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ARTICLE

Relative Importance of Time, Country and Bank-specific Effects on Bank Performance: A Three-Level Hierarchical Approach

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Abstract

The present study employs the variance component model to assess the relative significance of time, firm, and country-specific factors in driving the performance fluctuations of 37 African banks over the period from 2004 to 2021. The findings indicate that time-specific factors hold greater explanatory power in elucidating variations in bank performance, followed by country-specific and bank-specific effects. Furthermore, the impact of various risk factors on bank performance is conducted, utilizing panel data estimation techniques. The study outcome is that explicit deposit insurance schemes demonstrate an adverse performance effect when implemented in conjunction with escalating leverage ratios. Consequently, it is recommended that deposit insurance schemes must be accompanied by a reduction in leverage ratios. Lastly, bank managers should closely monitor year-specific events as they account for a substantial portion of the observed performance variation.

Keywords: bank performance, deposit insurance, and variance component models-hierarchical model

JEL classification: G1, G32, G380, C10

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1. Introduction

In mitigating the economic risks due to the high unemployment rate, lack of entrepreneurial initiative, low investments, and lack of business opportunities, Africa needs an efficient and robust banking sector. Banks are crucial in driving economic activity to create employment and reduce poverty. When banks fail to fulfill their central role, it has immediate spillover consequences on the real economy (Financial Policy and Systems, 1990). It is in this context that the drivers of bank performance are investigated for a sample of 37 banks across Nigeria, Ghana, Kenya, Uganda, Rwanda, South Africa, Namibia, Botswana, and Zimbabwe.

While significant strides have been achieved in understanding the multifaceted determinants of bank performance in Africa, as evidenced by studies such as; Tarus, Chekol, & Mutwol (2012), Gatsi (2012), Ezike & Oke (2013), Boutin-Dufresne et al. (2015), Godspower-Akpomiemie & Ojah (2017), and Lotto & Kakozi (2019), it is notable that these prior investigations have not taken into account the role of deposit insurance in driving bank performance.

This study strategically determines its variables of interest by drawing upon the seminal theories of Ho & Saunders (1981), Allen (1988) and Saunders & Schumacher (2000). Ho & Saunders (1981) contend that bank performance is intricately linked to interest-bearing fixed-income assets, albeit within a risk-uncertain framework. To extend this model liquidity risk is incorporated by taking in to account different types of deposits. Allen (1988) has expanded on the Ho and Saunders model by considering different types of loans. It is emphasized that when different types of deposits are introduced liquidity risk emerges when there is loan and deposit maturity mismatch. Additionally, critical variables such as market structure, risk factors, yield on fixed income assets and deposit insurance dummy are introduced. Particular emphasis on the hotly debated topic of explicit deposit insurance is given detailed attention. It is worth noting that the prevailing literature has raised substantial concerns about explicit deposit insurance, citing its potential to erode market discipline, introduce financial inefficiencies, exacerbate systemic vulnerabilities, diminish depositor vigilance, and foster moral hazard (Okeahalam and Maxwell, 2001; Laeven, 2002; Demirgüç-Kunt et al., 2006; Camara, Davidson, and Fodor, 2020; and Havemann, 2020).

This study achieves two objectives through the amalgamation of two seminal theoretical frameworks (Ho & Saunders, 1981 and Allen,1988). Firstly, it endeavors to elucidate the impact of deposit insurance on performance within the unique scene of African banks. Secondly, it aspires to ascertain the relative significance of temporal, bank-specific, and country-specific factors in elucidating the variance observed in bank performance. To address these objectives comprehensively, this study employs a three-level hierarchical approach.

This study makes a significant contribution to the existing literature on bank performance in two distinct dimensions. Firstly, it perceives that temporal factors exhibit a more pronounced role in explaining the variance observed in bank performance, followed by country-specific factors and subsequently bank-specific factors. Notably, during the Global Financial Crisis (GFC) period, bank-specific factors assume heightened importance. This observation underscores the policy implication that bank managers should accord greater attention to temporal shocks, as the repercussions of a single shock in the current period can echo across subsequent periods. Secondly, contrary to the prevailing body of literature that questions the efficacy of explicit deposit guarantees, this study unveils a counterintuitive finding. It reveals that the presence of explicit deposit insurance can indeed be more efficacious in enhancing bank performance when leverage ratios remain stable.

Furthermore, the synergistic effect of deposit insurance and equity capitalization yields favorable outcomes for bank performance. Consequently, the implementation of deposit insurance should be coupled with an emphasis on bolstering capital reserves and curbing excessive debt ratios. Nations contemplating the adoption of deposit insurance guarantees must, therefore, caution banks against an unwarranted surge in leverage ratios and the erosion of capital adequacy.

The subsequent sections of this paper are structured as follows: Section Two provides an extensive review of the relevant literature. Section Three outlines the research methodology. Section Four delves into the empirical findings, and the concluding insights are presented in the final section.

2. Literature Review

Performance is understood as the quantifiable measure of competence with which a task can be accomplished. Performance is a multi-facet concept but in the financial literature performance may be indicated by various metrics such as; return on equity (ROE), return on assets (ROA), earnings per share (EPS), and the spread between interest earned on bank assets (loans) and liabilities (deposits) (Gatsi, 2012; Anarfo & Appiahene, 2017, Godspower-Akpomiemie & Ojah, 2017; Lotto & Kakozi, 2019). In the context of this paper, performance is interpreted as the spread between interest earned on bank assets and liabilities.

Ho & Saunders (1981) develops a performance model in which bank interest margin depends on the extent of managerial risk aversion, transaction size undertaken by the bank, bank market

structure, and the variance in interest rate risk. In this model, a bank can change the demand for loan and deposit products by altering its fees. It is predicted that when loans are heterogenous and deposits are homogenous, cross elasticity on loan and deposit products demand may reduce the bank performance measured by Net Interest Margin (NIM) (Allen, 1988). Saunders & Schumacher (2000) extends on the Ho & Saunders (1981) model by applying it on a multi country setting and empirically testing the market structure variable to establish if it leads to increase in NIMs as predicted in Ho & Saunders equation manipulations. As in the previous studies, the ground work of our model follows that of Ho & Saunders (1981).

Following Ho & Saunders (1981), this study assumes that a bank has three components to its wealth. The first component is the initial wealth, Y, which is invested in a diversified portfolio. The second component is the net credit inventory, I. The third component is C, the net cash position. Considering that the prices of loans and deposits are given as:

$$p_L = p - s \tag{1}$$

$$p_D = p + t \tag{2}$$

where s and t are fees for providing convenience of banking services. The spread between the price of loans and deposit is the net interest margin (NIM) is formally defined as:

$$p_D - p_L = p + t - (p - s) = t + s \tag{3}$$

High deposit price translates into low deposit rate. This may be due to the fact that banks would not want to pay high rates on high deposits due to the banking business model. It is further assumed that once the deposit and loan prices are set at the beginning of the period they remain unchanged for the rest of the decision period. Moreover, loan and deposit terms are the same, as well as the transaction size, q. The probability of the deposit supply, $\omega(t)$ and loan demand, $\omega(s)$ depends on the respective fees, t and s. By raising s, the price of loans falls. Likewise, by raising $\underline{t}$ the price of deposits rises. Moreover, banks can manipulate the probability of loan arrivals by changing the fees. It is assumed that due to long-term maturity of deposits and loans, and the unclear path of transaction arrivals, the bank will face interest rate risk if it holds heterogeneous portfolio of deposits and loans at the end of decision period.

The bank's decision problem in the midst of transaction and interest rate risk is to determine the optimal expected utility function that maximises the *NIM*. The expected utility function at the end of decision period is approximated by the second order Taylor series expansion at the initial wealth.

$$EU(\widehat{w}) = U(w_0) + U'(w_0)\, r_w w_0 + \frac{1}{2} U''(w_0)\, (\sigma_I I_0 + \sigma_Y Y)^2 . \tag{4}$$

Where, $r_w = \frac{1}{w_0}(r_Y Y_0 + r_I I_0 + r C_0)$. In the case when new deposit transaction is made, the net cash position is given by $C_0 + q + qs$. The present study extends this intuition by amending the previously held assumption of uniform maturity in both deposits and loans. In this study, it is assumed that there are two different types of deposits, deposit x with a shorter maturity, and deposit y with a longer maturity. However, it is important to note that the Ho & Saunders model, originally proposed in its fundamental form, has undergone significant evolution in subsequent research. One noteworthy extension was introduced by Allen in 1988, where the framework was adapted to encompass various types of loans.

In the current study, a similar approach is adopted, building upon the foundational work of Ho & Saunders. However, what distinguishes the current treatment from Allen's 1988 model is the inclusion of different types of deposits. This expansion allows us to investigate the intricate dynamics of the banking sector, taking into account the presence and influence of deposit insurance.

