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Changes in Basel Capital Requirements and Lending Ability of African Commercial Banks

Abstract: This research examines the potential impact of Basel IV capital requirements (CAR) on bank lending ability in Africa. To achieve the objective, the study simulated Basel IV capital ratio using historical data to create sample representative banks as if the selected banks had implemented Basel IV CAR for the period 2000 and 2018 and used actual data for existing Basel II and III CAR. Dynamic panel regression analyses, namely the System GMM and P-ARDL, were utilised. First, our results suggest that higher Basel CAR, particularly the new Basel IV, portends short-term negative impacts on bank lending while the long-term impact on bank lending is favorable. Second, the weight of non-performing loans tends to decline as banks transitioned from lower to higher Basel CAR. Lastly, this study shows that complying with Basel IV CAR will help African banks to achieve financial deepening and increase bank lending ability.

Keywords: African Banks, Bank lending, Basel capital requirements, risk assessment.

JEL Classification: G18, G21, G28.

1. Introduction

Banking regulation originates from microeconomic concerns over the stability of the banking system. This is because banks play an important role in the global economy (Nkopane, 2017; Al-Rjoub, 2021). Banks do not entirely bear the

cost of bank failure, and as a result, banks are subjected to internationally coordinated regulations (BCBS, 2017; Oino, 2018). In recent years, regulation in banking has undergone significant changes and has shifted from being non-risk sensitive to becoming more risk-sensitive by placing more emphasis on the mitigation of risk (Munoz & Soler, 2017; Noss & Toffano, 2016). The first sets of Basel accords, namely Basel I and Basel II, were not sufficiently risk-sensitive because risk-weight systems in these accords opened opportunities for regulatory capital arbitrage (Jablecki, 2009). This resulted in the introduction of Basel III accord in 2009 to increase the quality and quantity of capital. In addition, the finalisation of Basel III in 2016, referred to as Basel IV accord introduces a wider catalogue of risk weights for different risk exposures, simplicity, and comparability of capital ratios, to increase the risk sensitivity of Basel capital ratios (BCBS, 2017; Oyetade, Obalade & Muzindutsi, 2021). As a result, Basel III and Basel IV have changed bank capital regulations from structural regulation to more market-oriented regulation (Munoz & Soler, 2017).

A universal tool among bank regulators to regulate banks is capital. The social benefits of higher capital requirements (hereafter CAR) entail promoting a healthy financial system, lowering the probability of bank failure, and increasing lending activities, which may ultimately increase economic activities (Admati, DeMarzo, Hellwig, & Pfleiderer, 2013; BCBS, 2017). However, higher CAR could also constrain bank lending. For example, BCBS (2010) and Nkopane (2017) posit that implementing higher CAR may increase funding and lending costs, reduce the return on equity, and less capital available for bank lending. As a result, higher CAR may have a negative impact on bank lending and consequently harm economic growth (Ljung & Schennings, 2018; Psillaki & Georgoulea, 2016).

Since the 1990s, African economies have experienced accelerated economic growth (Mecagni, Marchettini, & Maino, 2015). The robust economic growth in Africa may be attributed to the expansion of access to financial services, upgraded regulatory and institutional capacities of the commercial banks (Mecagni et al., 2015). Additionally, African banks remain highly profitable as measured by net interest income and return on assets (Chironga, Cunha, Grandis, & Kuyoro, 2018). Despite these achievements, African banking systems lack depth when compared to the rest of the world (European Investment Bank, 2016). Also, bank loans to the private sector declined by 23.5% in the last decade (World Bank, 2020). Factors such as capital inadequacy often restrict African banks' capacity to finance loan demands to customers. Hence, most of the loan facilities provided by African banks are short-term, having a maximum maturity of one year, and many African banks are excessively liquid for fear of bad loans (Waithaka, 2013; Asongu & Odhiambo, 2018).

As a key element of the Basel regulations, the Basel capital requirements (CAR) have undergone significant changes over the years. Basel IV is proposed to be implemented in 2022[1]. Nevertheless, most African banks are lagging in compliance with the changes in existing Basel CAR. For example, countries such as South Africa, Egypt, Mauritius, Morocco and Namibia have implemented Basel III CAR while countries such as Nigeria and Botswana are in the process of implementing Basel III CAR. Other countries such as Kenya, Uganda, and Ghana are Basel II complianct while Tanzania has no specific Basel accord that the Bank of Tanzania uses in its Banking Act. Lack of compliance to changes in Basel CAR will leave African banks to have low capital ratios, constrain such banks from increasing lending and risk assessments. In light of the proposed Basel IV CAR, African banks` slow compliance to existing Basel CAR, as well as the interplay between higher CAR and bank lending, it is imperative to examine the potential impact of Basel IV CAR on bank lending in Africa. As a result, we examine the impact of changes in Basel CAR and other determinants on bank lending at different Basel levels (Basel II, III and proposed Basel IV). Our findings provide insight for African banks and regulatory authorities as to the implementation of the proposed new Basel IV framework.

2. Review of empirical literature

The impact of higher CAR on bank lending has been studied from several perspectives. A strand of literature explored the impact of capital on the cost of funding and lending spreads (Slovik & Cournède, 2011; Šutorova & Teply, 2013). In contrast, others followed the macroeconomic approach (Angelini, Clerc, & Cúrdia, 2015; BCBS, 2010) of providing evidence on the impact of higher capital on the economy. However, these studies do not offer a detailed analysis of the impact of higher CAR on individual bank behavior. Another strand of literature (Carbó-Valverde, Marqués-Ibáñez, & Rodriguez-Fernandez, 2011; Kim & Sohn, 2017; Oyetade, Obalade & Muzindutsi, 2022) uses a microeconomic approach to explore the impact of higher capital on bank lending using bank-level data. The microeconomic approach remains a reliable method to examine the objective of the study.

