

Bank Regulatory Capital and Performance: Evidence from Sub Saharan Africa

Adamu Yahaya¹, Fauziah Mahat² and
B.T Matemilola³

Continuous failure of banks witnessed across the Sub Saharan African region is a great source of concern among practitioners and society. The study seeks to evaluate the association between bank regulatory capital and performance. A panel of 50 public listed banks was drawn across 6 Sub Saharan African countries for a period of 9 years (2010-2018). This research paper makes use of the two-step system-generalized method of moment (GMM) as the most relevant technique of estimation due to its advantages of mitigating endogeneity problems and providing consistent estimates. The study found that bank regulatory capital has a positive significant association with performance. Moreover, the non-performing loan was found to have a negative significant association with bank performance. The results suggest that bank management should keep their non-performing loans at the barest minimal rate and ensure compliance with bank capital regulations.

Keyword: Tier 1 Capital, Non-Performing Loan, Return on Asset, SSA, System GMM

JEL Code: G03, G21, G28

1. Introduction

Banks play a vital function in the economic well-being of developing economies. They help in the mobilization of finance from surplus units to the unit of the economy in deficit so as to facilitate business activities (Rao, Shahzad, Sun, & Umar, 2018). Banks serve as a financial

¹ Department of Business Management, Federal University Dutsinma, Nigeria.
ayahaya2@fudutsinma.edu.ng

² Department of Accounting and Finance, Faculty of Economics and Management,
Universiti Putra Malaysia f_mahat@upm.edu.my

³ Department of Accounting and Finance, Faculty of Economics and Management,
Universiti Putra Malaysia matemilolabt@gmail.com

intermediary and provide indispensable financial services that initiate and promote economic growth (Oppong & Pattanayak, 2019).

The financial intermediary theory provides that liquidity creation is among the major function of banks alongside risk intermediation role. Guillen, Rengifo, & Ozsoz, (2014), posits that the importance of banks is not only restricted to promoting economic growth, but it is also equally vital to know that, they are in a sector characterized with high instability which could have a serious effect on the economy in general. It is equally found that stability in economic and political system helps in enhancing bank capitalization and reducing financial sector risk (Bitar, Hassan and Saad, 2020; Bitar, Hassan, & Hippler, 2018; Bitar, Hassan, Pukthuanthong and Walker; Bitar, Hassan and Walker, 2017). Firms need to measure their performance to a larger extent in order to identify problems and provide improvement, particularly in a complex and competitive environment like the banking sector (Celen, 2014). The increasing failure rate of Sub Saharan African banks has become a great source of concern with very limited attention given by scholars.

Banks in Sub Saharan Africa are generally poorly capitalized. Trabelsi and Trad, (2017), showed that bank capital is found to be the major indicator that promotes profits maximization and stability of Islamic banks and minimization of their credit risk. Better capitalized banks are seen to have better chances of having good performance ratings. Many factors have justified reasons why banks should hold large amounts of capital in their fold (Berlin, 2011). Allen, Carletti, and Marquez, (2011) and Mehran and Thakor, (2011), note that a higher level of capital encourages proper handling of loans which in return results in higher profits or market valuation. On the other hand, other scholars believe that larger capital levels could result in excessive risk-taking. Vanhooose,(2007), believes that holding larger capital could result in excessive risk-taking, which may affect profit due to problems with non-performing loans. In view of this likelihood, debtors require a premium to finance banks. The expectation of international reform towards an increase in capital requirements to safeguard bank performance is highly relevant in Sub-Saharan Africa (International Bank for Reconstruction and Development, 2013). The banking industry has been among the sectors that are highly regulated in the economy (Bleck & Bleck, 2018).

Since the emergence of the Basel Agreement, a series of banks' regulatory requirement has come in to being particularly on bank capital. The Basel I Accord was enacted in 1989, which was followed by Basel II in 2004 and the most recent in 2010, which is the Basel III, coming immediately after the global financial crises to correct the weaknesses of Basel II, which led to global financial crises. Banks' capital regulation has emerged following the series of Basel Accord in an attempt to sustain the banking system stability and address some of the challenges with banks which result in financial crises.

The main aim of Basel III agreement is to enhance the size and value of bank's equity base. The recent prudential standard, makes provision for three related capital measurement requirement; i.) Tier 1 capital, with 6 percent of tier 1 capital to risk weighted asset minimum requirement, ii.) At least, 8 percent of capital to risk weighted assets, for capital adequacy ratio and iii.) A minimum requirement of 4.5 percent of common to risk weighted assets for tier1 common equity. Banks in Sub Saharan Africa continue experiencing poor performance despite these new capital regulatory requirement reforms. Capital regulations do not increase the capital ratios of banks in developing countries. Moreover, attention should be given to the business, environmental, legal, cultural realities of such countries while designing and implementing policies for developing countries (Hussain, Hassan and Haque, 2014; Tran, Hassan, Paltrinieri and Nguyen, 2020; Hossain, Hassan and Haque, 2011; Hassan, Hossain and Kayed, 2011).

