*CESINDEXSQ*) show right-skewness (0.414 and 0.482) and moderate kurtosis, highlighting nonlinear institutional effects. *ROA* is right-skewed (0.386) with high leptokurtosis (3.485), reflecting occasional exceptional profitability amid frequent low or negative returns. Inflation exhibits (*INFLATION*) slight right-skewness (0.289) with episodic shocks, while *GDP* is left-skewed (-0.429) and platykurtic (2.845), reflecting stable expansion. The distributions' skewness and kurtosis, combined with extreme values and outliers, necessitate robust estimation approaches such as quantile regression and dynamic panel techniques, including Two-step system GMM, FE, and RE models, to ensure consistent, unbiased inference across heterogeneous African banking systems (Baltagi, 2021).

The data cleaning and preparation (Table A.2) identified outliers across most variables, which were normalized using min-max scaling to mitigate extreme-value influence, while *TEFF* remained untransformed due to its bounded nature. Normality assessment (Table A.3) via the Jarque-Bera test (p = 0.742) confirmed residual normality, supporting regression assumptions and reliable inference. Unit root tests (Tables A.4 and A.5) show all variables are stationary at level (I(0)), justifying the use of FE, RE, and two-step system GMM estimators without differencing, minimizing spurious regression risk. Cross-sectional dependency tests (Table A.6) indicate no significant residual dependence, affirming estimator validity under independence assumptions. Multicollinearity checks (Table A.7) reveal acceptable Pearson correlations below 0.8, while Kao residual cointegration (Table A.8a) and ADF residual stationarity tests (Table A.8b) confirm long-run equilibrium among panel variables. Homoscedasticity is supported by Breusch-Pagan (p = 0.615) and White's (p = 0.253) tests (Table A.9), while Arellano-Bond AR(2) results (p = 0.231; Table A.10) indicate no second-order autocorrelation, validating GMM moment conditions. Finally, the Hansen J-test (p = 0.518; Table A.11) confirms instrument exogeneity.

The Hausman test yielded a p-value of 0. The results decisively reject the null hypothesis of RE and indicate that the FE model is more appropriate. This outcome suggests that individual bank-specific characteristics are correlated with the explanatory variables, and therefore, the FE approach provides more consistent, unbiased, and reliable estimates for analysing the determinants of capital structure in African banks.

Table 1. Presentation of Hausman test results-impact of *CESINDEX* on *CAR*

Test summary	*Chi² statistic*	*Chi² df*	*Prob.*
Cross-section random	51.834	8	0.000

Source: Authors' elaboration.

The intercept term, as shown in Table 2, has a coefficient of -0.335 (p = 0.049), is statistically significant but lacks economic meaning, representing *CAR* when all predictors are zero. The *LERNER INDEX* exhibits a weak but significant negative effect on *CAR* (-0.052; p = 0.094), reflecting how intensified competition compresses interest margins, limits internal capital generation, and incentivizes riskier lending strategies, ultimately reducing banks' equity buffers (Kanoujiya et al., 2023). Competition similarly erodes Tier 1 capital, undermining shock absorption and systemic stability, as banks prioritize market share through aggressive growth, operational efficiency, and cost-cutting measures while potentially weakening internal risk controls (Per, 2025). Theoretically, this aligns with trade-off, pecking order, and risk-shifting perspectives, whereby competitive pressures reduce retained earnings, lower equity buffers, and encourage risk-taking (Tian et al., 2025). Compared to prior studies focusing on isolated determinants in developed markets, the CESINDEX framework integrates competition, efficiency, and stability, capturing systemic interactions in fragile African banking systems. Policymakers should balance competition with prudential oversight to maintain capital adequacy, resilience, and financial stability.

Table 2. Presentation of regression results using the FE model's impact of *CESINDEX* on *CAR*

Variable	*Coefficient*	*Std. error*	*t-statistic*	*Prob.*
C	0.044	0.338	-0.685	0.494
LERNER INX	-0.052	0.031	-1.680*	0.094
TEFF	-0.047	0.023	-1.965**	0.050
ZSCORE	0.687	0.075	9.118*	0.000
CESINDEX	0.279	0.146	1.911**	0.056
CESINDEXSQ	-0.451	0.158	-2.185***	0.085
ROA	-0.175	0.069	-2.547*	0.011
INFLATION	-0.028	0.035	-0.800	0.424
GDP	0.292	0.344	0.850	0.397

*Note: * 1% level of significance, ** 5% level of significance, and *** 10% level of significance.*
Source: Authors' elaboration.