The view on the impact of higher CAR on bank lending is not the same across the literature. Certain studies (Cohen & Scatigna, 2016; Karmakar & Mok, 2015; Kim & Sohn, 2017) find a positive impact of higher CAR on bank lending. Kim and Sohn posit that higher capital has a significantly positive effect on loan growth

[1] Revised to 2023 due to COVID-I9 (BCBS, 2020)

only after large banks retain sufficient liquid assets. Similarly, Karmakar and Mok find a moderate positive relationship between capital ratios and bank lending for commercial banks in the United States from 1996 to 2010 and that bigger banks respond more to changes in capital ratio. Additionally, Oyetade, Obalade & Muzindutsi (2020) found that Basel IV capital requirements will positively impact on securitization activities of commercial banks in South Africa. Contrariwise, Bridges et al. (2014) for UK banks, Peek and Rosengren (1995) for US banks, Roulet (2018) for EU banks establish a negative impact of higher CAR on bank lending. Bridges et al. find that an increase in CAR reduces loan growth, but the loan growth recovers on average within three years. Furthermore, Ljung and Schennings (2018) find that Basel III CAR has no impact on bank lending in Sweden and concludes that the regulators were successful in increasing bank capital levels without harming the lending behavior of Swedish banks. This finding was supported by Neethling (2014) for South African banks that higher capital has insignificant impact on credit supply for the period 1990-2013. Neethling (2014) and Nkopane (2017) observed that South African banks hold capital in excess of the minimum regulatory capital. This can be a reason why changes in capital levels did not affect bank lending in South Africa.

Additionally, capitalised and non-capitalised banks tend to react differently to regulatory CAR. For example, the most significant constraint will be for undercapitalised banks to achieve higher CAR, even if loan demand increases (Bernanke, Lown, & Friedman, 1991; Nkopane, 2017). Undercapitalised banks can increase interest margin via high-interest rates to achieve higher capital, but customers that are willing to borrow from such banks at high-interest rates are considered inherently risky (Chiaramonte & Casu, 2017; Ozili, 2015). Contrarily, banks with higher capital will attract credit-worthy customers. Higher capital may induce the ability of a bank to take more risks, which means its ability to give out more loans and, in turn, generate higher returns (Roulet, 2018; Waithaka, 2013). On the other hand, Gabriel (2016) and Junge and Kugler (2013) have suggested that an increase in CAR will reduce bank's ability to taking more risk and, therefore, lower expected returns on equity. This may reduce the ability of banks to provide lending to the economy (Gabriel, 2016). From the foregoing, the effects of higher CAR are mixed. Considering that African banks are undercapitalised, the mixed findings present a researchable gap on the impact of higher capital on bank lending in Africa, especially with the proposed Basel IV CAR.

Many other important factors can affect bank lending other than changes in regulatory CAR (BCBS, 2009). These factors range from bank size, accounting treatment, macroeconomic conditions, bank's capital structure, and differences in the cost of capital in various countries (BCBS, 2009; Noss & Toffano, 2016). On bank

size, higher CAR is likely to crowd out smaller banks that cannot raise sufficient capital (Nkopane, 2017). Still, smaller banks are needed for competition with large banks to drive down the cost of loans to borrowers (Asongu & Odhiambo, 2018). Similarly, the deposit ratio is a factor that can affect bank lending (Carbó-Valverde et al., 2011). Depositors' funds positively impacted loangrowth in Nigerian and Spanish banks (Carbó-Valverde et al., 2011; Olokoyo, 2011). Higher capital increased the deposit ratio in Egypt but did not increase lending (Abdel-Baki, 2012). In addition, non-performing loans are a result of lax credit policies of banks that can affect loan performance and affect the asset quality of banks in the balance sheet (Carbó-Valverde et al., 2011; Žunić, Kozarić, & Dželihodžić, 2021). Gavalas (2015) finds that non-performing loans have an insignificant impact on bank lending in advanced European countries.

Furthermore, Brei and Gambacorta (2014) opine that leverage ratio can interact with monetary policy and adjust bank behavior to alter the supply of loans in response to changes in monetary policy. They also indicate that Basel III and IV regulations provide a non-risk weighted leverage ratio, which is expected to be negatively correlated with loangrowth. Roulet (2018) argues that macroeconomic conditions prevailing in a country as measured by macroeconomic indicators such as inflation, Reporate, and Gdpgrowth can positively or negatively impact on bank lending. Roulet and Kim and Sohn (2017) find a positive and significant impact of Gdpgrowth on commercial bank lending in Europe and the US. On the contrary, BCBS (2010); Rizvi, Kashiramka and Singh (2018) find that implementation of Basel III CAR can lower Gdpgrowth in the future because higher lending rates as a result of higher CAR can lower loan demands. From the foregoing, other determinants such as bank size, deposit ratio, macroeconomic conditions can impact on bank lending other than CAR. As a result, it is relevant to incorporate these factors to investigate the impact of higher Basel CAR on bank lending ability.

In summary, there is no consensus in the literature on the impact of higher capital on bank lending ability. Higher capital has been found to increase or decrease lending in literature. In Africa, lending is low, despite the opportunity for revenue growth. Because it is a novelty, the literature on Basel IV capital requirement is limited. New Basel IV creates a disconnection between capital and risk. It raises some questions as to the potential impact of Basel IV CAR on bank lending. Therefore, the study examines the impact of changing Basel CAR on bank lending in Africa.

3. Methodology

This research adopted a quantitative approach with the use of panel data analysis to examine the impact of changes from Basel II to Basel III and the potential impact of Basel IV CAR on bank lending in Africa.

3.1. Data and Sample size

The sample includes panel data of commercial banks from 13 African countries over 2000-2018 for which data is available. The financial data was collected from Bloomberg and S&P Capital IQ databases. The macroeconomic data were obtained from Reserves banks of selected countries, the World Bank, and the Infront database. One hundred thirty-seven commercial banks listed on respective African stock exchanges were identified for the study. The sample period of 2000-2018 is selected prior to the introduction of the Basel II accord in 2004 and the Basel III accord in 2009. On this basis, this allowed the study to draw a conclusion on the impact of the new Basel IV CAR as if they had been adopted in the period considered vis-à-vis existing Basel regulations. Then the study analyses the sample bank simulated data in comparison to existing Basel capital ratios using regression analysis. As a rule of thumb, each bank included in the sample must have complied with Basel II or Basel III CAR. Based on the availability of comprehensive data on the dependent and explanatory variables, the final sample size is an unbalanced panel of 41 banks that have adopted Basel II or III from 13 African countries. Table 1 presents the distribution of banks by country.