Increasing deposit fee d_x, will reduce the probability of arrival of supply of deposit x, but the price of deposits will increase (the deposit fees will decrease), and the demand of type x deposits will decline. Agents will then substitute type x deposits for type y deposits as illustrated in Equation 5. The probability of supply of different types of deposits and demand of loans are represented by linear functions below:

$$\omega(x) = \alpha_x - \varphi d_x + \rho d_y \tag{5}$$

$$\omega(y) = \alpha_y - \varphi d_y + \tau d_x \tag{6}$$

$$\omega(s) = \alpha - \varphi s \tag{7}$$

The parameters of all the models are greater than zero and smaller than 1. It is comprehended that the maturity mismatch creates liquidity risk. For instance, excessive short-term deposits against the background of long-term loans may lead to a bank run. Banks may protect themselves against liquidity risk by taking deposit insurance. Deposit insurance guarantees depositors up to a certain limit. The expected utility function given type x deposit is:

$$EU(\widehat{w} \mid x \text{ deposits }) = U'(w_0)\, d_x q + \frac{1}{2} U''(w_0) \left(\sigma_I q^2 + 2\sigma_I^2 q I_0\right) + [4] \tag{8}$$

Where the square bracket indicates Equation 4. Likewise, the utility function given type y deposit is:

$$EU(\widehat{w} \mid y \text{ deposits }) = U'(w_0)\, d_y q + \frac{1}{2} U''(w_0) \left(\sigma_I q^2 + 2\sigma_I^2 q I_0\right) + [4] \tag{9}$$

In parallel, the utility function of loans is:

$$EU(\widehat{w} \mid \text{ loans }) = U'(w_0)\, sq + \frac{1}{2} U''(w_0) \left(\sigma_I q^2 - 2\sigma_I^2 q I_0\right) + [4] \tag{10}$$

The expected utility of wealth is defined as:

$$EU(\widehat{w}) = \omega(x)[8] + \omega(y)[9] + \omega(s)[10] \tag{11}$$

The expected utility function in Equation 11 is then maximised subject to deposit insurance (DI) defined as:

$$DI = \delta - \left[(\alpha - \varphi s) - \left(\alpha_x - \varphi d_x + \rho d_y\right)\right] \tag{12}$$

In order to ensure that there is liquidity risk it is assumed that the demand of loans is greater than the supply of type x deposit such that; $(\alpha - \varphi s) > \left(\alpha_x - \varphi d_x + \rho d_y\right)$. Furthermore, the supply of type x deposit is greater than the supply of type y deposits. Moreover, to ensure full cover, the deposit insurance fund should be strictly greater than the difference between loan demand and deposit supply, that is; $\delta > \left[(\alpha - \varphi s) - \left(\alpha_x - \varphi d_x + \rho d_y\right)\right]$. Hence, the optimisation problem below is solved: maximise $EU(\widehat{w}) = \omega(x)[8] + \omega(y)[9] + \omega(s)[10]$ subject to

$$DI = \delta - \left[(\alpha - \varphi s) - \left(\alpha_x - \varphi d_x + \rho d_y\right)\right.$$

The Lagrangian is formed such that:

$$EU(\widehat{w}) = \omega(x)[8] + \omega(y)[9] + \omega(s)[10] - \lambda DI \tag{13}$$

It remains to solve for the deposit and loan margins that maximise Equation 13. To solve for the interest rate margin of type x deposit we have the following:

$$\frac{\partial EU(\widehat{w})}{\partial d_x} = \alpha_x U'(w_0)\, q - \frac{1}{2}\varphi U''(w_0)\left(\sigma_I q^2 + 2\sigma_I^2 q I_0\right) - \varphi U(w_0) - \varphi U'(w_0)\, r_w w_0 - \frac{1}{2}\varphi U''$$

$$(w_0)\left(\sigma_I I_0 + \sigma_Y Y_0\right)^2 + \rho d_y U'(w_0)\, q + \lambda\varphi - 2\varphi U'(w_0)\, d_x q + \tau[9] = 0 \tag{14}$$

$$d_x = \frac{\alpha_x}{2\varphi} + \frac{(\rho+\tau)d_y}{2\varphi} + \frac{R\left(\sigma_I q^2 + 2\sigma_I^2 q I_0\right)}{4q}\left(1 - \frac{\tau}{\varphi}\right) + \frac{R\left(\sigma_I I_0 + Y\sigma_Y\right)^2}{2q}\left(1 - \frac{\tau}{2\varphi}\right) + \frac{U(w_0)}{2U'(w_0)\, q}$$

$$\left(1 - \tfrac{1}{\varphi}\right) - \tfrac{w_0 r_w}{2q}\left(1 - \tfrac{1}{\varphi}\right) + \tfrac{\lambda}{2U'(w_0)q} \tag{15}$$

$$\frac{\partial EU(\widehat{w})}{\partial S} = \alpha U'(w_0)\, q - 2\varphi U'(w_0)\, sq - \frac{1}{2}\varphi U''(w_0)\left(\sigma_I q^2 - 2\sigma_I^2 q I_0\right) - \varphi U(w_0) - \varphi U'(w_0)\, r_w w_0 - \frac{1}{2}$$

$$\varphi U''(w_0)\left(\sigma_I I_0 + \sigma_Y Y_0\right)^2 + \lambda\varphi = 0 \tag{16}$$

$$s = \frac{\alpha}{2\varphi} + \frac{\lambda}{2U'(w_0)\, q} - \frac{U(w_0)}{2U'(w_0)\, q} - \frac{w_0 r_w}{2q} + \frac{R\left(\sigma_I I_0 + Y\sigma_Y\right)^2}{4q} + \frac{R\left(\sigma_I q^2 - 2\sigma_I^2 I_0\right)}{4q} \tag{17}$$

The NIM of loans and type x deposit is then:

$$s + d_x = \frac{\alpha}{2\varphi} + \frac{\alpha_x}{2\varphi} + \frac{(\rho+\tau)}{2\varphi} d_y + \frac{R\sigma_I q}{2} + \frac{U(w_0)}{qU\prime(w_0)}\left(\frac{1}{2\varphi} - 1\right) + \frac{\lambda}{U'(w_0)\, q} - \frac{w_0 r_w}{2q\varphi} + \frac{R\left(\sigma_I I_0 + Y\sigma_Y\right)^2}{2q}$$

$$\left(\tfrac{3}{2} - \tfrac{\tau}{2\varphi}\right) - \tfrac{R\tau\left(\sigma_I q^2 + 2\sigma_I^2 q I_0\right)}{8q\varphi} 1 \tag{18}$$

As in Ho & Saunders (1981), Allen (1988) and Saunders & Schumacher (2000) the first two terms of Equation 18 capture the bank's monopoly power and the term is positively related to NIM. The third term captures the substitution effect between type x and type y deposits. If the banking fees of type y deposits increase, agents will demand type x deposit which has positive effect on NIM. The fourth term of Equation 18 is similar to the one that emerges in Ho & Saunders (1981), and Allen (1988) and it captures the Ho and Saunders risk premium. Moreover, the variable of absolute risk aversion is, , $(-1) * \frac{U\prime\prime(w_0)}{U\prime(w_0)} = R$. The last two terms of Equation 18 indicate the risk premium for taking on more risk. The prediction is consistent with the notion that banks should take more risk to increase the value of deposit insurance. However, this prediction must be taken with a caution. The availability of DI has positive effect on NIM, as λ, the deposit insurance constraint term, enters the NIM equation positive.

Aggregate return on initial wealth has negative outcome on NIM. This prediction confirms Ho & Saunders (1981) claim that the bank will face interest rate risk if it holds deposits and loans with different maturity. Intuitively, a bank may borrow money at a fixed rate in the money market, but when the interest rate decreases, the bank will be disadvantaged. In addition, a bank may issue a loan at a given rate for the duration of a contract. When the interest rate increases, the bank will lose out if the fixed rate is lower than the prevailing interest rate. Moreover, funds that are invested by a bank

1. We get the same result when we solve for $s + d_y$

are also subject to interest rate risk. There are other factors that affect banks' NIMs other than the factors that are detailed in our simple theoretical model.

In the empirical model, the following control variables are accounted for: leverage ratio or capital structure, systemic risk, capital adequacy ratio, provision for income tax, corporate income tax, repo rate, treasury bill rates, and economic cycle performance (Ho & Saunders,1981;Ben Naceur & Kandil, 2009, and Lotto & Kakozi, 2019). Variables that operationalise the theoretical model are; NIM which is interpreted as measure of bank performance, presence of deposit insurance to capture the concept of expected utility maximisation subject to the availability of DI, spread between lending and deposit rates which capture monopoly power or market structure and substitution effect, leverage ratio which captures risk tolerance, and equity ratio, capital adequacy ratio, reserves, and provision for loan loss which capture absolute risk aversion, treasury bill rates and government bond yield which capture return on initial wealth and interest rate risk. Furthermore, the variable selection process is guided by the empirical literature. The variables can be classified as bank specific and macroeconomics factors also known as country specific factors.

Accordingly, several studies have documented that bank performance is driven by bank specific, institutional, financial and macroeconomic factors (Ezike & Oke, 2013 ; and Boutin-Dufresne et al., 2015). Moreover the effect of bank specific factors on performance have been widely studied (Berger, 1995; Ben Naceur & Kandil, 2009 ; Kobeissi & Sun, 2010; Gatsi, 2012; Ezike & Oke, 2013; Boutin-Dufresne et al., 2015; Anarfo & Appiahene, 2017; Godspower-Akpomiemie & Ojah, 2017; and Lotto & Kakozi, 2019). Bank specific factors such as; operating expenses and credit risk have substantial positive impact on a performance of banks that operate in Kenya (Tarus et al. 2012).

Amongst the variables that are used in the determinants of NIM, the common variables are; capital adequacy ratio, liquidity ratio, capital structure and asset size. The effect of capital adequacy ratio on performance is mixed (Berger, 1995 and Ezike & Oke, 2013). While other studies record positive performance (Berger, 1995; Ben Naceur & Kandil, 2009; Al-Kayed, Zain, & Duasa, 2014 and Godspower-Akpomiemie & Ojah, 2017) . Others record negative performance (Berger, 1995 and Ezike & Oke, 2013) . The unclear impact of capital adequacy on capital may be that; requiring banks to hold large capital relative to risk weighted assets limits the extent to which funds are employed for loans, which reduces performance. Likewise, under strict assumptions, high capital ratio is associated with low performance. What drives the negative relationship is the foregone tax shield advantage that comes with employing capital instead of debt. Similarly, high capital is associated with low risk which results in reduced return on equity (Berger, 1995). Conversely, it is argued that the capital accord has been praised for its international coverage and reduction of banks risk taking tendencies (Ben Naceur & Kandil, 2009). Capital structure, liquidity and size have also been recorded to have implications for bank performance (Ben Naceur & Kandil, 2009, and Lotto & Kakozi, 2019), where debt ratio has negative implications for performance (Ben Naceur & Kandil, 2009).