The study has in many ways add to the stock of the relevant literatures. To the best of my knowledge, it is hard to find a study that examines the causal correlation between bank performance and bank capital from Sub Saharan Africa. Specifically, the study evaluates the influence of one of the Basel III measures of bank capital on Sub Saharan African Banks. Therefore, the study contributed to the body of existing literature relating to bank capital and bank performance (Altunbas, Gardener, Molyneux, & Moore, 2001; Berger & Bonaccorsi di Patti, 2006; Rao et al., 2018). Moreover, the study investigates the relationship of banks in emerging economies with respect to their performance and capital formation, using a recent set of data and focusing on SSA countries. Our focus on SSA countries (developing economies) is because of its potentials in the future as most literature focused on advanced countries. In addition, the study provides policymakers with the importance of maintaining bank

regulatory capital requirements as well as the danger attached to high non-performing loan profiles.

The remainder of the study is organized as follows: Section 2 discuss the literature review and hypotheses development. Section 3 explain the methodology and data description. Section 4 discusses the empirical result while section 5 provides conclusion and the policy implication.

2. Literature review

Basel III provision made a strong recommendation to the compliance to Tier 1 Capital. Regulatory Tier 1 Capital is a tangible subordinated tool or common equity with a complete non-cumulative dividend and having neither maturity nor a redeem incentive. There is a phase-out in innovative hybrid capital tools. Therefore, an increase in Tier 1 Capital, increase shareholders equity. Based on theoretical postulation, equities of the bank is seen as the most difficult form of capital because of its residual claim and higher risk. Empirically, banks Tier 1 Capital as a share of total assets is minimal, which explains why a major rise in equity would be needed to meet up available stable funding. Various empirical studies on bank capital and performance are discussed below.

Berger, (1995), reported a positive association between return on equity (ROE) and capital adequacy ratio (CAR) and further proposes many theoretical explanations. One of such is the prediction that for a bank sustaining CAR less than the position of its equilibrium, the anticipated rate of bankruptcy may be relatively high. He added that an additional increase in CAR should result to minimize expenses of insurance on uninsured debt through ROE increase. Bourke, (1989), find a positive association between profitability of banks and capital ratios. He added that better capitalized banks might benefit from access to less risky and cheaper funds sources and better quality.

Molyneux and Thornton, (1992), in their work on European Banks, reveal a positive association between concentration and return on capital and a positive association with nominal interest rates. In contrast, to Bourke, (1989), who reported a negative association between government ownership and return on capital, this study finds an important association, which suggests that private sector competitors receive fewer profits compared to state-owned banks.

Jacques and Nigro, (1997), in their study, which examines the effect of risk-based capital standards on the portfolio's risk and bank capital. The research used the three-stage least square (3SLS) technique to identify the association between the variables and found that the standards risk-based capital was strong in minimizing risks of the portfolio in public listed banks and increasing capital ratios. Rime, (2001), investigates the association between bank behaviour and capital requirement of Swiss banks. The study uses a simultaneous equation method to determine capital adjustment and risk. The result showed that regulatory authorities need to encourage banks to raise their capital, but it does not affect the risk level.

Goddard, Molyneux, and Wilson, (2004), in their research work which evaluates European banks' profitability using dynamic, cross-sectional and pool cross-sectional time series. The result of any systematic size profitability or consistent association is weak. The association between the relevant of off-balance sheet business on profitability and banks' portfolio is positive for the UK, but it is either negative or neutral elsewhere. The association between profitability and capital asset ratio is positive. Meanwhile, Goddard et al., (2010), found an association between profitability and capital to be negative which exhibits the standard risk-return pay off for 8 European country members in 1992 and 2007.

Hoffmann, (2011), investigates profitability determinants of banks in the US between the periods of 1995-2007. The study used the GMM system estimator and the findings revealed that there is a negative association between banks' profit and capital ratios, which is backed the views that banks operate over cautiously and neglecting opportunities with better profit prospects. Moreover, they highlight, to a non- monotonic association between profits and capital ratios

Mehran and Thakor, (2011), study the bank capital and bank value in the cross-section. The empirical results support the hypothesis, which states a positive correlation between total bank value and bank's equity. In addition, this research also confirms the hypothesis that different banks value components are associated with positively cross-sectional with bank capital. Osei-assibey and Asenso, (2015), conducted a study to find the association between bank performance and capital regulatory requirement of banks in Ghana. The findings of the research reveal that

despite the fact that excess capital increases profitability as a result of net interest margin (NIM), it may also lead to surplus risk-taking that result to a higher rate of non-performing loans.

Maji and Hazarika, (2018), conducted a study, which evaluates the associates between risk-taking and capital regulations of banks in India, after considering the effect of competition. They use listed 39 sampled commercial banks in India within the period of 15 years. The research used the 3SLS method in a simultaneous equation form to control the direction of the relationships. The findings of the research show that bank risk and regulatory capital maintain a positive relationship, with an insignificant effect of capital on risk. Competition effect on risk is inverse, for both models that support the stability view of competition. The correlation between bank risk and human capital is found to be all-negative.

In view of the above empirical studies, the below hypotheses have been formulated and would be used to guide the study.

H₁: There is significant association between bank regulatory capital and performance in Sub Saharan Africa.