Very few studies (Giordana & Schumacher, 2017; Gyntelberg, 2018; Swamy, 2018) have considered examining the impact of a proposed Basel regulatory before its implementation. In this context, these studies used historical financial data of banks based on the proposed Basel CAR to create sample representative banks to examine the potential impact of the new Basel CAR before it was implemented and provided necessary recommendations. The use of representative banks is a common and well-accepted practice in the literature. This study considers the proposed changes in Basel IV CAR to assess its potential impact on bank lending in Africa since Basel IV has not commenced. Consequently, the study simulates the Basel IV capital ratio from the balance sheet of the selected African banks to create sample representative banks using the new Basel IV requirements. For a robust comparison, the study further examines the impact of changes from Basel II, III on bank lending in Africa.

Table 1: Panel data of banks from selected African countries

Country	No of banks	Cum.
Botswana	3	7.32
Egypt	6	21.95
Ghana	2	26.83
Kenya	7	43.9
Mauritius	1	46.34
Morocco	1	48.78
Namibia	1	51.22
Nigeria	9	73.17
South Africa	6	87.8
Swaziland	1	90.24
Tanzania	2	95.12
Uganda	1	97.56
Zimbabwe	1	100
Total	41	

Source: Author's own compilation (2020)

3.2. Model Specification

The impact of capital on lending is commonly examined using dynamic panel models (Carbó-Valverde et al., 2011; Kim & Sohn, 2017). The dynamic framework is required to capture the impact of higher CAR on bank's optimal lending. Equation 1 presents bank lending as a function of the capital ratio and other relevant determinants.

$$Loangrowth_{it} = f(Loangrowth_{it-1}, \mathrm{Lev}_{it}, Cap_{it-1}, Bankspec_{it-1}, Macroeco_t) \quad (1)$$

The formula and expected signs of the model variables are presented in Table 2.

Table 2: Definition of model variables

Variables	Definition	Formula	Expected sign
$Loangrowth_{it}$	Bank lending proxy by Loan growth		Dependent var
Lagged loan growth			Positive
Cap_{it}	Basel IV capital ratios	Tangible common equity/RWA	Positive
Lev_{it}	Non-risk leverage ≥4%	Tier1 Capital/average-total assets	Negative
Roe	*Bankspec* Cost of capital	Profit/Total Asset	Negative
Nplta	*Bankspec*	Non-performing asset/total loan	Negative
Bank size	*Bankspec*	Quintiles of total assets	Negative/Positive
Deposit to total asset	*Bankspec*-liquidity	Deposit/Tot asset	Positive
Reporate	*macroec*		Negative
Gdp growth, inflation	*macroec*	Gdpgrowth rate and inflation	Positive

Source: Author's own compilation (2020)

The study lagged loangrowth since it is expected that the current loan supply is affected by the previous loan supply (Carbó-Valverde et al., 2011). Cap_{it} defined as tangible common equity (tce) (numerator) which consists of common equity, made up of common shares, retained earnings, and other reserves; divided by the risk-weighted assets (denominator) which consist of risk-weight assigned to each category of bank assets in the balance sheet (loans-mortgage, corporate loans, government securities, and interbank borrowing). For a robust conclusion, three Basel capital ratios are considered based on Basel standards (Basel II, III and IV). Lev_{it} represents Basel III and IV simple non-risk leverage ratio. Leverage is expected to negatively impact lending because it was introduced to act a back-stop against risk (Gavalas, 2015) such that either a bank increases capital to take on more risk or reduce lending (BCBSa, 2017; Brei & Gambacorta, 2014).

Bank-specific variables include cost of capital, bank size and bank liquidity. Cost of capital is proxy by return on equity (Roe) (Dionne & Harchaoui, 2008; Roulet, 2018). Dionne & Harchaoui argue that in theory, the higher the cost of equity capital, the more expensive achieving higher capital becomes, which decline lending and, vice versa (For bank size - the study uses total assets to generate five dummy variables known as size quintiles to match banks into different sizes for comparison of observable and unobservable differences on the dependent variable. Quintiles of bank assets are considered for this study because, according to

Roulet (2018) and Mashamba (2022), large banks tend to lend few loans to small scale businesses (SMEs); thus, a negative relationship with loangrowth is expected. While a positive relationship is expected with small banks as they will have a comparative advantage to process information on SMEs. But if through technical expertise, large banks are able to process the information on SMEs, then a positive relationship is expected (Roulet, 2018). Additionally, deposit to total asset is a proxy for bank liquidity available to finance lending (Carbó-Valverde et al., 2011). It is included to examine if liquidity is important for loangrowth in Africa. Non-performing loans to total assets (Nplta) is lagged because non-performing loans for the previous year can influence bank decisions to lend in the current period. The higher the Basel level, the lower the Nplta. The study included Gdpgrowth, inflation, and interest rate proxied by Reporate to control for the macroeconomic ($macroec_t$) environment that is likely to affect the quality and the performance of bank loan assets in Africa. An increase in Gdpgrowth increases loangrowth; thus, a positive and significant relationship is expected. A negative Reporate means an increase in repo rate leads to a decline in loangrowth.