In parallel, the effect of macroeconomic or institutional factors on bank performance have been extensively controlled for (Ho & Saunders, 1981 ; Ben Naceur & Kandil, 2009; Kobeissi & Sun, 2010; Klomp & De Haan, 2015; and Godspower-Akpomiemie & Ojah, 2017). Amongst these studies, the variables that have gained popularity are; GDP per capita, inflation , interest rates, banking climate and regulation. It is uncovered that GDP per capita has positive outcomes for performance (Kobeissi & Sun, 2010), whereas in the other studies it increases banking fragility (Klomp & De Haan, 2015). Inflation has negative impact on performance as it increases the cost of financial intermediation (Ben Naceur & Kandil, 2009).

Interest rates influence performance through the interest rate risk. It is argued that banks net interest margin is driven by interest rate risk as banks are always striving to match maturing liabilities or deposits to loans. When the loans and deposit mismatch occurs it manifests into interest rate risk (Ho & Saunders, 1981). By means of using a sample of banks that operate in the United States it is revealed that the spread between interest income and expense is positively and significantly related

to the rate of bonds (Ho & Saunders, 1981). By investigating a sample of African and emerging economies it is revealed that interest rate shocks have a positive effect on profitability of banks that operate in emerging markets. However interest volatility has no obvious effect on profitability of African banks (Godspower-Akpomiemie & Ojah, 2017). Banking climate and regulatory capital have positive outcomes for performance (Ben Naceur & Kandil, 2009).

Bank regulation in the form of explicit deposit guarantee is a developed world phenomenon, and other countries are contemplating its implementation (Bergbrant, Campbell, Hunter, & Owers, 2016). The explicit DI scheme was introduced to deal with the apparent bank failures that occurred in the United States in the early 1930s (Diamond & Dybvig, 1983). Nonetheless, it is warned that the adoption of explicit DI guarantees undermine financial stability and retards financial development when institutions are weak, and the scheme is poorly designed (Okeahalam & Maxwell, 2001 and Bergbrant. et al, 2016)

It is argued that when all the disadvantages of DI are combined, they may outweigh the benefit of the DI scheme. However, if the DI is well designed with risk based premiums, the advantages far outweigh the disadvantages and moral hazard is minimised (Assa & Okhrati, 2018; Sabah & Hassan, 2019 and Camara, Davidson, & Fodor, 2020). For instance, explicit DI eliminates the inconsistencies that come with how central banks deal with failures in the presence of implicit DI (Havemann, 2020). In addition, explicit DI allows for internal risk control where banks are fully in charge of risk management. Hence, banks will self-manage in the event they exceed the DI scheme policy limits.

It is clearly mapped in the literature that firm specific, macroeconomic factors and financial environment do exhibit significant effects on performance. The popular approaches that are utilised in the literature to uncover both macroeconomic and bank-specific factors' effect on performance are;panel data techniques (Ben Naceur & Kandil, 2009; Tarus et al. 2012; Boutin-Dufresne et al., 2015; and Godspower-Akpomiemie & Ojah, 2017) and pooled OLS techniques (Kobeissi & Sun, 2010; Boutin-Dufresne et al., 2015, Lotto & Kakozi, 2019) .

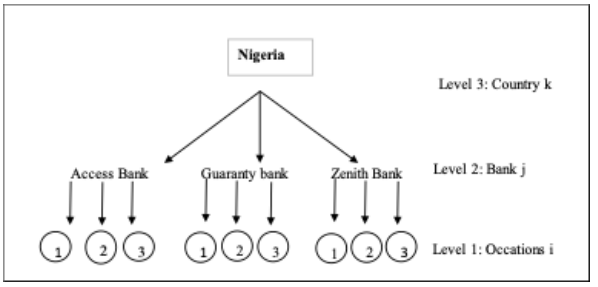
Following Bilgin (2019) and Perveen, Aksar, Haq, & Hassan (2020) the current paper extends on the existing literature by investigating the relative importance of not only bank and country-specific factors but also time effects in driving bank performance. The investigation is carried out by exploiting the three-level hierarchical model. In addition, explicit DI is investigated as potential link to bank inefficiencies, eroded market discipline, moral hazard and systemic vulnerability (Furlong and Keeley, 1989; Okeahalam and Maxwell, 2001; Berger and Bonaccorsi, 2006; Gropp and Heider, 2010; Bitar et al., 2016 and Camara, Davidson, & Fodor, 2020). The direct effect of explicit DI scheme on bank performance remains an open question. This question is more relevant for Africa, since African central banks are faced with increased pressure to design explicit DI guarantees to keep up with the developed nations.[2] Building from Ho & Saunders (1981) , Allen (1988) and Saunders & Schumacher (2000) models , this study proposes and tests the combined effect of deposit insurance, systemic risk, fixed interest bearing assets, and capital structure on bank performance within a unified framework.

3. Methodology

It is plausible to assume that different banks operating in the same country are correlated. Moreover, observations captured on the same bank at different instances bear even more association. Random intercept models do take into account such within cluster cross dependence. In parallel, variance component models serve as a tool to enable one to uncover the relative importance of time, bank and country specific factors in driving the variation in the outcome variable, that is, bank performance. The structure of the hierarchical model used is illustrated in Figure 1.

To operationalize the ideas conveyed in the theoretical model, bank performance is proxied by NIM (Net interest margin). The difference between interest rates earned on banks assets and

2. See Table 4: Progression towards the Adoption of DI Scheme



Note: Level 1 denotes between occasions or time variation

Figure 1. Illustration of a three-level hierarchical model, with Nigeria as an example

interest rate paid on deposits is perceived to be the most important indicator of banks' profitability and efficiency (Godspower-Akpomiemie & Ojah, 2017) . The three- level hierarchical model that apprehends the conceptual framework is detailed on Equation 19;

$$NIM_{ijk} = \alpha + \boldsymbol{x}'_{ijk}\boldsymbol{\beta}_f + \mathbf{z}'_{ik}\boldsymbol{\beta}_c + \delta^{(2)}_{jk} + \delta^{(3)}_{k} + \varepsilon_{ijk}. \tag{19}$$

The variable NIM_{ijk} denotes the dependent variable interpreted as net interest rate margin. The time-level covariates are denoted by $\boldsymbol{x}_{ijk}$ and they vary across time, banks and countries. The time-level covariate matrix includes systemic risk, net interest margin, profit, leverage, tier 1 capital ratio, retained earnings, loan loss provision, liquidity ratio and tax provision. The risk variables are represented by the systemic risk measure, presence of deposit insurance, leverage ratios, loan loss provision and non-performing loans. Loan loss provision maybe used as a measure of credit risk. Banks that take on risky loans would have more provision for non-performing loans to guard against credit risk (Tarus et al.,2012).Systemic risk is derived in the study following the △CoVaR (Delta Conditional Value at Risk) approach (Adrian & Brunnermeier, 2011). Treasury bill rates and long-term government bonds are used to capture fixed income earning assets as in Ho & Saunders (1981). The deposit insurance is an indicator variable that assumes the value 1 when there is explicit deposit guarantee, and 0 otherwise.

Capital adequacy measures are tier 1 capital ratio, loan loss reserves, liquidity and retained earnings. Variables that represent tax are corporate income tax and provision for income tax. Credit inventory is captured by deposits and net loans. Capital structure measures are leverage and equity ratios. Therefore, leverage ratios are the intersection of risk and capital structure measures. The coefficients of Equation (19) will enable one to test the model's predictions. For example, the first set of $\boldsymbol{\beta}_f$ represents; $\boldsymbol{\beta}_f = \left[\beta_{\text{loanloss provision}}, \beta_{\text{lev}}, \beta_{\text{equity}}, \beta_{\text{capital adequacy}}\right]^T$ which represents, all else equal, marginal change in NIM, as a result of marginal change in loan loss provision, everything held constant, marginal change in performance as a result of marginal change in leverage, ceteris paribus, infinitesimal change in performance due to infinitesimal change in equity and small change in performance as a result of equivalent change in capital adequacy measures respectively. Moreover, $\boldsymbol{\beta}_f$ is a column matrix of firm or bank level coefficients. Similarly, $\boldsymbol{\beta}_c$ is a column matrix of country level coefficients which is represented by $\boldsymbol{\beta}_c = [\beta_{DI}, \beta_{\text{risk}}]^T$. Likewise, attention is drawn on concepts that are mentioned in the theoretical model derivation, β_{DI} is the marginal change in NIM that is brought by a change in the presence of DI, and β_{risk} is the marginal change in performance that is brought by equivalent change in risk tolerance or aversion measures.

The country-level variable is denoted as $\mathbf{z}_{ik}$ where the subscripts represent the level at which the random variable varies. For instance, repo rate varies across time or at level 1 , and countries, but fixed across banks that operate in the same country. Hence $\mathbf{z}_{ik}$ = [Economic cycle, GDP, Taxpolicy,

Deposit Insurance Policy, Repo rate, treasury bill rate, long-term government bond, inflation and Market Concentration]. The full description of the model's variables is detailed on Table 1 below.