H₂ : There is a significant relationship between bank size and performance in Sub Saharan Africa.

3. Data and Methodology

3.1 Data

Sub Saharan Africa has a total of 49 Countries. According to the International Institute of Finance report in 2016, the largest financial market in the region is found in Nigeria, Ghana, South Africa, Zambia, Kenya, and Tanzania, representing West, South and East Africa respectively. The banks within the six countries constitute our population. The sample of the study is drawn based on available data within the study period of 2010 to 2018. From the population of 84 public listed commercial banks in these six Sub-Saharan Africa countries, a sample of 14 banks was drawn from Nigeria, 9 from Ghana, 9 from South Africa, 3 from Zambia and 5 from Tanzania. Other banks could not make the sample due to the inability of the researcher to get access to their data from the source. Data associated with the banking industry-specific

variables are obtained from Thomson and Reuters Data Stream, while macro-economic variables data are collected from the World Bank database. This study intends to use data from public listed banks only, in line with (Distinguin, Roulet, & Tarazi, 2013).

3.2 Variable Description

The variables are divided in to four categories; they include the dependent variables, the independent variable, the bank specific variable and the macroeconomic level variables. Details of the description of the variables is presented in the table below;

Table:1

Variable	Definition	Code
Dependent Variable		
Return on asset	The bank's net profit after tax divided by total asset	ROA _{ijt}
Return on equity	The bank's net profit divided by total equity	ROE _{ijt}
Independent		
Tier 1 capital	Ratio of core equity capital to total risk-weighted assets	TIER _{1ijt}
Bank specific variable		
Deposit ratio	Proportion of total deposit to total asset	DEP _{ijt}
Capital adequacy ratio	Proportion of total equity to total asset	CAR _{ijt}
Loan ratio	Proportion of total loan to total asset	LON _{ijt}
Bank size	log of total asset	BSZ _{ijt}
Capital asset ratio	total capital to total asset	CAS _{ijt}
Non-performing loan	Proportion of non-performing loan to total loan	NPL _{ijt}
Leverage	Total debt to total capital	LEV _{ijt}
Macro level		
Inflation	Annual consumer price index percent	INF _{jt}
Gross domestic product	GDP growth rate in percent	GDP _{jt}

Source: Author Compilation based on Literature, 2020

3.2.1 Regulatory tier 1 Capital

This is one of the latest capital measurements tool invented by Basel III Accord. It is the primary capital component of the bank. This is the main

variable of interest. It is estimated as a proportion of risk-weighted assets. A rise in values of the ratios means more capital value as a proportion of assets. According to the hypothesis of the absorption of risk, the association between bank liquidity creation and bank capital is positive (Bhattacharya, & Thakor, 1993; Repullo & Suarez, 2004). On the other hand, based on the Gorton and Winton, (2017), crowding out effect of deposit theory and the fragility, financial structure of Diamond and Rajan, (2000), hold that there is a negative association between regulatory bank capital and creation of liquid in the bank. It is worthy to note that, banks can only perform better if they operate within optimal liquidity. It is therefore worthy of the research undertaking to evaluate bank regulatory capital and performance association within the context of Sub Saharan Africa.

3.2.2 Bank specific variables

It is important while conducting research relating to banking industries to incorporate variables that will add impact on the predicted relationship based on available literature. The variables to include consist of total deposit to total asset ratio (DEP), which is a good bank liquidity measurement and bank stability behaviour. Having higher value means lower risk and vice versa. The study intends to use the natural log of total assets to determine the Bank size as used by (Berger, Bouwman, Kick, & Schaeck, 2016). The association between bank size and profitability is ambiguous. Profitability and bank size are positively correlated (Smirlock, 2013). Others like Dietrich and Wanzenried, (2011), posits a relative larger banks are in a better position to minimize processing information and gathering cost and realize the scale of economies. Therefore, bank size should be positively related to its performance.

The ratio of total loan to the total asset is used to measure lending specialization, as used in (Le, 2017). The proportion of non-performing loans to the total loan (NPL) is used as a measurement of bank stability (Chaabouni, Zouaoui, & Ellouz, 2018). Total equity to total asset measures the capital adequacy ratio (CAR), total capital to total asset measures capital asset ratio (CAS) and total debt to total capital was used to measure leverage (LEV).

Return on equity and return on asset are bank performance measurement in terms of its profitability. Return on asset is measured as total net income

to the total assets, where return on equity is the net profit by total equity (Al-Sartawi, 2018). Higher profitability is associated with having a high capital ratio, which is a result of higher liquidity creation. In other words, having higher profitability may result in having a high rate of non-performing loans, which may affect liquidity as well. According to Tabak, Noronha, and Cajueiro, (2011), a positive relationship exist between return on asset and capital ratios. This is also in agreements with the views of Berger & Bonaccorsi di Patti, (2006), on charter value hypothesis who hold that efficient and greater profitable banks are encouraged to hold extra capital from their returns so as to be safeguarded against liquidation. In other words, Berger et al., (2016), belief that the relationship is negative. The association between capital ratios and bank performance has received limited attention in Sub Saharan Africa.