3.3. Estimation techniques

The study uses a dynamic panel model because the lagged dependent variable is included as an explanatory variable. The study used similar equations as Kim and Sohn (2017). In a dynamic panel model, the use of Ordinary Least Square (OLS), fixed and random effects estimation techniques become inconsistent estimators because of biases arising from the correlations between lagged dependent variable and the error terms and endogeneity issues (Das, 2019). This study employs System GMM developed by Arellano and Bover (1995) and Blundell and Bond (1998) as the estimation technique because it produces reliable results in the presence of a lagged dependent variable. In addition, S-GMM also greatly reduce bias for unbalanced panel data with any omitted variables and is best suited where there is a large panel (n) over a relatively small time period (t) (Roodman, 2009). The study employs system GMM with forward orthogonal deviation to estimate equation (2) below.

$$L_{it} = \beta L_{it-1} + \eta CAP_{it-1} + \theta Lev_{it} + \rho Bankspe_{it-1} + \delta macroeco_t + Yeardum_t + \alpha_i + \gamma_i + \epsilon_{it} \quad (2)$$

From the GMM model in equation 2, Basel capital ratios, cost of capital, and non-performing variables are lagged because the future response to higher CAR today is to either decrease loan or increase loan. Subsequently, the study employs the pooled mean group (PMG), mean group (MG), and dynamic fixed effects (DFE) estimators of the panel Autoregressive Distributed Lag (PARDL) model

to capture the short and long-run impacts of higher capital on lending ability as these cannot be revealed by the GMM estimation. PMG estimator provides a way of dealing with homogeneity issues contained in the pool of panel data across countries by constraining the long-run coefficient to be the same but allows the short-run coefficients and the error variances to differ across groups in the short-run (Goswami & Junayed, 2006; Pesaran, Shin, & Smith, 1999; Simões, 2011). In addition to PMG, the study use alternative panel data estimators such as dynamic fixed effects (DFE) and mean group (MG) to facilitate comparison of the short-run and long-run findings. The PARDL (p, q, q, -------, q) model is expressed as:

$$L_{it} = \alpha_i + \sum_{j=1}^{p} \lambda_{ij} L_{i,t-j} + \sum_{j=0}^{q} \delta_{1,ij} Cap_{i,t-j} + \sum_{j=0}^{q} \delta_{2,ij} Nplta_{i,t-j} + \epsilon_{it} \quad (3)$$

Reparameterization of equation (3) is estimated as:

$$\Delta L_{it} = \alpha_i + \phi_i L_{i,t-1} + \beta_{1i}^{'} Cap_{it-1} + \beta_{2i}^{'} Nplta_{it-1} + \sum_{j=1}^{p-1} \lambda_{ij}^{*} \Delta L_{i,t-j} + \sum_{j=0}^{q-1} \delta_{i,ij}^{s'} \Delta Nplta_{i,t-j} + \sum_{j=0}^{q-1} \delta_{2,ij}^{s'} \Delta Cap_{i,t-j} + \epsilon_{it} \quad (4)$$

Where L_{it} is the loangrowth of bank i at time t. i represent banks =1…….N and t represent time period, 2000, 2001, 2002, ……2018 and and $L_{i,t-1}$ is a lagged dependent variable. Cap_{it} represents Basel CAR variables. $Nplta_{it}$ is non-performing loans to explain the effect on bank lending.

In terms of the econometric properties of equation (2) and (4), each coefficient ($\beta, \eta, \theta, \rho, \delta, \phi, \lambda$) captures the impact of the specified explanatory variable on the dependent variable-loangrowth, and ϵ_{it} is the error term for bank *i* in year *t*. The Hausman test is employed to test null hypothesis of the long-run slope homogeneity in the coefficients (Tan, 2009). The Hausman test is used to determine the best efficient estimator among PMG, MG and DFE (Blackburne & Frank, 2007). In other words, Hausman tests are carried out for the selection of the estimation techniques for equation (4).

4. Results and discussion

4.1. Descriptive Statistics and Specification tests

Table 3 presents the summary statistics of key variables. The annual growth in total loans averages 22.8% over the sample period, while the standard deviation (sd) is 55.8%. This is an indication of low lending over the sample period. BIIcap measured using Basel II CAR showed that the average capital ratio is 16.07%, and sd is 5.7%, implying that African banks are well-capitalised above the Basel II 8% minimum regulatory CAR, but the sd of 5.7% for BIIcap shows that there

are banks in Africa that are below the 8% Basel II CAR. For BIIIcap, the mean and sd are 18.2% and 7.2%, respectively. Under BIIIcap, the average capital ratio increased as shown with the sd; however, the banks still fall below the 10.5% minimum regulatory CAR for Basel III. BIVcap is a simulated capital ratio using historical data as if the banks had implemented the Basel IV accord in the sample period, the mean and sd are 19.7% and 21.7%. The sd at 21% is above the 10.5% minimum regulatory CAR. The minimum capital ratio was 1.32% average for BIVcap; the figures arise because of the low equity capital (numerator) of the capital ratio. Thus, this suggests that for some banks in Africa to comply with higher Basel IV CAR, they will have to raise more equity capital.

Table 3: Summary statistics of key variables

Stats	mean	N	min	max	sd	Variance	skewness
loangrowth	22.845	687	-89.955	640.049	55.796	3113.146	5.209
BIIcap	16.070	449	5	46	5.724	32.766	1.449
BIIIcap	18.222	477	2.901	73.807	7.181	51.560	2.174
BIVcap	19.731	589	1.320	301.589	21.697	470.750	8.669
Deptotasset	73.545	650	5.947	92.180	11.877	141.055	-1.317
Roe	21.598	722	-76.001	92.900	13.824	191.093	0.348
Lev	11.747	510	2.842	94.125	10.432	108.820	4.989
Nplta	3.574	575	0.029	48.526	4.837	23.400	4.623
Gdpgrowth	4.645	722	-7.652	19.675	2.858	8.171	0.272
Inflation	9.083	693	-2.410	32.905	5.184	26.872	1.284
Reporate	5.452	666	-16.307	19.538	5.476	29.986	-0.008

Source: Author's own calculation (2019)

4.2. Specification tests for Basel CAR and bank lending

Specification tests for S-GMM for equation 2 is presented. Furthermore, unit root tests and Hausman tests are carried out for P-ARDL estimations of equation 4. A test for serial auto-correlation was carried out for S-GMM to test for the validity of the instruments and the absence of serial correlation (Arellano & Bond, 1991). Table 4 reports the p-values for AR1 and AR2 tests and the Hansen test. The test confirms the validity of the selected instruments. The consistency of the S-GMM estimations was confirmed because there is no second-order serial correlation. The study rejects H0 in the case of AR (1) but fails to reject H_0 in the case of AR (2) for all the three models in Table 4.

The Augmenet Dicker Fuller (ADF) and Phillips Perron (PP) unit root tests for unbalanced panel establish that none of the variables is I(2). This confirms P-ARDL can be used to estimate equation 4. Loangrowth, BIIcap BIIIcap BIVcap, and Nplta are stationary at level or I(0) and the p-value is significant at 1percent. Therefore, the study rejects the H_0 for presence of unit root and accept H_1.