Table 1. Descriptive Statistics of Key Variables

Variables	Full Description	Definition	Source
NIM	Net interest rate margin	Spread between interest income and interest expense.	Thomson Reuters
srisk	Systemic risk	Quantile regression models of bank stock prices.	CoVaR approach. Author's derivation
npl	Non-performing loans	The ratio of non-performing loans to assets	Thomson Reuters
tier1	Tier 1 Capital ratio	Tier 1 Capital ratio as detailed on banks balance sheet	Thomson Reuters
llp	Loan loss provision	Loan loss provision expressed as a ratio of total assets	Thomson Reuters
lev	Leverage	total debt as a ratio of the sum of total leverage and equity	Thomson Reuters
lqd	Liquidity	Ratio of current liabilities to current assets	Thomson Reuters
size	Size	Log of total assets	Thomson Reuters
loans	Net loans	Net loans as a ratio of total assets	Thomson Reuters
dep	Deposits	log of total deposits	Thomson Reuters
cit	Corporate Income Tax	Corporate income tax that prevails in different countries	KPMG
pit	Provision for income tax	Provision for income tax as a ratio of total assets	Thomson Reuters
infl	Inflation	Change in consumer price index	IFS
tbill	Treasury Bill rates	Short term treasury bill rates	IFS
gdp	GDP	Rate of change of GDP	IFS
gov	Long term government bonds	Yield in the 5-10 year government bond	IFS
rep	Repo rate	Countries repo rate	IFS
conc	Market concentration	Spread between lending and deposit rates	IFS
cyc	Economic cycle	Unemployment rate	IFS

Further note that that $\delta_{jk}^{(2)}$ is the random intercept for bank j and country k, whereas $\delta_{k}^{(3)}$ is the random intercept for country k. The super subscripts denote the level of variation of the random intercepts. The error components; $\delta_{jk}^{(2)}$, $\delta_{k}^{(3)}$, and ε_{ijk} are assumed to have zero mean and uncorrelated such that they sum up to the total variance. The corresponding variance components are, for level 1 residuals, the variance $\psi^{(2)}$ of level 2 random intercepts, and the variance $\psi^{(3)}$ of level 3 random intercepts. The level 1 variance is interpreted as between occasions or time variation, within a bank and within a country. The level 2 variance measures the between banks' variation and within a country variation. Finally, level 3 variance captures the between country variance. A large between banks and within countries variance is a strong signal of the bank-bycountry interaction. All the three error components should bear no correlation. For finer details of random intercept models, see Rabe-Hesketh and Skrondal (2012).

4. Data analysis

The time span and countries that are included in the study are guided by data availability from various databases used. Bank specific variables are sourced from Thomson and Reuters, and macroeconomic variables are sourced from International financial statistics. The semi-annual sample ranges between the period of 2004 and 2021. The time range consists of 34 observations, which are subject to the issue of time-varying moments, or unit roots. Moreover, the data is panel in nature and unbalanced as a result of missing observations. The unbalanced feature of the panel renders conventional approaches for testing unit roots challenging. There is also strong presence of cross-sectional dependence as the Pesaran test for cross sectional independence is rejected at less than 5% level of significance.[3] Variance Decomposition models are designed to deal with cross sectional dependence. Prior to model estimation exploratory data analysis is carried out.

3. The results of this test can be made available upon request.

Table 2. Descriptive Statistics of Key Variables

	Mean	Min	Max	Std dev	Banks	Mean	Min	Max	Std dev
Profitability Variables	Net-profit Before Tax					Net Interest Margin			
Botswana	34.5	11.1	58.7	11.174	2	48.25	23.7	79.9	2
Ghana	8.2	-13.63	40.72	9.983	6	16.77	1.65	64.82	13.11
Kenya	23.875	0.98	54.9	12.16	5	39.64	3.04	99.2	19.58
Namibia	166.8	34.3	1127.9	173.37	2	273.3	47.4	724.2	229.87
Nigeria	223.92	-82.2	1734.4	425.13	8	350.61	-41.3	2341.9	590.52
South Africa	697.13	5.8	1734.4	465.13	6	1092.42	30.6	2341.9	631.18
Uganda	15.76	-12.42	56.3	14.03	3	24.56	4.87	71.1	18.06
Zimbabwe	15.6	-54	180.1	30.75	3	21.35	-14	186.9	25.38
Rwanda	9.48	2.8	17.46	36	1	17.21	5.21	33.86	6.42
Capitalisation Variables	Tier 1 Capital					Liquidity			
Botswana	0.13	0.12	0.14	0.007	2	2.15	0.35	3.67	0.67
Ghana	0.12	0	0.23	0.065	6	0.73	0.29	1.5	0.18
Kenya	0.16	0.12	0.22	0.02	5	1.06	0.73	2.17	0.4
Namibia	0.12	0.09	0.15	0.02	2	0.76	0.57	1	0.08
Nigeria	0.17	0.12	0.4	0.05	8	0.96	0.55	3.56	0.4
South Africa	0.18	0	0.36	0.08	6	1.12	0.27	4.74	0.98
Uganda	0.21	0.12	0.38	0.09	3	1.09	0.58	8.31	1.06
Zimbabwe	0.17	0.08	0.4	0.06	3	0.9	0.7	1.01	0.06
Rwanda	0.22	0.21	0.29	0.02	1	0.96	0.49	1.19	0.15
	Retained Earnings					Loan loss Provision			
Botswana	173.53	65.20	351.50	70.69	2	7.46	-3.00	21.50	5.58
Ghana	59.44	4.00	341.30	55.54	6	1.83	-4.78	22.33	3.12
Kenya	189.12	0.90	510.00	152.77	5	6.08	-1.85	58.95	7.35
Namibia	888.87	-614.00	4273.00	1197.96	2	62.89	0.90	310.90	88.92
Nigeria	18507.88	-1456.65	193024.00	48295.48	8	63.38	-295.80	777.70	144.87
South Africa	4231.54	-614.00	11306.00	2748.23	6	252.39	2.10	1106.80	172.12
Uganda	85.80	14.90	398.80	71.23	3	2.78	-3.56	31.49	5.19
Zimbabwe	73.11	-0.10	558.10	95.99	3	6.61	-1.40	74.60	13.08
Rwanda	124.83	26.00	194.10	51.79	1	3.95	-0.71	11.19	2.39
Risk Variables	SRISK					Non-Performing Loans			
Botswana	-0.02	-0.15	0.02	0.03	2	0.06	0.02	0.08	0.02
Ghana	0.16	-0.01	0.75	0.18	6	0.01	0.00	0.05	0.02
Kenya	0.09	-0.62	0.83 0.14	5	0.02	0.02	0.11	0.02	
Namibia	0.35	0.04	3.05	0.41	2	0.00	0.00	0.00	0.00
Nigeria	0.11	-8.22	10.85	1.04	8	0.04	0.02	0.11	0.02
South Africa	-0.02	-0.13	0.04	0.03	6	0.05	0.02	0.05	0.01
Uganda	0.28	-0.04	0.76	0.15	3	0.05	0.05	0.05	0.00
Zimbabwe	0.33	-0.55	1.55	0.32	3	0.06	0.06	0.06	0.00
Rwanda	1.00	1.00	1.00	0.00	1	0.02	0.02	0.02	0.00
Taxation Variables	Corporate Income Tax					Tax Provision			
Botswana	0.22	0.17	0.26	0.04	2	7.11	-1.40	15.00	3.15
Ghana	0.26	0.25	0.33	0.02	6	2.56	-4.20	14.19	3.01
Kenya	0.30	0.30	0.30	0.00	5	6.95	-3.95	16.70	3.75
Namibia	0.34	0.32	0.35	0.01	2	36.35	-34.10	168.80	36.94
Nigeria	0.30	0.30	0.35	0.01	8	54.10	-25.55	481.40	113.97
South Africa	0.31	0.28	0.38	0.04	6	175.10	-34.10	481.40	126.68
Uganda	0.34	0.33	0.37	0.01	3	3.72	-4.10	13.40	3.59
Zimbabwe	0.27	0.24	0.31	0.03	3	5.59	-7.10	136.10	15.17
Rwanda	0.31	0.30	0.35	0.02	1	2.65	0.06	5.89	1.27

Table 2. continue.. Descriptive Statistics of Key Variables

	Mean	Min	Max	Std dev	Banks	Mean	Min	Max	Std dev
Capital Structure Variables	Leverage					Equity Ratio			
Botswana	0.90	0.86	0.96	0.03	2	0.10	0.04	0.14	0.03
Ghana	0.86	0.78	0.92	0.03	6	0.14	0.08	0.22	0.03
Kenya	0.86	0.82	0.90	0.02	5	0.14	0.10	0.18	0.02
Namibia	0.90	0.86	0.95	0.03	2	0.10	0.05	0.14	0.03
Nigeria	0.87	0.67	1.12	0.05	8	0.13	-0.12	0.33	0.05
South Africa	0.89	0.16	0.95	0.11	6	0.11	0.05	0.84	0.11
Uganda	0.85	0.75	0.92	0.04	3	0.15	0.08	0.25	0.04
Zimbabwe	0.82	0.59	0.91	0.06	3	0.18	0.09	0.41	0.06
Rwanda	0.82	0.78	0.88	0.02	1	0.18	0.12	0.22	0.02

Source: Author's estimates based on the sample data set

The descriptive statistics of the key variables are detailed on Table 2 to explore the properties of the data. According to Table 2, South African banking sector is the most profitable, followed by Nigeria and then Namibia. The least profitable banking sectors are Ghana, and R wanda. The standard deviation for profitability measures is very high, indicating that the data are widely dispersed around the mean. The observation signals that the banking sector of the countries included in the study is very diverse. High corporate income tax is not a factor as far as collection of taxes is concerned. Countries with highly profitable banking sector tends to add greatly to the tax revenue.

Contrary to popular believe the African banking sector is well capitalised. The tier 1 ratio is well above the 8-10% that is recommended by international standards of banking regulation. However, solvency or liquidity is of concern. In the study, solvency is measured as the ratio of current liability to current assets. A low ratio indicates that the banks can quickly convert assets in to cash to meet immediate credit demands. Solvency ratios of the banks across countries are very high indicating that banks may struggle to settle short-term liability.