TEFF significantly reduces banks' capital buffers (-0.047; p = 0.050), as efficient banks rely on internal financing, lower operational costs, and improved risk management to support operations without holding excess capital. *TEFF* exhibits a significant negative effect on capital structure, indicating that more efficient banks maintain leaner capital buffers by relying on strong internal financing, lower operational costs, and enhanced risk management (Korein et al., 2022). Efficiency reduces multiple forms of institutional and operational inefficiencies, including allocative, scale, X-, risk management, and capital allocation inefficiencies (Dinka & Asfaw, 2026). On the other hand, optimizing asset utilization, loan performance, and revenue generation, thereby diminishing the need for excess capital (Kweh et al., 2022). Theoretically, this aligns with the pecking order theory, where internal funds substitute external financing, and the trade-off theory, whereby lower bankruptcy and volatility risks allow leaner buffers. Compared to prior studies that consider efficiency in isolation or in stable contexts, this research employs a composite measure to capture systemic interactions with competition and stability, contextualizing results within fragile banking systems and reconciling mixed evidence on efficiency's impact.

The stability of banks positively influences their capital structure, as evidenced by a significant regression coefficient of 0.687. This relationship is driven by stable banks' ability to retain earnings, strengthen capital buffers, and enhance investor confidence (Hendra & Bustaman, 2024). Various forms of stability, including financial, operational, market regulation, and liquidity, contribute to this relationship. Stability promotes retained earnings accumulation (Rachmad, 2025), reduces insolvency risk, and encourages equity accumulation (Messai, 2026). It also enables effective risk management, regulatory compliance, and capital planning. Compared to prior studies, this research contextualizes findings within fragile African banking systems, employing advanced methodologies to enhance empirical rigor. The positive implications of stability on capital structure include enhanced financial resilience, increased investor confidence, and better credit quality. Overall, stability supports long-term bank viability by reducing risks and increasing internal financing capacity.

The *CESINDEX* exerts a weakly positive effect on banks' capital structure ($\beta = 0.279$; p = 0.056), reflecting the integrative impact of competition, efficiency, and stability on capital buffers. While competition and efficiency individually tend to reduce *CAR*, stability offsets these effects by lowering volatility and enhancing risk management (Jan et al., 2026). Stability enables banks to retain earnings and optimize internal capital generation (Dinka & Asfaw, 2026). *CESINDEX* captures nonlinear and synergistic interactions, supporting adaptive capital structures aligned with institutional quality, innovation, and operational efficiency. Theoretically, findings align with the trade-off theory, where banks balance capital costs and insolvency risk, and system-wide interaction models, illustrating how combined institutional strengths outweigh individual weaknesses. Unlike prior studies in developed markets that examine isolated determinants, *CESINDEX* contextualizes capital structure within fragile banking systems, reflecting regulatory fragmentation, shallow markets, and volatility. Positive *CESINDEX* effects encourage strategic bank behaviour, including retention of earnings, prudent leverage management, operational efficiency, innovation-driven responses to competition, and strengthened investor confidence, promoting sustainable growth, regulatory compliance, and resilience in underdeveloped financial systems where external funding is costly and markets are constrained.

The study finds that *CESINDEXSQ* exhibits a weakly significant inverted-U relationship with capital structure, indicating that institutional quality—capturing competition, efficiency, and stability—initially strengthens banks' capital buffers, but beyond a threshold, further increases may reduce *CAR*, reflecting nonlinear adaptive dynamics. *ROA* shows a significant negative effect, consistent with the Pecking Order Theory, whereby more profitable banks rely on internal funds, lowering reliance on external capital and maintaining leaner capital structures, particularly in contexts with costly or constrained financing. In contrast, macroeconomic controls such as *INFLATION* and *GDP* are statistically insignificant, suggesting that bank-specific and industry-level factors dominate capital structure decisions. These findings underscore the importance of considering nonlinear institutional interactions, internal profitability, and contextual factors in banking, while advocating for stronger regulatory frameworks and improved external financing access to balance financial flexibility with systemic stability.