3.2.3 Macroeconomic control variable.

The two major macroeconomic variables have been incorporated into the work, so as to control for macroeconomic factors influence on bank performance. A consumer price index and gross domestic product growth rate measures Inflation rate (INF) and gross domestic product respectively (GDP) respectively. The measures control for the business cycle, as in Chaabouni et al., (2018).

3.3 Model Specification and Estimation Technique

3.3.1 Model Specification

This study seek to determine the association between regulatory tier1 capital and performance. The main independent variable of interest is the tier1 capital ratio. Other bank-specific variables includes capital adequacy ratio (CAR), total deposit loan ratio(DEP), total loan ratio(LON), natural log of total asset(BSZ), non-performing loan ratio(NPL), capital asset ratio (CAS), leverage (LEV), and other macroeconomic variables that include inflation(INF) and gross domestic product (GDP). Based on the earlier discussed literature, and the purpose of this research, we modified the work of Ashraf, Rahman, Rahman, and Zheng, (2018), to establish the association between bank capital and performance.

$$\begin{aligned}
PER_{ijt} = & PER_{ijt-1} + \beta_0 + \beta_1 TIER1_{ijt} + \beta_2 CAR_{ijt} + \beta_3 DEP_{ijt} \\
& + \beta_4 BSZ_{ijt} + \beta_5 NPL_{ijt} + \beta_6 LON_{ijt} + \beta_7 CAS_{ijt} \\
& + \beta_8 LEV_{ijt} + \beta_9 INF_{jt} + \beta_{10} GDP_{jt} + \eta_i + \lambda_t + \varepsilon_{ijt}
\end{aligned}$$

Panel data is the most relevant approach when the study sample consisted of cross-section and time-series data. In this regard, one of the key importance of the use of panel data is that it permits addressing issues relating to heterogeneous characteristics, unobservable (Matemilola et al., 2018) and constant issues of each bank that constitute part of the study sample (Hoffmann, 2011). Meanwhile, the classical problem of endogeneity has to be addressed in this kind of study, through the methodology, because of the possibility of reverse causality as the dependent variable (ROA and ROE) can predict the independent variables on the right-hand side of the model (Baltagi, 1995). Moreover, previous year bank performance (PER_{ijt-1}) can affect current year performance (PER_{ijt}) which justifies the use of dynamic panel model specification. Subscript i , j , and t stand for the bank, country, and time respectively.

3.3.2 Estimation Technique

The study uses the system GMM to evaluate the association between bank regulatory capital and bank performance. The reason behind the choice of this method is due to the numerous advantages of the method over others. One of the main reason, is because, the main static panel data models, that include Pooled OLS model, random effect model, and fixed effect model posed prospective endogeneity related problems initiated by explanatory variables or provide parameters values that are inconsistent and bias because of lagged dependent variable presence (Harris & Mátyás, 2004; Nickell, 1981). Therefore, the technique propounded by Arellano and Bover, (1995) and Blundell and Bond, (1998), that is the system GMM is capable of addressing the biases produced by other less strong models like the random and fixed effect. In addition, the system GMM method provides a consistent and efficient co-efficient value despite having predictor variables that are not mainly exogenous and even if autocorrelation and heteroscedasticity exist within (Ahmed, Fauziah, & Noor Azman, 2018).

The technique of GMM steadiness relies on two diagnostic tests that include an autocorrelation test of the error terms and the Sargan test for

instrument validity. The Sargan test, which tests for over-identifying restriction comes first, to identify the model specification or by evaluating the instruments validity which should be related to the error term. The instrument are said to be valid when the null hypothesis of the Sargan test was fail to reject, which means that, the instruments are not associated with the disturbance and are highly valid, which indicates correct model specification. The test of serial correlation which is the second aspect, test for no presence of first-order serial correlation [AR(1)] as the null hypothesis, which should be rejected while the second null hypothesis which indicates that there is no presence of second-order serial correlation [AR(2)) in the disturbance should not be declined. The study would also report a result for difference GMM as a robustness check on our main model.

4. Empirical results and explanation

The outcomes of the research study are discussed on the basis of descriptive analysis, correlation association and the regression result of the main system GMM co-efficient estimate relating to the variable of interest of the study.

4.1 Descriptive Statistics

The data has a total observation of 450. The data distribution among the variables is within range. The return on asset (ROA) has a mean value of 2.7078, which indicate a good return to the banks. Return on equity (ROE) has an average returns of 18.4320, which indicate a better returns compared to returns on asset. The tier 1 capital shows an average of 19.4797, although there seems to be banks with large size of regulatory tier 1 capital up to 104.13. Capital adequacy ratio indicate a fair mean value of 29.0618, although some banks seems to have a negative capital adequacy ratio, of -1.8588, which shows a bad signal of the liquidity position of the banks which may be due to increase rate of bad debt and non-performing loans within the banks. The deposit ratio indicate on average how the banks maintain a stable deposit of 66.1834 within the period. The bank size, which is obtained from the natural log of total asset, has a mean value of 22.6219, this shows that there is no much variations among the banks in terms of their size.