The Hausman test result chose PMG for Basel II, III, and IV for long-run impact analysis as the more suitable estimation method. The φi (error correction coefficients-ECT) across PMG, MG, and DFE in Table 5 remain significant and negative across all the three Basel models (2, 3, and 4). Indicating that there is co-integration among the panel variables. It also indicates the existence of a stable and converging long-run relationship between Basel capital ratios, Nplta, and loangrowth.

4.3. Analysis of Results for impact of Basel CAR on bank lending

This section presents S-GMM and PARDL results on the impact of changes from Basel II to Basel III and the potential impact of Basel IV CAR on bank lending in Africa estimated using dynamic panel models in equations 2 and 4. The study first presents the results for S-GMM on factors such as Basel capital ratios, bank-specific, and macroeconomic that can affect bank lending in Africa and account for unobservable effects using year dummies. Thereafter, the results of the short and long-term impact using P-ARDL estimation techniques were presented.

4.3.1. S-GMM Results with forward orthogonal deviation (FOD)

Table 4 presents the estimation results for system GMM with FOD for equations (2) on the impact of changes in Basel CAR and other determinants on loangrowth. The results in Table 4 shows that Lagged loangrowth is not persistent across the three Basel levels. The lagged growth under Basel 2 and Basel 4 models is not significant but under Basel 3 model, lagged loangrowth is positive and significant to loangrowth at the 5% level of significance. Furthermore, the coefficient on BIIcap is positive and significant at the 5% level of significance, implying a higher CAR increase loangrowth under Basel ll. BIIIcap is not significant. BIVcap is negative and significant, while lagged BIVcap is positive and significant at the 1% significance level. The results imply that BIVcap will have a negative impact on current bank lending, but the positive coefficient on lagged BIVcap suggests that banks will increase lending in the subsequent period or future.

The quintiles of size (Isize 2, 3,4 & 5) were intended to capture the importance of large banks having the ability to increase equity capital and provide more loans relative to smaller banks for each Basel level. For banks in the fourth quintiles under Basel 2 model, size is significant at 10%. Suggesting that banks in the fourth quintiles created more loans. Size under Basel 3 and Basel 4 model has no significant impact on loangrowth, suggesting that bank size have no significant impact on bank lending in Africa under Basel 3 and 4.

Table 4: Basel CAR and bank lending in Africa: S-GMM Results

Variables	Basel 2	Basel 3	Basel 4
	Loan_growth	Loan_growth	Loan_growth
L.loangrowth	0.117	0.171**	0.173
	(0.161)	(0.085)	(0.145)
BIIcap	1.119**		
	(0.453)		
L.BIIcap	-0.191		
	(0.514)		
BIIIcap		-0.237	
		(0.321)	
L.BIIIcap		0.325	
		(0.362)	
BIVcap			-0.608***
			(0.182)
L.BIVcap			0.603***
			(0.179)
_Isize_2	0.029	0.141	-0.028
	(0.214)	(0.332)	(0.278)
_Isize_3	0.335	0.114	-0.05
	(0.206)	(0.306)	(0.213)
_Isize_4	0.511*	0.185	-0.092
	(0.265)	(0.362)	(0.202)
_Isize_5	-0.216	0.101	-0.067
	(0.139)	(0.379)	(0.233)
Leverage	-0.725***	0.062	0.146
	(0.125)	(0.249)	(0.217)
Roe	-3.775**	0.263	-0.109
	(1.762)	(0.332)	(0.386)
L.Roe	1.592*	-0.96	0.288
	(0.835)	(1.083)	(1.324)
Deptotasset	-1.023*	0.678	0.389
	(0.532)	(0.927)	(0.476)
Gdpgrowth	-0.178*	-0.035	-0.117
	(0.107)	(0.110)	(0.072)
Reporate	-0.086**	-0.096	-0.02
	(0.039)	(0.074)	(0.061)
L.Nplta	-0.155***	-0.070**	-0.039
	(0.045)	(0.034)	(0.024)
Inflat	-0.074	-0.093	-0.169**
	(0.112)	(0.145)	(0.082)
N	352	363	372
AR1	0.001	0.008	0.004
AR2	0.327	0.483	0.327
Hansen	0.998	0.999	0.51

Standard errors are in parentheses * p<0.1, ** p<0.05, *** p<0.001

Source: Author's calculation (2019)

Leverage and Roe have a negative and significant impact on loangrowth under Basel 2 model, but they are not statistically significant under Basel 3 and Basel 4 models. Deptotasset has a negative and significant impact on loangrowth under Basel 2 model at the 10% level of significance but it has no significant impact on loangrowth under Basel 3 and Basel 4 models. Nplta is negative and significant at 1% and 5% significance levels under Basel 2 Basel 3, respectively but not significant under Basel 4 model. Gdpgrowth, Reporate, and inflation rate have a negative impact on loangrowth in Basel 2 model. Gdpgrowth, Reporate, and inflation rate are not significant under Basel 3 and 4 models.

4.3.2. Impact of Basel CAR on bank lending: Short-run vs long-run analysis

The long-run impact of implementing Basel CAR cannot be revealed by GMM estimation. Consequently, Table 5 presents PMG, MG, and DFE results for the short-run and long-run impact of higher Basel CAR on bank lending in Africa. The PMG results imply that BIIcap, BIIIcap, and BIVcap have a negative and significant impact on loangrowth in the short run and a positive and significant impact on loangrowth in the long run. Nplta is negative and significant across the Basel levels in the short run. In the long run, Nplta became insignificant with higher Basel levels under Basel 3 and 4 models. These suggest that higher Basel levels will help African banks achieve quality loan assets and increase lending in the long run because they can better assess the credit-worthiness of their borrowers. In the long run under Basel 2 model, Nplta has a positive and significant impact, implying that non-performing loans were still an issue for some banks under Basel 2 model perhaps because they adopt selective compliance.