Countries with oligopolistic banking industry tend to have exaggerated systemic risk. However, when the sector is well diversified with many banks, systemic risk tends to be moderate. The sector is also not characterised by a significant portion of non-performing loans, which is an indication of risk. On average, the sector is highly leveraged. High leverage, non-performing and solvency ratios pose system wide risk for the sector. It remains to analyse figures of some of the key variables.

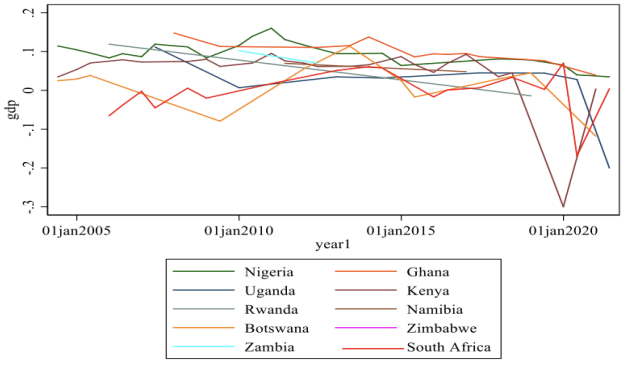


Figure 2. The GDP growth rate of African countries

The GDP growth rate of the African countries is very marginal. This may be the reason why

GDP growth rate comes out insignificant in empirical studies.

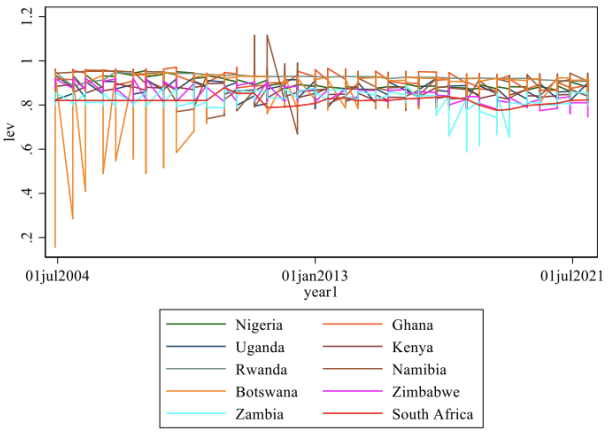


Figure 3. Leverage ratios of banks across countries

African banks maintain very high leverage ratios. Botswana is an exception, but the country also started to raise its leverage ratios to keep up with its peers.

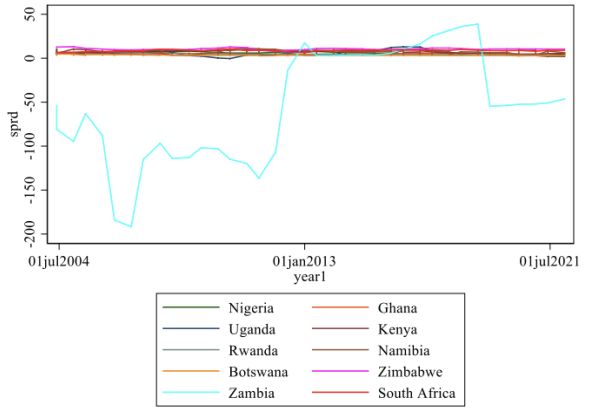


Figure 4. The spread between lending and deposit rates across countries.

The spread between lending and deposit rates is very small indicating that the African banking sector is very competitive. There is a very weak monopoly power hence the banks do not enjoy the benefit of setting very low deposit rates and very high lending rates. It remains to assess the correlation amongst the variables. There is no sign of perfect multi-collinearity amongst model's variables.

Deposit insurance schemes are traditionally used to combat systemic risk. Similarly, the schemes are also used as a tool to safeguard depositors in the event of bank failure. Recently, deposit insurance is taking momentum in Africa (Financial Policy and Systems, 1990). Table 4 below indicates the progression towards the adoption of deposit guarantees by African banks.

Variables	NIM	srisk	npl	tier1	Llp	lev	lqd	size	loans	depo	cit	pit	infl
NIM	1.00												
srisk	-0.02	1.00											
npl	0.07	-0.07	1.00										
tier1	0.03	0.06	0.13	1.00									
llp	**0.36**	0.01	0.01	-0.04	1.00								
lev	-0.23	0.13	-0.15	-0.14	-0.01	1.00							
lqd	0.00	0.00	-0.02	0.02	0.01	-0.01	1.00						
size	0.21	0.00	0.02	-0.02	0.10	-0.03	-0.02	1.00					
loans	**-0.81**	-0.01	0.04	0.04	-0.34	0.03	0.00	-0.23	1.00				
dep	-0.08	-0.09	0.02	0.00	0.01	0.41	0.03	0.09	-0.05	1.00			
cit	0.04	0.01	0.17	0.16	-0.01	-0.31	-0.01	0.00	0.02	0.12	1.00		
pit	**0.53**	0.01	0.00	0.01	0.46	-0.02	0.00	0.21	-0.50	0.02	0.00	1.00	
infl	0.01	0.03	0.07	0.00	0.00	-0.02	0.00	0.04	0.08	-0.10	0.02	-0.03	1.00
tbill	0.06	-0.07	-0.25	-0.12	0.00	-0.10	-0.03	0.01	-0.15	-0.18	-0.11	-0.01	-0.09
gdp	0.06	-0.04	-0.01	0.04	-0.10	-0.02	0.00	0.08	-0.05	-0.02	-0.24	-0.08	-0.11
gov	0.04	-0.10	-0.20	-0.11	0.00	-0.36	-0.01	0.00	-0.18	-0.29	0.05	-0.01	-0.12
rep	0.03	0.08	0.11	-0.05	0.02	-0.02	0.00	-0.02	0.05	-0.23	-0.08	-0.01	0.34
conc	-0.03	-0.07	-0.17	0.02	0.01	0.02	0.00	0.04	-0.09	0.17	0.00	0.03	-0.34
cyc	0.06	-0.11	0.14	-0.05	-0.01	0.19	0.00	0.02	0.04	0.59	0.09	0.00	-0.05
vol	-0.05	-0.07	0.13	0.03	0.00	0.02	0.00	-0.08	-0.03	0.21	0.09	0.00	-0.02

	tbill	gdp	gov	rep	conc	cyc	vol
tbill	1.00						
gdp	0.12	1.00					
gov	0.75	0.01	1.00				
rep	-0.14	-0.03	-0.23	1.00			
conc	0.25	0.12	0.32	-0.94	1.00		
cyc	-0.22	-0.04	-0.27	-0.18	0.07	1.00	
vol	-0.01	0.02	-0.03	-0.04	0.06	-0.11	1.00

Table 3. Correlation Matrix

Table 4. Progression towards the Adoption of the DI Scheme

Year of Establishment	Countries	DI Scheme
2016	Botswana	None.
	Ghana	The Ghana Deposit Insurance Protection
1989	Kenya	Kenya Deposit Insurance Corporation (KDIC)
	Namibia	None
1988	Nigeria	Nigerian Deposit Insurance Corporation
2021	South Africa	Corporation for Deposit Insurance
2019	Uganda	Deposit Protection Fund
2021	Zambia	Deposit Protection Scheme
2003	Zimbabwe	Deposit Protection Corporation
2016	Rwanda	The Deposit Guarantee Fund

Source: Author's own compilation from central banks' websites

4.1 Results

It is a standard practice to estimate the Variance Component Model without covariates to necessitate variation at different levels (Rabe-Hesketh & Skrondal, 2012; Bilgin, 2019; and Perveen et al., 2020). Hence, bank performance is modelled without covariates across four different time periods. In the first results the model is estimated by using the entire sample. The second model is estimated during the period of the Global Financial Crisis (GFC). The third model is estimated prior to the occurrence of the GFC. Lastly, the fourth model is estimated after the GFC. The empirical model that is estimated is:

$$NIM_{ijk} = \beta + \delta_{jk}^{(2)} + \delta_{k}^{(3)} + \varepsilon_{ijk} \tag{20}$$

Equation (20) represents the net interest margin (NIM) at time i of bank j in country k. NIM deviates from the overall mean by the error components, $\delta_{jk}^{(2)}$, $\delta_{k}^{(3)}$ and ε_{ijk}. The entire error term is made up of three error components, hence the term variance components. The model estimates are summarised on Table 5 .

Table 5. Progression towards the Adoption of the DI Scheme

	NIM	NIM	NIM	NIM
	Full Sample	GFC	Pre-GFC	Post-GFC
	2004-2021	2008-2010	2004-2007	2011-2021
Grant mean	0.0232***	0.0236***	0.0289**	0.0221***
	(0.00346)	(0.00345)	(0.00958)	(0.00349)
Country level	-14.27	-5.138***	-23.01	-4.958***
	(7.399)	(0.935)	(.)	(0.544)
Bank level	-3.962***	-4.116***	-2.943***	-4.736***
	(0.145)	(0.147)	(0.131)	(0.406)
Time level	-2.965***	-5.037***	-3.963***	-2.831***
	(0.0216)	(0.0555)	(0.0514)	(0.0255)
		Intraclass Correlation		
ρ (Banks.Country)	0.12	0.877	0.885	0.035
ρ (Countries)	0.001	0.1005	0.0001	0.0213
ρ (Banks)	0.119	0.776	0.885	0.0214
ρ((Time)	0.88	0.1201	0.115	0.965

Standard errors in parentheses. * p < 0.05, ** p < 0.01, *** p < 0.001

In estimating the model, Restricted maximum Likelihood (REML) is used due to limited number of level 3 clusters, that is, only 10 countries are considered (Rabe-Hesketh Skrondal, 2012). According to the results, all the country, bank and time level effects have a significant effect on the mean of NIMs. However, before the crisis, and in the full sample, country level factors have no effect on the outcome of NIMs. This observation is in parallel with the results that are obtained in Tarus et al.(2012) where inflation is revealed to have no significant effect on Kenyan banks NIM. Likewise, in a sample of banks that operate in Tanzania, it is revealed that GDP and inflation worth less to banks NIM (Lotto Kakozi, 2019).The focus is drawn to intra-class correlation to explain the variation that is brought forward by country level, bank level and time level effects on NIM. Across the sample period, the correlation of banks that operate within a country is estimated at 12%. However, before and during the crisis, NIMs of banks that operate within the same country is pronounced, recording a staggering average figure that is above 80%. Likewise, bank level effects explain much of the variation in NIMs

during and before the GFC. This observation is in alignment with the results presented in the study conducted by Tarus et al. (2012), which demonstrate that bank-specific variables exert a notable influence on a sample of banks operating in Kenya. However, bank level factors do not explain much of NIMs variability in the full sample and post the GFC.