Some banks appear to have high rate of non-performing loans as compared to others. The non-performing loan maintain a minimum value of 0.02 with a maximum value of 69.33. The loan ratio indicate a better average of 58.4985, which indicate how committed the banks are in giving out loans. The distribution has a mean leverage of 39.9072. The macroeconomic variables has a fair distribution between the countries under study. Inflation has a mean value of 9.2171, with a minimum of 3.4945 and a maximum of 17.8697 while gross domestic product has an average of 4.7577, with a minimum of -1.6168 and a maximum of 14.0471.

Table:2 Descriptive statistics

Variable	Definition	Obs	Mean	Std. Dev.	Min	Max
ROA _{ijt}	Return on Asset	450	2.707807	1.700719	-2.5218	9.97
ROE _{ijt}	Return on Equity	450	18.43196	13.4848	-67.8	98.37
TIER1 _{ijt}	Regulatory Bank Capital	450	19.47974	9.971852	2.27	104.13
CAR _{ijt}	Capital Adequacy Ratio	450	29.0618	20.01715	-1.8588	101.01
DEP _{ijt}	Deposit Ratio	450	66.18336	17.69756	4.81	158.7518
BSZ _{ijt}	Bank Size	450	18.67842	2.70824	12.5874	22.62188
NPL _{ijt}	Non-Performing Loan	450	5.304511	6.304748	0.02	69.33
LON _{ijt}	Loan Ratio	450	58.49849	14.55861	8.425177	95.201
CAS _{ijt}	Capital Asset Ratio	450	19.60471	5.997585	3.69	42.87
LEV _{ijt}	Leverage	450	39.9072	23.37944	-171.87	170.52
INF _{jt}	Inflation	450	9.217126	3.985096	3.494458	17.86973
GDP _{jt}	Gross Domestic Product	450	4.757667	2.908784	-1.6168	14.04712

Source: STATA 15 Result

4.2 Correlation Matrix

The correlation matrix shows a moderate positive and negative relationship among the variables. The strongest correlation in the matrix, is the association between return on asset and return on equity with 0.5965, which are alternative measures of bank performance, hence the absence of multicollinearity problem. As it is shown on the table, tier 1

capital maintain a positive association with ROA and ROE with a coefficient of 0.3019 and 0.1686 respectively. Capital adequacy ratio maintain a positive relationship with ROA, ROE and Tier 1, so also deposit ratio except association with capital adequacy ratio appears negative. Bank size sustain a negative correlation with ROA, ROE, Tier1, CAR, with a co-efficient of -3.008, -0.0793, -0.4173, -0.1376, except with deposit ratio which has a positive of 0.1359. Non-performing loan maintain a negative relationship with most of the variables and a positive with a few. Other bank specific variables reveal a moderate negative and positive association among them. While the most weak association among the variables is the correlation between inflation and ROE with -0.0023 , inflation maintain a weak negative relationship with other variables but with a moderate positive with Tier 1 capital with 0.241. Gross domestic product maintain a positive correlation with ROA, ROE and Tier 1 with 0.2719, 0.2203 and 0.2458 respectively.

Table:3 Correlation Matrix

	ROA _{ijt}	ROE _{ijt}	TIER1 _{ijt}	CAR _{ijt}	DEP _{ijt}	BSZ _{ijt}	NPL _{ijt}	LON _{ijt}	CAS _{ijt}	LEV _{ijt}	INF _{jt}	GDP _{jt}
ROA _{ijt}	1											
ROE _{ijt}	0.5965	1										
TIER1 _{ijt}	0.3019	0.1686	1									
CAR _{ijt}	0.0856	0.0631	0.062	1								
DEP _{ijt}	0.1933	0.129	0.0025	-0.1376	1							
BSZ _{ijt}	-0.3008	-0.0793	-0.4173	-0.2051	0.1359	1						
NPL _{ijt}	-0.057	-0.036	-0.0618	-0.0975	0.0259	-0.0265	1					
LON _{ijt}	-0.1079	-0.0794	-0.1391	0.1743	0.0354	0.1294	-0.1862	1				
CAS _{ijt}	0.1276	-0.0712	0.0232	-0.2234	-0.1038	0.0831	0.0494	-0.0334	1			
LEV _{ijt}	-0.2004	-0.1556	-0.088	0.0535	-0.1659	0.0883	-0.0172	0.0702	-0.0555	1		
INF _{jt}	-0.006	-0.0023	0.241	-0.1767	-0.0201	-0.0908	0.1712	-0.393	0.1899	-0.0188	1	
GDP _{jt}	0.2719	0.2203	0.2458	0.1001	0.0496	-0.335	0.0066	-0.1627	-0.0044	-0.1747	-0.1637	1

Source: STATA 15 Result

4.3 Regression Result

4.3.1 First result

Table IV, presents the regression result of the association between bank regulatory capital and performance, for the period of 2010-2018, using the GMM, system estimator. The consistency of the system GMM technique was reflected in the null hypothesis of the Sargan test, where the test for the validity of the instrument is not rejected and the confirmation of the absence of second order serial correlation [AR2] and the presence of first order serial correlation [AR1].