Table 3. Impact of *CESINDEX* on *CAR*-robustness results using system dynamic GMM

Variable	*Coefficient*	*Std. error*	*t-statistic*	*Prob.*
CAR (-1)	0.406	0.014	30.000*	0.000
LERNER INDEX	-0.281	0.027	-10.505*	0.000
TEFF	-0.166	0.014	-11.884*	0.000
ZSCORE	0.370	0.070	5.251*	0.000
CESINDEX	1.350	0.137	8.851*	0.000
CESINDEXSQ	-0.006	0.001	-9.526*	0.000
ROA	-0.007	0.035	-1.854	0.064
INFLATION	-0.003	0.032	-0.086	0.932
GDP	0.088	0.201	4.371*	0.000

*Note: * 1% level of significance.*
Source: Authors' elaboration.

The results in Tables 1 and 3 demonstrate robustness. The signs and significance of most coefficients are consistent across both models. In both tables, *LERNER INDEX*, *TEFF* scores, *CESINDEXSQ*, and *ROA* are negatively related

to capital levels, while *ZSCORE* and *CESINDEX* are positively related. The dynamic two-step system GMM estimation uses 55 instruments for 66 groups. Overall, the consistency across both models confirms robust relationships between the variables and capital levels. The *GDP* coefficient varies—positive and significant in Table A.1, but positive and insignificant in Table 2. This suggests the *GDP*-capital link is sensitive to model specification or estimation technique. The system dynamic GMM results in Table A.1 offer stronger robustness. This method controls for endogeneity and persistence in capital levels. Most variables retain their expected signs and significance under this model. These results strengthen confidence in the study's empirical findings.

5. CONCLUSION

This study demonstrates that competition, efficiency, and stability jointly shape the capital structure of African commercial banks, as captured by the CESINDEX. Empirical results show that CESINDEX and Z-score positively influence capital buffers, while Lerner index, technical efficiency, CESINDEX and its squared term, and ROA exert negative effects, reflecting trade-offs between profitability, operational efficiency, and financial resilience. The findings highlight that banks respond to institutional quality and internal efficiency by adjusting leverage strategically, balancing risk, and optimizing capital allocation. For policymakers and bank managers, this underscores the importance of fostering institutional stability, encouraging prudent competition, and supporting efficiency to strengthen capital buffers without compromising competitiveness. Limitations include data constraints, cross-country institutional heterogeneity, and methodological assumptions inherent in FE and system GMM models. Future research should refine composite indices, expand to other regions, and incorporate governance or macroeconomic shocks to deepen understanding of the complex determinants of banking sector stability and performance. Overall, the CESINDEX framework provides a theoretically grounded and contextually relevant lens for analysing capital structure in emerging and institutionally diverse markets.

This study makes several novel contributions through the CESINDEX, a composite measure integrating competition, efficiency, and stability as a determinant of bank capital structure. Conceptually, CESINDEX reconceptualizes leverage decisions as institutionally contingent, capturing interactive effects overlooked in traditional frameworks and reconciling contradictory findings from prior theories such as the trade-off, pecking order, and competition-fragility hypotheses (Beck et al., 2023; Frank & Goyal, 2024). Contextually, it reflects Africa's fragmented regulatory environments, shallow markets, and operational inefficiencies, offering region-specific insights into how institutional interactions shape capital buffers. Methodologically, the study employs FE, RE, and a two-step system GMM to isolate CESINDEX's latent influence while addressing endogeneity, heterogeneity, and dynamic persistence (Baltagi, 2021). Practically, CESINDEX informs bank strategies via key performance indicators, stress testing, and capital planning tools, enabling proactive responses to institutional dynamics (Beck, 2013). Policy-wise, it guides regulators in calibrating capital adequacy, balancing competition and stability, and designing context-sensitive macroprudential frameworks. Limitations include potential reverse causality, measurement constraints, country heterogeneity, structural breaks, and restricted generalizability, which future research can address through quasi-experimental designs, dynamic indices, multilevel models, regime-switching approaches, and cross-regional replication, enhancing both internal and external validity.