The correlation of banks that operate within the same country lowers substantially to 3.5% post the crisis. Strong correlation of banks that operate within the same country is a clear indication of spill over effects that comes with financial crisis. A large between banks, and within country variation is also a convincing indication of banks by country interaction. Hence, it can also be deduced that banks that operate within the same country also benefit from information spill-overs. There is little correlation in banks that operate across Africa, indicating that the sector is unique across countries. The only period when there is improvement in correlation of banks across countries is during the period of global financial crisis. Time level variation does matter for NIMs of African banks. Throughout the sample size, time level effects explain 88% of the variation in NIMs. The time level effect is even more meaningful after the period of global financial crisis. Hence bank managers must pay special attention to time factor as they explain much of the variation in NIMs. However, time effects do not explain much of the variation in NIMs before - and- during the GFC period. It is probable to credit the observation to small sample size associated with both periods. Similarly, country level effects do not drive the variation in NIMs to a large extent. Country level effects are only elevated during the GFC. It remains to estimate the three level hierarchical model with covariates.

4.2 Three-level Hierarchical Model with Covariates

The baseline model estimates with NIM as a dependent variable is summarized on Table 6.

The variance component models with covariates set the platform to test the predictions that are made by the theoretical model. In the first two models leverage ratio is used as a measure of capital structure. Model 2 is estimated without DI to reveal if DI matters in explaining performance. Alternatively, in Model 3 and Model 4 equity ratio is used as a measure of capital structure. In Model 1 the presence of explicit DI reduces performance, which is inconsistent with the model prediction in Equation 18. However, when DI interacts with leverage ratio, all else equal, adoption of DI brings about (0.3-0.267 = 0.03) 3% increase in performance. Intuitively, when explicit DI is in place, the policy improves performance provided that leverage ratio remains fixed.

An increase in leverage leads to a decline in performance, which is consistent with the prediction made by the theoretical model. The results add to the strand of literature that supports the importance of capital structure in explaining performance (DeAngelo & Masulis, 1980; Gatsi, 2012; Boutin-Dufresne et al., 2015; and Anarfo & Appiahene, 2017). In a sample of banks that operate in Ghana it is revealed that long term debt has significant negative effect on performance (Gatsi, 2012). But when leverage interacts with DI, an increase in leverage brings about (0.3-0.399=-0.099) 9.9% decline in performance. Loosely speaking, increasing leverage subject to explicit DI scheme retards performance. The observation is consistent with the moral hazard nature of DI (Berger and di Patti, 2005; Egbuna, Oduh and Ujunwa, 2017 ; and Calomiris and Chen, 2020).

In parallel with model prediction, an increase in equity ratio leads to enhanced performance. In Equation 18 the coefficient of absolute risk aversion is positive. High equity ratio is interpreted as risk aversion as highly capitalized banks are less likely to fail. The observation is consistent with corporate finance theory. When corporates are well capitalized they can undertake projects with positive net present value which improves performance (DeAngelo & Masulis, 1980 and Emery, Finnerty, & Stowe, 2017). In coherent with Equation 18 model prediction, isolated effect of DI on performance is positive when equity ratio is used as a measure of capital structure. Furthermore, when DI interacts with equity, ceterus paribus, an implementation of explicit DI scheme leads to (0.0329 -0.03) 0.29% increase in performance. When equity interacts with explicit DI, an increase in equity leads to

Table 6. Progression towards the Adoption of the DI Scheme

NIM-dependent variable	Model 1 Leverage	Model 2 DI&Leverage	Model 3 DI&Equity	Model 4 Equity
DI	-0.267***		0.0329***	
	(0.0571)		(0.00748)	
SRISK	-0.000626	-0.000906	-0.000626	-0.000906
	(0.000560)	(0.000557)	(0.000560)	(0.000557)
Non-performing loans	0.0753	0.0843	0.0753	0.0843
	(0.0571)	(0.0562)	(0.0571)	(0.0562)
DI*leverage	0.300***			
	(0.0621)			
leverage	-0.399***	-0.325***		
	(0.0746)	(0.0910)		
CIT	0.0321	0.0516	0.0321	0.0516
	(0.0380)	(0.0424)	(0.0380)	(0.0424)
Provision-income tax	1.085*	1.091	1.085*	1.091
	(0.551)	(0.571)	(0.551)	(0.571)
Deposit	-0.0108	-0.0122	-0.0108	-0.0122
	(0.00775)	(0.00918)	(0.00775)	(0.00918)
Net loans	-0.00368	-0.00552	-0.00368	-0.00552
	(0.00474)	(0.00529)	(0.00474)	(0.00529)
Retained earnings	0.00502	0.0105	0.00502	0.0105
	(0.0151)	(0.0207)	(0.0151)	(0.0207)
Liquidity	0.000349	0.000470	0.000349	0.000470
	(0.00195)	(0.00217)	(0.00195)	(0.00217)
Tier 1 capital	-0.0663***	-0.0694***	-0.0663***	-0.0694***
	(0.0159)	(0.0157)	(0.0159)	(0.0157)
Loan-loss provision	0.165*	0.218**	0.165*	0.218**
	(0.0685)	(0.0823)	(0.0685)	(0.0823)
T-bill rate	0.0507***	0.0396***	0.0507***	0.0396***
	(0.0117)	(0.00627)	(0.0117)	(0.00627)
Government bonds	-0.000800**	-0.000920***	-0.000800**	-0.000920***
	(0.000261)	(0.000276)	(0.000261)	(0.000276)
GFC	0.00285	0.00308	0.00285	0.00308
	(0.00182)	(0.00204)	(0.00182)	(0.00204)
COVID 19	-0.000210	-0.00235	-0.000210	-0.00235
	(0.00276)	(0.00342)	(0.00276)	(0.00342)
Size	0.00714	0.00564	0.00714	0.00564
	(0.00736)	(0.00840)	(0.00736)	(0.00840)
Inflation	-0.00000609	-0.00000809	-0.00000609	-0.00000809
	(0.00000419)	(0.00000511)	(0.00000419)	(0.00000511)
GDP	-0.00626	-0.00986	-0.00626	-0.00986
	(0.00990)	(0.0137)	(0.00990)	(0.0137)
Repo	0.0416	0.0269	0.0416	0.0269
	(0.0255)	(0.0272)	(0.0255)	(0.0272)
conc	0.000398	0.000237	0.000398	0.000237
	(0.000250)	(0.000261)	(0.000250)	(0.000261)
Eco-cycle	0.0465	0.0802*	0.0465	0.0802*
	(0.0273)	(0.0404)	(0.0273)	(0.0404)
DI*Equity			-0.300***	
			(0.0621)	
Equity			0.399***	0.325***
			(0.0746)	(0.0910)
_cons	0.387***	0.335***	-0.0116	0.00987
	(0.0621)	(0.0858)	(0.0218)	(0.0254)
Country	-4.754***	-4.504***	-4.754***	-4.504***
	(0.317)	(0.233)	(0.317)	(0.233)
Bank	-5.159***	-4.862***	-5.159***	-4.862***
	(0.677)	(0.544)	(0.677)	(0.544)
Time	-4.373***	-4.312***	-4.373***	-4.312***
	(0.167)	(0.158)	(0.167)	(0.158)
		Intra-clas correlation		
ρ (Banks Country)	0.40	0.50	0.40	0.50
ρ (Countries)	0.28	0.34	0.28	0.34
ρ (Banks)	0.12	0.17	0.12	0.17
ρ((Time)	0.60	0.49	0.60	0.49

Standard errors in parentheses. * p < 0.05, ** p < 0.01, *** p < 0.001. **Note:** In Model 1 performance is estimated with leverage ratio as a measure of capital structure where the presence of DI is controlled for. In Model 2, leverage is still the measure of capital structure, but the presence of DI is omitted to reveal its explanatory power. In Model 3 performance is estimated with equity ratio as a measure of capital structure where the presence of DI is controlled for. Likewise, In Model 4, equity ratio is still the measure of capital structure, and DI is omitted to reveal its explanatory power.

(0.399-0.3), 9.9% improvement in performance. Contrast to what is observed in the case of leverage, DI has favorable outcomes for performance when it is implemented alongside increased capitalisation. The policy implication of the results is that, countries that are contemplating to implement DI should implement the policy along with improved capitalisation and leverage ratios. The observation is also consistent with the claim made by Mao Cheng (2020), that is, reducing deposit insurance coverage along with increased capital reduces the social costs of deposit guarantee. Moreover, high capital has a positive effect on performance of banks that operate within the Tanzanian financial landscape (Lotto & Kakozi, 2019). Risk aversion measure captured by loan loss provision has a positive effect on NIM across all models. The results are in parallel with the Equation 18 model prediction where the coefficient of absolute risk aversion has a positive effect on NIM. The results are also consistent with what is revealed in Tarus et al.,(2012) where loan loss provision has a positive effect on performance of Kenyan banks. The market structure variable comes out positive as predicted in Equation 18, albeit insignificant. The results is in contrast with what is revealed in the sample of Kenyan banks where market concentration has negative effect on bank performance (Tarus et al., 2012).