Table 5: Results for PMG, MG, and DFE

	PMG			MG			DFE		
	Basel 2	Basel 3	Basel 4	Basel 2	Basel 3	Basel 4	Basel 2	Basel 3	Basel 4
	Loan_growth	Loan_growth	Loan_growth	Loan_growth	Loan_growth	Loan_growth	Loan_growth	Loan_growth	Loan_growth
LR									
BIIcap	0.255***			0.004			0.007		
	(0.032)			(0.012)			(0.004)		
BIIIcap		0.197***			0.005			-0.004	
		(0.017)			(0.021)			(0.002)	
BIVcap			0.175***			-0.005			-0.003
			(0.050)			(0.007)			(0.002)
Nplta	0.081***	0.05	0.161	-0.043	-0.052	-0.045**	-0.014*	-0.008***	-0.007**
	(0.004)	(0.047)	(0.206)	(0.033)	(0.054)	(0.020)	(0.008)	(0.003)	(0.003)
SR									
ECT	-1.241***	-1.096***	-1.261***	-1.241***	-1.096***	-1.261***	-1.124***	-1.125***	-1.124***
	(0.128)	(0.055)	(0.069)	(0.128)	(0.055)	(0.069)	(0.045)	(0.041)	(0.035)
BIIcap	-0.314***			0.002			0.008		
	(0.037)			(0.014)			(0.005)		
Nplta	-0.132***	-0.105**	-0.264***	-0.031	-0.051	-0.060**	-0.016*	-0.009***	-0.008**
	(0.042)	(0.045)	(0.033)	(0.044)	(0.045)	(0.029)	(0.009)	(0.004)	(0.004)
BIIIcap		-0.215***			0.001			-0.004	
		(0.016)			(0.013)			(0.003)	
BIVcap			-0.229***			-0.008			-0.003
			(0.014)			(0.007)			(0.002)
_cons	5.670***	5.284***	6.137***	5.670***	5.284***	6.137***	5.123***	5.319***	5.308***
	(0.595)	(0.279)	(0.347)	(0.595)	(0.279)	(0.347)	(0.219)	(0.197)	(0.176)
N	418	457	497	418	457	497	418	457	497

Standard errors are in parentheses * p<0.1, ** p<0.05, *** p<0.001

Source: Author's estimation (2019)

For MG, BIIcap, BIIIcap, and BIVcap have no significant impact on loangrowth in the short and long run. Nplta has a significant but negative impact on loangrowth under Basel 4 model both in the short and long run. The Hausman test was performed between MG and PMG estimator; the test confirmed PMG as the more efficient estimator. Using DFE, Basel capital ratios have no significant impact on loangrowth in the short and long run. Still, on DFE, Nplta has a significant but negative impact on loangrowth across Basel II, III, and IV in the short and long run. The Hausman test was performed between MG and DFE estimators. The Hausman test selects DFE as the more efficient estimator. According to Tan (2009), the DFE estimation method is the opposite of the MG estimation method, which restricts both long and the short-run coefficients. In particular, the restrictions on short-run effects are not consistent with economic intuition. As shown in the DFE estimation results in Table 5, the Basel capital ratio and loangrowth have a long-run correlation, and the long-run coefficient is insignificant. Hence, the long-run effect is not stable, possibly owing to the DFE estimation restrictions. Consequently PMG is selected as the better estimator between PMG, MG and DFE. From the result in Table 5, PMG performs best among all the three P-ARDL estimations as far as the sign, significant impact, and theoretical consistency of the estimated coefficients in the results presented.

4.4. Discussion of Findings

The objective of the study was to examine the impact of changes from Basel II to Basel III and the potential impact of Basel IV CAR on bank lending in Africa. Initially, BIIcap increased loangrowth as expected, but the change from BIIcap to higher BIIIcap has no significant impact on loangrowth. This finding was consistent with Ljung and Schennings (2018) findings that Basel III has no impact on bank lending for Swedish banks. Furthermore, the results for simulated BIVcap a further higher CAR have a negative and significant impact on loangrowth in the current period but could have an increasing effect in the subsequent period. The negative impact of BIVcap is supported by Cosimano and Hakura (2011) for banks in advanced countries and Šutorova and Teply (2013) for EU banks where an increase in Basel CAR led to a decline in bank lending ability.

The results further reveal that the negative impact of the simulated Basil IV CAR will be only in the short run. The result indicates that implementing higher CAR in Africa negatively impacts bank lending ability in the short run and positively impacts bank lending ability in the long run. This finding is consistent with Kim and Sohn (2017) and Karmakar and Mok (2015), which posit that higher capital will increase loangrowth in the US banks in the long run but inconsistent with

Cosimano and Hakura (2011) findings showing that higher capital will reduce loangrowth in the long run. Also, lagged loangrowth is not persistent across the three Basel levels. Lagged loangrowth has a positive and significant impact on loangrowth under Basel 3 model. The result is consistent with Carbó-Valverde et al. (2011) for Spanish banks that current loangrowth is positively affected by lagged loangrowth. The result for leverage implies that African banks tend not to take on more risk with higher capital. Size is used to make a comparison of the relevance of large banks, medium-sized, and small banks on loangrowth. The result shows that loangrowth is not affected by bank size. This implies that the size of African commercial banks does not influence the volume of lending. The result is consistent with Naceur and Kandil (2009) for Egyptian banks that higher capital increased size but did not increase bank lending ability.

Roe proxy for cost of capital, and negatively impact on loangrowth under Basel 2 model, suggesting that African commercial banks pass the cost of higher capital to customers when they were in compliance to Basel II CAR, and hene the increase in the cost of lending. This is consistent with Naceur and Kandil (2009) in Egypt, Nkopane (2017) and Oyetade et al. (2020) in South Africa, and Gavalas (2015) for European banks. The result is inconsistent with Carbó-Valverde et al. (2011) that the cost of capital positively affects loan growth for Spanish banks. Our results shows that as the banks moved to Basel III CAR which requires higher equity capital, Roe became insignificant. Thus, implying that since equity capital is expensive, the banks rely on retained earnings to increase capital to achieve Basel III CAR than to incur the cost of capital via issuing of shares, which would have been passed on to bank customers (Cohen & Scatigna, 2016; Ross, Westerfield, & Jordan, 2008).