Two models are presented, the first model excludes non-performing loan, while the non-performing loan is included in the second model. Moreover, the two models used the same bank specific characteristics variables and the macroeconomic level variables, which controls the specific country effects. The models presented in the table have estimate for difference GMM in two columns and that of system GMM in two columns so as to facilitate comparism but the overall inference will be based on system GMM. The lagged dependent variable in both the models with and without non-performing loan are significant which means that the dynamic GMM is the most relevant estimator for the study and the empirical findings can be relied upon for inference.

Table: IV First Regression Result

VARIABLES	WITHOUT NPL	ROA	WITH NPL	
	(1)	(2)	(3)	(4)
	Diff. GMM	System GMM	Diff. GMM	System GMM
ROA _{ijt-1}	0.5311*** (0.0149)	0.6390*** (0.00615)	0.5020*** (0.0148)	0.6120*** (0.00459)
TIER1 _{ijt}	0.0118*** (0.00307)	0.0145*** (0.00129)	0.0123*** (0.00279)	0.0121*** (0.00132)
CAR _{ijt}	0.00395*** (0.00123)	0.0003 (0.000635)	0.0045*** (0.00118)	-0.0003 (0.000627)
DEP _{ijt}	0.0063*** (0.00137)	0.0040*** (0.000597)	0.0060*** (0.00154)	0.0051*** (0.000645)
BSZ _{ijt}	-0.330*** (0.0525)	-0.1150*** (0.00616)	-0.3240*** (0.0559)	-0.0974*** (0.00483)
NPL _{ijt}			-0.0077** (0.00365)	-0.0203*** (0.00160)
LON _{ijt}	0.00610* (0.00338)	0.0012 (0.00159)	0.0032 (0.00343)	-0.0017 (0.00139)
CAS _{ijt}	0.0195*** (0.00226)	0.0408*** (0.00173)	0.0192*** (0.00231)	0.0417*** (0.00132)
LEV _{ijt}	0.00294** (0.00150)	0.0070*** (0.000352)	0.0040** (0.00169)	0.0071*** (0.000323)
INF _{ijt}	-0.0109*** (0.00271)	0.0262*** (0.00174)	-0.0102*** (0.00299)	0.0275*** (0.00206)
GDP _{ijt}	0.0331*** (0.00546)	0.0896*** (0.00306)	0.0337*** (0.00547)	0.0911*** (0.00453)
Observations	350	400	350	400
Number of code	50	50	50	50
<i>Diagnostic test</i>				
No. of Instrument	37	44	38	45
AR(1): <i>P</i> -Value	0.0864	0.0872	0.0902	0.0928
AR(2): <i>P</i> -Value	0.9289	0.9459	0.8988	0.8359
Sargan test: <i>P</i> -Value	0.1786	0.1535	0.1644	0.1470

Source: STATA 15 Result Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The aim of the research paper is to evaluate the effect of bank regulatory capital on bank performance. From the empirical results shown in Table IV above, bank regulatory capital is proxy by Tier 1 capital. Tier 1 capital is significant at 1 percent in the first and second model with 0.6390 and

0.6120 respectively. As can be seen, the inclusion of non-performing loan in the second model has affected the size of the Tier 1 capital. Tier 1 capital has positive significant association with ROA. An increase in the volume of Tier 1 capital is expected to positively increase return on asset. This finding is similar with the findings of (Aebi, Sabato, & Schmid, 2012; Ashraf et al., 2018). Capital adequacy ratio is not significant. Deposit ratio is positively significant at 1 percent. Bank size is negatively significant in the second model with non-performing loan at 1 percent. This means that, as the size of the banks increase by a unit, the level of their return on asset decrease by a unit, this findings is in line with the findings (Ghenimi, Chaibi, & Omri, 2017; Luo, Tanna, & Vita, 2016). Non-performing loan is negatively significant at 1 percent. This implies that, increase in the rate of non-performing loan decrease the level of return on asset. Loan ratio also not significant in the model. Capital asset ratio is positively significant at 1 percent. Leverage is positively significant at 1 percent. Inflation and gross domestic product are both positively significant at 1 percent, which implies that macroeconomic level variables affect return on asset positively in the model, this findings is consistent with the work of (Abdul-Rahman, Sulaiman, & Mohd Said, 2017; Berglund & Mäkinen, 2019).

4.3.2 Second result

The study also employed a second measure of bank performance that is return on equity (ROE). Return on asset (ROA) and return on equity (ROE) are the two most common and reliable bank performance measures. Addition of return on equity in the study will provide a more broaden result of the study. The analysis reported the result of both the two-step system and difference GMM in the first and second model for comparison, but the statistical inference will be based on system GMM result. The dependent lagged variable is significant in the two models, which justify the appropriateness of using system generalized method of moment estimator due to the dynamic nature of the data.