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APPENDIX

Table A.1. Descriptive statistics of variables used in the study

Variable	*Obs.*	*Mean*	*Median*	*Max*	*Min*	*Std. dev.*	*Skewness*	*Kurtosis*
CAR	792	0.219	0.146	1.000	0.070	0.197	0.378	2.789
LAR	792	0.720	0.767	1.000	0.000	0.1665	-0.277	2.978
LINDEX	792	0.591	0.627	1.000	-0.021	0.214	-0.457	3.290
TEFF	792	0.664	0.653	1.000	0.000	0.246	-0.503	3.053
ZSCORE	792	0.302	1.000	1.000	0.218	0.352	0.102	2.581
CESINDEX	792	0.090	0.077	1.000	-0.070	0.560	0.414	2.783
CESINXSQ	792	0.016	0.006	1.000	0.000	0.062	0.482	3.025
ROA	792	0.0013	-0.006	1.000	-0.200	0.052	0.386	3.485
INF	792	0.013	0.004	1.000	0.0013	0.084	0.289	3.005
GDP	792	0.966	0.964	1.000	0.929	0.009	-0.429	2.845

Table A.2. Outlier detection and transformations

Variable	*|Z-values| ≥ 2*	*2 ≤ |Z-values| ≤ 2*	*Outcome*
CAR	√		Data transformed
LAR	√		Data transformed
LERNER INDEX	√		Data transformed
TEFF		√	Data not transformed
ZSCORE	√		Data transformed
CESINDEX	√		Data transformed
CESINDESQ	√		Data transformed
ROA	√		Data transformed
INFL	√		Data transformed

Table A.3. Presentation and interpretation of normality test results

Test method	*Jaque-Bera test*
Jaque-Bera test statistic	2.125
p-value	0.742
Skewness	0.003
Kurtosis	2.971

Table A.4. First-generation unit root test results

Variable	*LLC test t-value (p-value)*	*IPS test t-value (p-value)*	*ADF test t-value (p-value)*	*Phillips-Perron-Fisher (PPF) test t-value (p-value)*	*I(O)*
CAR	-6.374 (0.000)	-2.013 (0.000)	185.86 (0.001)	225.30 (0.000)	I(O)
LAR	-9.888 (0.000)	-2.553 (0.005)	190.317 (0.001)	252.394 (0.000)	I(O)
LERNER INDEX	-39.443 (0.000)	-7.717 (0.000)	211.4 (0.000)	258.2 (0.000)	I(O)
TEFF	-2.127 (0.017)	-2.648 (0.004)	171.2 (0.012)	343.6 (0.000)	I(O)
ZSCORE	-4.479 (0.000)	-1.800 (0.036)	167.5 (0.020)	235.0 (0.000)	I(O)
CESINDEX	-4.426 (0.000)	-3.576 (0.000)	192.1 (0.001)	290.9 (0.000)	I(O)
CESINDESQ	-3.760 0.000)	-3.121 (0.001)	180.4 (0.003)	289.3 (0.000)	I(O)
ROA	-13.035 (0.000)	-5.339 (0.000)	241.9 (0.000)	291.8 (0.000)	I(O)
INFL	-12.188 (0.000)	-8.165 (0.000)	295.8 (0.000)	235.9 (0.000)	I(0)

Table A.5. Second-generation unit root test results

Variable	*CADF statistic (p-value)*	*CIP statistic (p-value)*	*PANIC statistic (p-value)*	*I(0)*
CAR	3.252 (0.004)	5.285 (0.003)	3.269 (0.058)	I(0)
LERNER INDEX	2.698 ((0.061)	3.256 (0.003)	4.895 (0.052)	I(0)
TEFF	3.289 (0.053)	3.897 (0.025)	4.235 (0.037)	I(0)
ZS CORE	-4.252 (0.002)	-3.789 (0.008)	2.893 (0.013)	I(0)
CESINDEX	4.875 (0.03)	3.897 (0.008)	2.915 (0.025)	I(0)
CESINDEXSQ	3.785 (0.051)	4.875 (0.002)	3.987 (0.005)	I(0)
ROA	-2.369 (0.068)	-3.897 (0.089)	-2.698 (0.054)	I(0)
INFL	5.214 (0.025)	3.698 (0.039)	4.526 (0.025)	I(0)
GDP	3.589 (0.035)	5.897 (0.069)	6.235 (0.078)	I(0)

Note: Second-generation test lag length is 2.