Treasury bill rates have substantial positive effect on performance which supports the fact that banks have exposure to the sovereign risk. Moreover, treasury bill rates have short maturity and subject banks to less interest rate risk. However long-term government bond yields have significant negative effect on bank performance, which is consistent with economic theory. For instance, long term government bond yields have interest risk, which may affect bank performance negatively (Ho & Saunders, 1981 and Adler & Lizarazo, 2015). This observation is also consistent with the theoretical model prediction where return on initial wealth contributes negatively to NIM. Regulatory capital has significant negative effect on performance across all the models. The results are consistent with the notion that regulatory capital restricts funds that can be allocated for loans, which is detrimental to performance (Berger, 1995, Ezike & Oke, 2013 and Anarfo & Appiahene, 2017).

In all the models bank and country level variables have mixed effect on bank performance. The observation drives one to question which variables have relatively more weight in explaining bank performance. For instance, when DI is controlled for, country level effects explains 23% variation in bank performance, whereas bank level effects explain 12% of the variation in bank performance. Consequently, time level effects have more weight in explaining changes in bank performance. However, in the absence of DI policy dummy variable, there is increase in the variation that is brought by country and bank level effects in explaining bank performance, whereas the variation that is brought forward by time level effect declines. In general, time level effect accounts for much of the variation in bank performance, followed by country and bank level effects. The results are consistent throughout all the models. The results of the study are consisted with the study that is conducted by Perveen, Aksar, Haq, & Hassan (2020), where it is revealed that firm-year level explains much of the variation in dividend payout. The realization that time level effects explains much of the variation in bank performance is conceivable. For instance, an economic shock that occurs at a particular point in time, has a tendency to spill-over to subsequent time periods before it dies off. In addition, observations or occasions within a bank bear even more correlations. However, in the study both the GFC and Corona Virus dummy variables are insignificant. This may be due to the fact that the GFC never had dire effects on bank performance of developing nations. In fact, during the GFC many emerging markets experienced increased capital inflows and relatively strong exchange rates (Mabe & Kabundi, 2012). In the case of the global pandemic, the emerging markets experienced it between 2020 and 2021. The sample size is not big enough to map out the after effects of the COVID 19 pandemic. In line with economic sense, GFC and COVID 19 have positive and negative effect on performance respectively, albeit insignificant. For robustness purposes, a three-level hierarchical model is estimated across different periods.

The model is estimated before, during and after the GFC to achieve consistency. In line with the results of the main regression, the presence of DI has significant negative impact on performance

Table 7a. Robustness Checks: Three level Hierarchical Model Across Different Time Periods

NIM	Model 5 Before GFC	Model 6 During GFC	Model 7 After GFC
DI	-0.175	-0.107**	-0.0131
	(0.209)	(0.0374)	(0.0267)
SRISK	-0.00459	-0.00369*	-0.000312**
	(0.00368)	(0.00162)	(0.000113)
Nonperforming loans	0.223	0.203*	-0.00797
	(0.139)	(0.0890)	(0.0143)
DI*leverage	0.203	0.111**	0.0105
	(0.233)	(0.0418)	(0.0310)
Leverage	-0.395***	-0.122***	-0.0648
	(0.0623)	(0.0242)	(0.0398)
CIT	-0.0365	0.0978*	-0.0139
	(0.0643)	(0.0410)	(0.0185)
Provision for income tax	1.523*	-0.580***	1.757***
	(0.617)	(0.114)	(0.252)
Deposits	-0.00603	-0.00136	0.00763
	(0.00519)	(0.00635)	(0.00464)
Net loans	-0.00478	0.00894***	0.0193
	(0.00773)	(0.000798)	(0.0112)
Retained earnings	0.00305	0.00940	0.00662
	(0.00702)	(0.0166)	(0.00676)
Liquidity	-0.00121	0.00177	0.0000293
	(0.00131)	(0.00251)	(0.00125)
Tier 1 capital	-0.112*	-0.0178	-0.00909
	(0.0448)	(0.0293)	(0.0103)
Loan loss provision	0.785***	0.144	0.432***
	(0.219)	(0.173)	(0.110)
Treasury bill	-0.0373	0.00244	0.0287*
	(0.0434)	(0.0140)	(0.0133)
Government Bonds	0.000567	-0.000268	-0.000310
	(0.000619)	(0.000510)	(0.000174)
GFC			0.00111
			(0.00120)
COVID 19			-0.000200
			(0.000937)
size	0.00139	-0.00591	-0.0119**
	(0.00578)	(0.00556)	(0.00404)
Inflation	-0.00000154	-0.00179	-0.0000730**
	(0.00000516)	(0.00169)	(0.0000224)
GDP	0.0119	-0.0216*	-0.00404
	(0.0226)	(0.0110)	(0.00604)
REPO	-0.216***	0.00845	0.00254
	(0.0569)	(0.0241)	(0.0151)
Conc	-0.00201***	0.0000571	-0.0000219
	(0.000578)	(0.000271)	(0.000152)
Eco-cycle	0.113	0.0693	0.00157
	(0.0680)	(0.0420)	(0.0101)
cons	0.448***	0.148***	0.107**
	(0.0524)	(0.0347)	(0.0336)
Country	-19.59	-23.31	-5.073***)
	(135.3)	(113.1)	(0.192))
Bank	-6.739	-4.591***	-5.675***
	(88.13)	(0.177)	(0.360)
Time	-4.058***	-5.338***	-5.055***
	(0.408)	(0.527)	(0.237)
	Intra-clas correlation		
ρ (Banks Country)	0.005	0.816	0.556
ρ (Countries)	0.000	0.001	0.428
ρ (Banks)	0.005	0.816	0.128
ρ((Time)	0.95	0.183	0.443

Standard errors in parentheses. * p < 0.05, ** p < 0.01, *** p < 0.001. **Note:** Model 5 is estimated before the GFC, which is the period between 2004 and 2007. Model 6 covers the period of the GFC, which is the period between 2008-2010. Finally Model 7, represents the post crisis period, which is between 2011-2021

Table 7b. Robustness Checks: Three level Hierarchical Model Across Different Time Periods without DI factor

NIM	Model 8 Before GFC	Model 9 During GFC	Model 10 After GFC
SRISK	-0.00546	-0.00358*	-0.000271*
	(0.00372)	(0.00165)	(0.000132)
Non-performing loans	0.186	0.264**	-0.0103
	(0.137)	(0.0854)	(0.0150)
leverage	-0.395***	-0.107***	-0.0510
	(0.0510)	(0.0230)	(0.0339)
CIT	-0.0308	0.0915*	-0.0141
	(0.0598)	(0.0463)	(0.0200)
Provision for income tax	1.490*	-0.574***	1.764***
	(0.581)	(0.119)	(0.247)
Deposit	-0.00600	-0.00277	0.00713
	(0.00493)	(0.00652)	(0.00520)
Netloans	-0.00798**	0.00670***	0.0208
	(0.00296)	(0.000538)	(0.0110)
Retained earnings	0.00237	0.0104	0.0102
	(0.00556)	(0.0158)	(0.00718)
Liquidity -	0.000736	0.00196	0.0000940
	(0.00115)	(0.00246)	(0.00124)
Tier 1 capital	-0.115*	-0.0179	-0.00889
	(0.0450)	(0.0315)	(0.00963)
Loan loss provision	0.810***	0.182	0.436***
	(0.204)	(0.174)	(0.117)
T-bill rates	-0.0380	-0.00426	0.0251*
	(0.0444)	(0.0151)	(0.0105)
Government bonds	0.000544	-0.0000559	-0.000297
	(0.000594)	(0.000557)	(0.000172)
GFC			0.00107
			(0.00122)
COVID 19			-0.00107
			(0.00102)
Size	0.00151	-0.00530	-0.0118*
	(0.00548)	(0.00588)	(0.00461)
Inflation	0.000000794	-0.00242	-0.0000605
	(0.00000540)	(0.00213)	(0.0000360)
GDP	0.00411	-0.0186	-0.00391
	(0.0360)	(0.0108)	(0.00638)
REPO	-0.213***	0.0110	0.00258
	(0.0611)	(0.0293)	(0.0158)
Conc	-0.00195**	0.000155	-0.0000226
	(0.000620)	(0.000290)	(0.000158)
Eco-cycle	0.106*	0.100***	0.00288
	(0.0527)	(0.0272)	(0.0114)
cons	0.450***	0.135***	0.0958***
	(0.0430)	(0.0318)	(0.0230)
Country	-18.55	-23.65	-4.880***
	(85.26)	(86.65)	(0.190)
Bank	-6.821	-4.586***	-5.640***
	(27.79)	(0.219)	(0.360)
Time	-4.054***	-5.322***	-5.050***
	(0.288)	(0.153)	(0.235)
	Intra-clas correlation		
ρ (Banks Country)	0.004	0.814	0.631
ρ (Countries)	0.000	0.001	0.518
ρ (Banks)	0.00396	0.813	0.113
ρ((Time)	0.996	0.186	0.368

Standard errors in parentheses. * p < 0.05, ** p < 0.01, *** p < 0.001. **Note:** : All the models are estimated without the DI factor. Model 8 is estimated before the GFC, which is the period between 2004 and 2007. Model 9 covers the period of the GFC, which is the period between 2008-2010. Finally Model 10, represents the post crisis period, which is between 2011-2021

during the GFC. Before and during the GFC, leverage remains to have negative effect on performance when it is interacted with DI. After the GFC the effect is negligible. Consistent with the baseline model, time effects explain much of the variation in bank performance before the GFC. In contrast with the main regression results, during the GFC much of the variation in bank performance is explained by bank level effects. There is also strong bank by country interaction. In parallel with main regression results, post the GFC much of the variation in bank performance is explained by country and time level effects. Likewise, there is a strong presence of bank by country interaction. It remains to be seen how the model estimations change in the absence of explicit DI dummy.