Regarding the liquidity of African commercial banks, the study expected a positive impact on loangrowth. The negative and significant relationship under Basel II and insignificant impact of liquidity on loangrowth under Basel III and IV suggest that loans are low in the African banking sector because banks are not utilising liquidity for lending purposes. This is inconsistent with Carbó-Valverde et al. (2011) findings for Spanish banks, which show that liquidity increases loan growth. This finding provides explaination for excessive liquidity observed in African banks (Asongu & Odhiambo, 2018). This phenomenon may be due to capital inadequacy to cover for loan losses and non-compliance to higher Basel CAR that increases banks risk assessments (Gabriel, 2016).

Lagged Nplta result implies that the past and current non-performing loans negatively affect loangrowth, which is an additional cost to the banks. The result is inconsistent with Gavalas (2015) that found that non-performing loans have

an insignificant impact on banks in Europe. However, as the banks move from BIIcap to BIIIcap, the weight and significance of non-performing loan declined, which show the reducing effect of BIII CAR on non-performing loans. Furthermore, BIVCARs tend to effectively tackle the non-performing loans challenge in the studied African banks. This is consistent with Admati et al. (2013) who concluded that higher CAR may be costly for banks but will improve bank decisions against poor lending. The macroeconomic conditions in Africa negatively affected loan growth under Basel II CAR. However, GDP growth has no significant impact on loan growth under Basel III and IV. This may be connected to additional capital buffers provided in Basel III and IV accords against business cyclicality. The effect of inflation may be subject to banks'ability to anticipate price changes.

5. Conclusion

This study examined the impact of changes in Basel CAR on bank lending using historical data for Basel capital ratio over the period 2000 and 2018. First, the result suggests that the implementation of Basel IV CAR negatively impact bank lending in Africa. Further analysis that separated short-run impact from long-run impact showed that such a negative impact is limited to the short-run as higher capital will positively impact loan growth in the long run. In order for banks to drive economic growth in Africa, deliberate government policies have to be put in place to provide an enabling environment for the banks to effectively carry out their obligations, which will contribute to economic growth. Thus, complying with Basel IV CAR will help African banks to achieve financial deepening and increase bank lending ability. Nevertheless, non-performing loans reduced significantly with higher Basel levels. To achieve higher Basel capital in Africa, bank regulators in African countries should implement higher Basel standards over a medium-term period to allow banks to prepare for a prevention of any macroeconomic costs from loan reductions in the short term. African banks are lagging behind in compliance with Basel's higher CAR; thus, this study contributes to understanding the implication of higher CAR for commercial banks in Africa. Overall, the potential impact of Basel IV CAR for lending is satisfactory, and consequently, it should be embraced with caution.

References

1. Abdel-Baki, M. (2012). Forecasting the Costs and Benefits of Implementing Basel III for North African Emerging Economies: An Application to Egypt and Tunisia. *African Development Bank, Economic Brief*, 1-40. Retrieved from www.afdb.org.
2. Admati, A. R., DeMarzo, P. M., Hellwig, M. F., & Pfleiderer, P. C. (2013). Fallacies, irrelevant facts, and myths in the discussion of capital regulation: Why bank equity is not socially expensive. *Max Planck Institute for Research on Collective Goods*, 23, 1-77.
3. Al-Rjoub, S. A. (2021). A financial stability index for Jordan. *Journal of Central Banking Theory and Practice*, 10(2), 157-178.
4. Angelini, P., Clerc, L., & Cúrdia, V. (2015). Basel III: Long-term Impact on Economic Performance and Fluctuations. *The Manchester School*, 83(2), 217-251. doi:10.1111/manc.12056.
5. Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The review of economic studies*, 58(2), 277-297.
6. Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of econometrics*, 68(1), 29-51.
7. Asongu, S., & Odhiambo, N. M. (2018). Testing the quiet life hypothesis in the African banking industry. Working Paper. *African Governance and Development Institute (AGDI), Yaoundé* 18(015), 1-21. Retrieved from http://hdl.handle.net/10419/191338.
8. BCBS. (2009). Strengthening the resilience of the banking sector. *Basel Committee on Banking Supervision*. Retrieved from https://www.bis.org/publ/bcbs164.pdf.
9. BCBS. (2010). An assessment of the long-term economic impact of stronger capital and liquidity requirement. *Basel Committee for Banking Supervision*, 1-69. Retrieved from http://www.bis.org.
10. BCBS. (2020). Governors and Heads of Supervision announce deferral of Basel III implementation to increase operational capacity of banks and supervisors to respond to Covid-19. Basel Committee on Banking Supervision. Retrieved from https://www.bis.org/press/p200327.htm.
11. BCBS (2017). Basel III: Finalising post-crisis reforms. *Basel Committee on Banking Supervision*, 1-162. Retrieved from http://www.bis.org.
12. Bernanke, B. S., Lown, C. S., & Friedman, B. M. (1991). The Credit Crunch. *Brookings Papers on Economic Activity*, 1991(2), 205-247. doi:10.2307/2534592.