Table:5 Second Regression Result

VARIABLES	WITHOUTNPL	ROE	WITH NPL	
	(1)	(2)	(3)	(4)
	Diff. GMM	System GMM	Diff. GMM	System GMM
ROE _{ijt-1}	0.7100*** (0.0126)	0.7011*** (0.00528)	0.6981*** (0.0116)	0.6980*** (0.00523)
TIER1 _{ijt}	0.1431*** (0.0423)	0.2360*** (0.0519)	0.1241*** (0.0370)	0.2160*** (0.0511)
CAR _{ijt}	-0.0210** (0.00973)	-0.0231*** (0.00699)	-0.0221** (0.00980)	-0.0276*** (0.00668)
DEP _{ijt}	-0.0815*** (0.0194)	-0.0498*** (0.00914)	-0.0785*** (0.0195)	-0.0473*** (0.0134)
BSZ _{ijt}	-2.2890*** (0.413)	-0.1621* (0.0918)	-2.3181*** (0.462)	-0.2440*** (0.0932)
NPL _{ijt}			-0.0306 (0.0512)	-0.1031*** (0.0333)
LON _{ijt}	-0.1030*** (0.0333)	-0.00861 (0.0123)	-0.0973*** (0.0299)	-0.0248** (0.0126)
CAS _{ijt}	-0.1970*** (0.0335)	-0.1171*** (0.0186)	-0.1930*** (0.0322)	-0.1140*** (0.0182)
LEV _{ijt}	0.0406*** (0.00768)	0.0477*** (0.00882)	0.0427*** (0.00750)	0.0548*** (0.00824)
INF _{jt}	-0.4831*** (0.0577)	-0.3390*** (0.0461)	-0.4570*** (0.0584)	-0.3481*** (0.0451)
GDP _{jt}	0.09810 (0.0775)	0.3911*** (0.0481)	0.1041 (0.0754)	0.3870*** (0.0472)
Observations	350	400	350	400
Number of code	50	50	50	50
<i>Diagnostic test</i>				
No. of Instrument	37	44	38	45
AR(1): P-Value	0.0053	0.0075	0.0053	0.0074
AR(2): P-Value	0.1986	0.1811	0.1988	0.1813
Sargan test: P-Value	0.1348	0.1476	0.1643	0.1275

Source: STATA 15 Result Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Tier 1 capital, a proxy of bank regulatory capital shows a significant positive association with return on equity at 1 percent. Increase in tier 1 capital affect return on equity positively, findings of this study is

compatible with the work of (Ashraf et al., 2018; Battaglia & Gallo, 2015; Varotto & Zhao, 2018). Capital adequacy ratio is negatively significant at 1 percent likewise deposit ratio. Bank size is significantly negative at 10 percent in the first model and also significantly negative at 1 percent in the second model, this confirms the findings of (Ghenimi et al., 2017; Waemustafa & Sukri, 2015). This means, that, as bank size increase by a unit, the return on equity decrease by the rate. Loan ratio is only significant in the second model. Capital asset ratio is negatively significant in the two model at 1 percent, while leverage is significantly positive at 1 percent.

Inflation is significant and negatively associated with return on equity at 1 percent. This implies that, every increase in inflation rate negatively affect return on equity, this is similar with the work of (Waemustafa & Sukri, 2015). Gross domestic product is significant and positive at 1 percent, which indicate an increase in return on equity with every increase in gross domestic product rate, the result conform with the findings of (Berglund & Mäkinen, 2019). The diagnostic test report the absence of second order auto correlation [AR2] and the presence of first order auto correlation [AR1] and the Sargan test has an insignificant P-value, which implies the validity of the instrument used in the study.

4.3.3 Discussion of Main Findings and Hypotheses testing

The main objective of this paper is to evaluate the association between regulatory bank capital and performance, using a sample of 50 public listed commercial banks operating in Sub Saharan African countries between the periods of 2010-2018. The study indicates the links of the model estimation between bank performance and bank capital with and without the non-performing loan, and it controls for bank-specific attributes effect and the level of macroeconomics of countries in Sub Saharan Africa.

From the empirical results shown in Table IV and Table V above, the aim of the research paper is to evaluate the effect of bank regulatory capital on bank performance. Bank regulatory capital that is proxy by Tier1 capital is found to be significant and positive at 1 percent in all the models used with both return on asset (ROA) and return on equity (ROE). Therefore, Tier 1 capital plays a very vital function in the performance of banks across Sub Saharan African. As tier 1 level of capital rises, it

directly brings about both increase in the performance of banks in the region.

The study support all the four hypotheses developed for the study. This implies the rejection of the entire null hypotheses. This further explain that tier 1 capital and return on asset are positively related at 1 percent significance level. It further confirm a significant and positive association between tier 1 capital and return on equity at 1 percent as well. On the other hand, relationship between bank size and return on equity revealed a significant and negative association at 1 percent significance level, likewise the relationship between bank size and return on equity indicate a significant negative association.

Table:6 Hypotheses table

Hypotheses	Hypotheses statement	Result
H ₁	There is significant relationship between bank regulatory capital and bank performance in SSA.	
H _{1a}	Tier 1 capital and ROA have a significant association in SSA banks.	Supported
H _{1b}	Tier 1 capital and ROE have a significant association in SSA banks.	Supported
H ₂	There is significant relationship between bank size and bank performance in SSA.	
H _{2a}	BSZ and ROA have a significant association in SSA banks.	Support
H _{2b}	BSZ and ROE have a significant association in SSA banks.	Support

Source: Author Compilation, 2020.