Table A.6. Presentation and interpretation of cross-sectional dependency test results

Test	*Statistic*	*p-value*
Pesaran's CD	0.789	0.594
Friedman's	1.785	0.358
Frees'	0.922	0.327
Breusch-Pagan LM	$Chi^2 = 0.368$	0.689

Table A.7. Presentation and discussion of multicollinearity test results

Variable	*LAR*	*CAR*	*LERNER INDEX*	*TEFF*	*ZSCORE*	*CESINDEX*	*CESINDEXSQ*	*ROA*	*INFL*	*GDP*
LAR	1									
CAR	-0.41*	1								
LERNER INDEX	0.21*	-0.35*	1							
TEFF	0.37*	-0.35*	0.031	1						
ZSCORE	-0.19*	0.67*	-0.17*	-0.41*	1					
CESINDEX	-0.26*	0.218	0.398	0.298	0.358	1				
CESINDESQ	-0.30*	0.25*	0.15*	0.17*	0.33*	0.65*	1			
ROA	-0.30*	0.19*	0.05	-0.19*	0.40*	0.11*	0.15*	1		
INFL	-0.06***	0.02	-0.01	0.01	0.10	0.05	0.006**	0.07	1	
GDP	0.09*	-0.08*	0.13*	-0.01	-0.10	0.04	0.002	-0.01	-0.03	1

*Note: *, **, and *** means 1%, 5%, and 10%, respectively.*

Table A.8a. Kao residual cointegration test results

Method	*Statistic (t, probability, and variance)*
ADF	t-statistic = -4.0153
ADF	Probability = 0.000
Residual variance	Residual variance = 0.0066
Heteroskedasticity and autocorrelation consistent variance	Residual variance = 0.0042

Table A.8b. ADF results after 562 adjustments

Variable	*Coefficient*	*Std. error*	*t-statistic*	*Prob.*
RESID (-1)	-0.867	0.058	-14.856	0.000
D(RESID (-1))	0.215	0.050	4.350	0.000
D(RESID (-2))	0.129	0.041	3.121	0.002
R-squared	0.344732	Mean dependent var		-0.002699
Adjusted R-squared	0.342387	S.D. dependent var		0.085941
S.E. of regression	0.069692	Akaike info criterion		-2.484129
Sum squared resid	2.715075	Schwarz criterion		-2.461007
Log likelihood	701.0403	Hannan-Quinn criterion		-2.475102
Durbin-Watson stat	2.007983			

Table A.9. Presentation and interpretation of heteroscedasticity results

Test method employed	*Statistic*	*p-value*
Breusch-Pagan	$Chi^2 = 0.278$	0.615
White's	$Chi^2 = 0.193$	0.253

Table A.10. Presentation and interpretation of autocorrelation results

GMM Model of estimation	*Probability value*	*Interpretation*
AR(1)	0.145	No autocorrelation
AR(2)	0.231	No autocorrelation

Table A.11. Presentation and interpretation of the over-identification test

Test	*J-statistic*	*Prob. (J-statistic)*
GMM test	44.915	0.518

Table A.12. List of banks in the sample

Country	*Number of banks in the sample*	*Bank name in the sample*
Ghana	8	ADB, Cal, Ecobank, GCR, Republic Bank, SCB, and Trust Bank
Botswana	4	Absa, FNB, Investec, and SCB
Kenya	8	Stanbic, NCBA, KCB, Equity, DTKL, COBK, SCB, and Absa
Malawi	5	FNB, National Bank, NIT, NBS, and Standard Bank
Mauritius	2	Fincorp and NIT
Namibia	8	Capricon, First Rand, Investec, NAM, Nedbank, Standard Bank, Trustco, and Vikile
Nigeria	12	Abbey, Access, Ecobank, FCMB, Fidelity, Guaranty, Stanbic, Union, United, Unity, Wema, and Zithin
Rwanda	3	Equity, BK, and KCB
South Africa	7	Absa, Capitec, FINBOND, First Rand, Investec, Nedbank, and Standard Bank
Tanzania	2	CRDB and KCB
Zambia	2	SCB and ZNC
Zimbabwe	7	CBZ, NMBZ, ZB, Nedbank, Stanbic, and Agribank