There is no substantial change in the results when the models are estimated without the DI factor. Country level effects do not explain much of the variation in performance before and during the financial crisis. Similar results are achieved when DI factor is controlled for. However, after the GFC, country level effects explain 52% of the variation in performance. The proportion of the variation in performance that is explained by country level effects improves by 9% in the absence of DI. Moreover, bank by country interaction increases in the absence of DI. In the presence of DI, there is reduced correlation between banks that operate in a single country. This observation is striking as it indicates that DI scheme is more likely to contain risk in the banking system. For instance, if one bank fails it will not threaten confidence in the banking sector for a given country. Similar results are obtained in the main regression. The observation is consistent with the fundamental principle of a DI cooperation scheme, which is to contain bank runs (Diamond & Dybvig, 1983). In line with Equation 18, less monopoly power has significant negative effect on bank performance before the GFC. As illustrated in Figure 4 the spread between lending and deposit rates in Africa is very small, which is an indication of weak monopoly power. The results are consistent with the revelation made in Tarus et al., (2012) where market concentration has negative effect on performance.

All the models point out to the importance of time and macroeconomic factors in driving performance (Tarus et al., 2012). However, the results do not overwrite the importance of bank level effects. Bank level effects explain much of the variation in performance during the GFC. The study contributes to the on-going debate on which factors are important in driving bank performance. It is revealed at some instances that macroeconomic factors are important, with time level effects carrying more weight.

Residual Diagnostic

Residual diagnostic of the two base-line models are detailed in Figure 5.

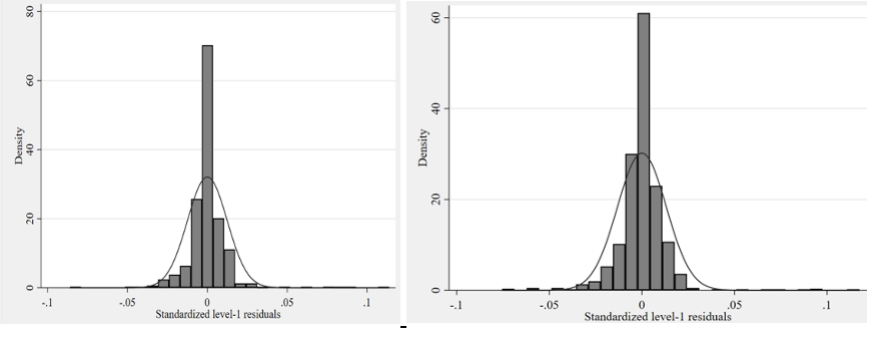


Figure 5. Residuals of full sample with and without DI policy dummy

The residuals of the main regression model with and without DI policy dummy variable is detailed in Figure 5. The residuals of both models are symmetric and approximately normal, with a peak at zero. All the models are predicted with robust residuals, where it is not an absolute requirement for the

residuals to be independent and identically distributed. However, approximately normal disturbances grant a level of comfort about the variables of the models. For instance, from normally distributed residuals, it is inferred that the model's variables have finite moments and are also approximately normal. Consequently, it is deduced that the sample estimates of population parameters are efficient and consistent.

4.3 Discussion

While bank-specific and country specific variables matter in explaining variation in NIMs or bank performance, time effects explain much of the variation in NIMs and the sensitivity increases during the periods of distress like GFC. The rationale of our findings are consistent with what is observed by Perveen et al. (2020) where it is observed that firm year effects explain much of the variation in dividend policy in a sample of firms that operate in Pakistan. Therefore, our results are consistent with the notion that temporal effects are crucial in understanding performance and policy dynamics in a range of financial contexts.

In order to further bolster the robustness of our models and to assess the predictive capacity of the theoretical framework, covariates are consequently added in the model. When adoption of DI by African banks is interacted with leverage, the combined effect has a tendency to increase net interest rate margin provided that leverage remains constant. However, when DI remains constant, the combined effect of leverage and DI reduces performance subject to increase in leverage. When equity ratio is used as a measure of capital structure, the combined effect of DI and equity on bank performance is positive, which indicates that explicit DI policy should be implemented alongside increased capitalization. The moral hazard traces of the results is illuminated when an increase in leverage reduces performance subject to explicit DI that is in place.

The results are in line with that of Egbuna et al.(2017) where it is revealed that explicit DI should be implemented alongside policies that enhance banking system resilience. For instance it is revealed in Egbuna et al.(2017) that explicit DI is associated with African countries with high corruption index, high inflation and low growth. Conversely, implicit DI is associated with strong institutions and well-developed financial sector. It is further emphasized that, instead of African countries to blindly jump into the explicit DI bandwagon, the countries should implement a policy that is favorable to each country's economic circumstances and the depth of institutional strength (Egbuna et al., 2017).

The study further controls for factors such as; interest rates, risk aversion and market structure as laid down in the theoretical model. Treasury bill rates have significant positive effect on NIMs in the baseline model. The results are consistent with that of Godspower-Akpomiemie & Ojah (2017) where it is revealed that interest rate shocks have positive outcomes for African banks' net worth. Variables that proxy for risk aversion are , tier 1 capital adequacy ratio, equity ratio, and loan loss provision. In the baseline model, the overall effect of tier 1 capital on NIM is negative and significant, which is consistent with the notion that regulatory capital is detrimental to bank performance. Ezike & Oke (2013) use shareholders fund as a measure of capital adequacy for a sample of banks that operate in Nigeria and establish that capital adequacy has significant negative effect on bank performance.

However, other measures of relative risk aversion such as equity ratio and loan loss provision have positive effect on NIM. The empirical findings aligns with previous research, notably that of Gatsi (2012) and Lotto & Kakozi (2019) where it is revealed that capital structure matters for performance of a sample of banks that operate in Ghana and Tanzania. Market structure variable is captured by the spread between lending and deposit rate indicated by conc. In the baseline model the market structure variable has no significant effect on NIMs. However, the theoretical model predicts positive relationship between NIM and monopoly power. It is strongly believed that the variable matters, hence we need to pursue a better proxy to capture market power. The market power variable proves to matter in the analysis carried out by Saunders & Schumacher, (2000) as it is associated with high

NIMs for a sample of banks that operate in the US and Europe.

Overall, empirical evidence leads to four policy recommendations. Firstly, bank managers should pay more attention to year-specific events as they explain much of the variation in bank performance. For instance, there should be enough reserves to contain economic shocks as the African banking sector is susceptible to shock spells. Moreover, banks should increase the level of risk-weighted assets due to negative outcomes of holding excessive regulatory capital. Consequently, banks should strive to achieve optimum capital. Optimum capital is the capital that is enough to contain economic shocks yet not detrimental to performance (Mao & Cheng, 2020).

Secondly, macroeconomic policy can be used as a tool in improving bank performance. Thirdly, bank specific factors matter during the period of GFC, and should also be considered in bank performance enhancement. Finally, countries that have intensions to implement explicit deposit schemes must be cautious due to the moral hazard element that comes with deposit insurance policies. Explicit DI Cooperation Schemes should be implemented along with reduced leverage and increased equity to ensure performance and elimination of moral hazard.

5. Conclusion

The purpose of the study is to develop a simple conceptual framework that sets the platform to quantify the relative importance of time, firm, and country specific factors in driving the variation in bank performance. The purpose is achieved by applying a three-level hierarchical model on a sample of 37 African banks that operate across; Nigeria, Ghana, Kenya, Uganda, Rwanda, South Africa, Namibia, Botswana, and Zimbabwe for the period between 2004 and 2021. In the analysis, it is empirically revealed that time effects carry more weight in explaining the variation in bank performance, followed by macroeconomic factors and lastly bank specific factors. Bank specific factors matter more in the period of the GFC. The reason time specific factors carry more weight is that observations of the same bank within a country bear more associations. Hence, a shock in one bank at a point in time is more likely to influence observations in the subsequent time for that specific bank, which ultimately influences performance. Strong within country and banking sector correlation is also revealed during the GFC.

The significant and unique contribution of the study is that deposit insurance policy has unfavorable outcomes for African bank performance when it is implemented along increasing leverage ratios. However, when equity is increased subject to explicit DI guarantee, the policy has favorable outcomes for performance. The results clearly establish that explicit DI schemes have positive outcomes when they are implemented sensibly. The limitation of the study is that only a limited number of banks within every country is considered. The study may lead to interesting results when more banks are added. Moreover, the study should be tested with different measures of market structure to test the theoretical model consistency.

Biography notes

Queen Magadi Mabe is currently a lecturer in the School of Economics, University of Johannesburg. She holds a Bachelor of Science degree in Economics and Pure Mathematics, complemented by a Bachelor of Science Honors degree in Pure Mathematics from the University of the Witwatersrand, and a Master of Commerce in Financial Economics from the University of Johannesburg. She is actively engaged in the pursuit of a Doctor of Philosophy (PhD) in Economics with the University of Johannesburg.

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Her perspective underscores the pivotal role played by banks in Africa as intermediaries facilitating the mobilization of capital from savers to investors. Driven by a steadfast belief in the transformative potential of banking institutions, she asserts that their performance holds the key to fostering the development urgently required in the African context.

Beatrice Desiree Simo-Kengne is professor in the School of Economics at the University of Johannesburg, South Africa. She holds a PhD in economics from the University of Pretoria, masters in monetary and banking economics, economics and financial economics respectively from the University of Douala, Cameroon, University of Pretoria and University of Johannesburg, South Africa. Her research interests lie in the fields of sustainable development- including but not limited to- housing, asset prices, agriculture, environment, performance evaluation, risk management, gender, health and trade. She is alumna of the World Academy of Sciences/DFG, affiliate of the African Academy of Sciences and serves as mentor for the ClimapAfrica programme of the German Academic Exchange Services.

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Conflicts of interest

The authors declare no conflict of interest.

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