4.4 Robustness test

This paper conduct a robustness test to evaluate whether the empirical findings hold when using different proxies. The study employed net interest margin (NIM), as alternative measure of bank performance so as to further prove the earlier result obtain while using ROA and ROE. Other modification in the robustness model is the use of tier 2 capital as alternative measure to tier1 capital, which was used as proxy of bank regulatory capital. Capital asset ratio is not included in the model. The analysis reported the result of the two models. The lagged dependent is also statistically in both models, which implies the suitability of the

dynamic GMM estimator and the reliability of the result for statistical inference.

Table:7 Regression result for robustness check

VARIABLES	WITHOUT NPL	NIM	WITH NPL	
	(1)	(2)	(3)	(4)
	Diff. GMM	System GMM	Diff. GMM	System GMM
NIM _{ijt-1}	-0.7251*** (0.0442)	0.5880*** (0.00760)	-0.7000*** (0.0576)	0.5701*** (0.00839)
TIER2 _{ijt}	0.0944** (0.0425)	0.113*** (0.0321)	0.0506 (0.0486)	0.0618** (0.0262)
CAR _{ijt}	-0.000881 (0.00694)	-0.0881*** (0.00989)	-0.0501 (0.00721)	-0.0862*** (0.0127)
DEP _{ijt}	-0.0488*** (0.0101)	0.0592*** (0.00940)	-0.0449*** (0.0123)	0.0460*** (0.0102)
BSZ _{ijt}	0.0515 (0.0635)	0.640*** (0.0401)	0.0711 (0.0804)	0.764*** (0.0569)
NPL _{ijt}			-0.0937*** (0.0321)	-0.166*** (0.0335)
LON _{ijt}	0.0744 (0.00859)	0.0222*** (0.00603)	0.0531 (0.00862)	0.0661 (0.00538)
LEV _{ijt}	0.0170*** (0.00265)	0.0480* (0.00251)	0.0182*** (0.00293)	0.0101*** (0.00290)
INF _{ijt}	0.130*** (0.0177)	-0.0673*** (0.0163)	0.117*** (0.0211)	-0.0638*** (0.0201)
GDP _{ijt}	-0.0217 (0.0237)	0.00543 (0.0122)	-0.0520** (0.0260)	-0.00913 (0.0155)
Observations	350	400	350	400
Number of code	50	50	50	50
<i>Diagnostic test</i>				
No. of Instrument	36	43	37	44
AR(1): P-Value	0.1887	0.0064	0.1964	0.0077
AR(2): P-Value	0.2269	0.3025	0.2254	0.3013
Sargan test: P-Value	0.3152	0.1464	0.3921	0.1965

Source: STATA 15 Result Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The tier 2 capital, which is the proxy for bank regulatory capital is positively significant at 1 and 5 percent for the first and second model. This result is very similar to the previous estimation obtained using tier 1

capital. This further show, an increase in the level of tier 2 capital will positively affect net interest margin (NIM). Capital adequacy ratio is negatively significant at 1 percent in both models will deposit ratio is positively significant in the two models.

Bank size is negatively significant in the in the second model which is in line with the result obtained in our baseline model. Non-performing loan is negatively significant at 1 percent. Loan ratio is positively significant only in the first model, so also leverage is positively significant at both 10 percent and 1 percent for the first and second model respectively. Inflation reported a negative association with net interest margin (NIM), while gross domestic product is not significant in the model. The diagnostic test reported a presence of first order auto correlation [AR1] and absence of second order auto correlation [AR2]. The p-value of the Sargan test is not significant which implies the validity of the instrument used in the study.

5. Conclusion and policy implication

The study reveals the increasing adverse effect of the non-performing loans on the performance of Sub Saharan African Banks. This paper examines the association between bank regulatory capital and bank performance using the GMM, two-step system analysis technique and 50 sampled public listed commercial banks in SSA economies within the periods of 2010 to 2018. The outcome of the study shows that an increase in bank regulatory capital results in a corresponding increase in the performance of banks. The study equally reveals that an increase in the rate of non-performing loan decrease the performance of banks. It is also worthy of note, that smaller banks in SSA performance are better when compared to larger banks. The results obtained are in line with the findings of previous research work. Thus, this shows an addition in the context of SSA countries.

The study outcomes have many policy consequences for the policymakers, bank practitioner society, and academics. This work unveils how important bank regulatory capital is towards better banking performance in SSA economies. Policymakers always test the efficacy of their policies through empirical studies of this nature. It is hopeful, this study will spur regulators to action and encourage them to make and enforce sound policies that will bring sanity to the banking industry. Bank practitioners should place more emphasis on the management of non-

performing loans, which negatively affect the performance of banks. Furthermore, they should pay more attention to complying with bank capital regulations in order to have a better performing bank.

The findings benefit the society, as it guides them in making the choice on which bank to patronize based on clear justification of their performance indices reveal in the study. The study would also be appreciated among academics, as it opens a research gap for future researchers to focus on other measures of bank capital introduced by Basel III, and how failure to comply may affect bank performance. This study opens a research gap for future researchers to focus on other measures of bank capital introduced by Basel III and how they affect bank performance.

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