13. Blackburne, E. F., & Frank, M. W. (2007). Estimation of Nonstationary Heterogeneous Panels. *The Stata Journal*, 7(2), 197-208. *doi:10.1177/1536867X0700700204*.
14. Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, 87(1), 115-143. *doi:https://doi.org/10.1016/S0304-4076(98)00009-8*.
15. Brei, M., & Gambacorta, L. (2014). The leverage ratio over the cycle. *Bank for International Settlement BIS Working Paper* No 471, 1-39. Retrieved from https://www.bis.org/events/conf140909/brei_gambacorta_paper.pdf.
16. Bridges, J., Gregory, D., Nielsen, M., Pezzini, S., Radia, A., & Spaltro, M. (2014). The impact of capital requirements on bank lending. *Bank of England Working Paper* No. 486.
17. Carbó-Valverde, Marqués-Ibáñez, & Rodriguez-Fernandez. (2011). Securitization, Bank Lending and Credit Quality: The Case of Spain. *European Central Bank*, 1-44. Retrieved from http://www.ecb.europa.eu.
18. Chiaramonte, L., & Casu, B. (2017). Capital and liquidity ratios and financial distress. Evidence from the European banking industry. *The British Accounting Review*, 49(2), 138-161. doi:https://doi.org/10.1016/j.bar.2016.04.001.
19. Chironga, M., Cunha, L., Grandis, H. D., & Kuyoro, M. (2018). *African retail banking's next growth frontier.* Retrieved from Online: https://www.mckinsey.com/industries/financial-services/our-insights/african-retail-bankings-next-growth-frontier.
20. Cohen, B. H., & Scatigna, M. (2016). Banks and capital requirements: channels of adjustment. *Journal of Banking & Finance*, 69, S56-S69.
21. Cosimano, T. F., & Hakura, D. (2011). Bank behavior in response to Basel III: A cross-country analysis. Working paper WP/11/119. *International Monetary Fund* 1-35.
22. Das, P. (2019). Dynamic Panel Model. In P. Das (Ed.), *Econometrics in Theory and Practice: Analysis of Cross Section, Time Series and Panel Data with Stata 15.1* (pp. 541-565). Singapore: Springer Singapore.
23. Dionne, G., & Harchaoui, T. M. (2008). Banks' capital, securitization and credit risk: An empirical evidence for Canada. *Journal of Insurance and Risk Management*, 75(4), 459-485.
24. European Investment Bank. (2016). Banking in sub-Saharan Africa: Recent trends and digital financial inclusion. *Regional Studies and Roundtables, European Investment Bank*, 1-179.
25. Gabriel, G. (2016). *The impact of the Basel 3 capital requirements on the performance of European banks*. (Masters). University of Liège, Online. Retrieved from http://lib.ulg.ac.be.

26. Gavalas, D. (2015). How do banks perform under Basel III? Tracing lending rates and loan quantity. *Journal of Economics and Business*, 81, 21-37. doi:https://doi.org/10.1016/j.jeconbus.2015.05.003.
27. Giordana, G. A., & Schumacher, I. (2017). An Empirical Study on the Impact of Basel III Standards on Banks' Default Risk: The Case of Luxembourg. *Journal of Risk and Financial Management*, 10(2). doi:10.3390/jrfm10020008.
28. Goswami, G. G., & Junayed, S. H. (2006). Pooled Mean Group Estimation of the Bilateral Trade Balance Equation: USA vis-à-vis her Trading Partners. *International Review of Applied Economics*, 20(4), 515-526. doi:10.1080/02692170600874218.
29. Gyntelberg, J. (2018). The consequences of "Basel IV"-a quantitative impact study. 1-14. Retrieved from https://www.voeb.de/download/die-folgen-von-basel-iv-englisch.
30. Jablecki, J. (2009). The impact of Basel I capital requirements on bank behavior and the efficacy of monetary policy. *International Journal of Economic Sciences and Applied Research*, 2(1), 16-35.
31. Junge, G., & Kugler, P. (2013). Quantifying the impact of higher capital requirements on the Swiss economy. *Swiss Journal of Economics and Statistics*, 149(3), 313-356. doi:10.1007/BF03399394.
32. Karmakar, S., & Mok, J. (2015). Bank capital and lending: An analysis of commercial banks in the United States. *Economics Letters*, 128, 21-24. doi:https://doi.org/10.1016/j.econlet.2015.01.002.
33. Kim, D., & Sohn, W. (2017). The effect of bank capital on lending: Does liquidity matter? *Journal of Banking & Finance*, 77, 95-107. doi:https://doi.org/10.1016/j.jbankfin.2017.01.011.
34. Ljung, A., & Schennings, A. (2018). *The impact of capital requirements on Swedish bank lending: A study on the effects of higher capital regulations*. Lund University, Retrieved from http://lup.lub.lu.se/.
35. Mashamba, T. (2022). *Liquidity Dynamics of Banks in Emerging Market Economies. Journal of Central Banking Theory and Practice*, 11(1), 179-206.
36. Mecagni, M., Marchettini, D., & Maino, M. R. (2015). *Evolving banking trends in Sub-Saharan Africa: Key features and challenges*: International Monetary Fund.
37. Michalak, T. C., & Uhde, A. (2012). Credit risk securitization and bank soundness in Europe. *The Quarterly Review of Economics and Finance*, 52(3), 272-285.
38. Munoz, S., & Soler, P. (2017). *Basel III End Game. Regulations and Public Policies*, 1-8. Retrieved from https://www.bbvaresearch.com.
39. Naceur, & Kandil. (2009). The impact of capital requirements on banks' cost of intermediation and performance: The case of Egypt. *Journal of Economics and Business*, 61(1), 70-89. doi:https://doi.org/10.1016/j.jeconbus.2007.12.001.

40. Neethling, S. B. (2014). *Empirical evidence of aggregate credit supply by South African banks since the introduction of international risk based capital regulation*. University of Cape Town, Retrieved from http://hdl.handle.net/11427/8569 Available from University of Cape Town Open UCT database.
41. Nkopane, T. (2017). *The relevance of the Basel III Accord within the South African banking system*. Wits University, South Africa Online. Retrieved from http://wiredspace.wits.ac.za.
42. Noss, J., & Toffano, P. (2016). Estimating the impact of changes in aggregate bank capital requirements on lending and growth during an upswing. *Journal of Banking & Finance*, 62, 15-27. doi:https://doi.org/10.1016/j.jbankfin.2015.09.020.
43. Oino, I. (2018). Impact of regulatory capital on European banks financial performance: A review of post global financial crisis. *Research in International Business and Finance*, 44, 309-318. doi:https://doi.org/10.1016/j.ribaf.2017.07.099.
44. Olokoyo, F. O. (2011). Determinants of Commercial Banks' Lending Behavior in Nigeria. *International Journal of Financial Research* 2(2), 61-72. Retrieved from http://eprints.covenantuniversity.edu.ng/id/eprint/527.
45. Ozili. (2015). Determinants of Bank Profitability and Basel Capital Regulation: Empirical Evidence from Nigeria *Research Journal of Finance and Accounting*, 6(2), 124-131. Retrieved from www.iiste.org.
46. Oyetade, D., Obalade, A. A., & Muzindutsi, P. F. (2020). Impact of the Basel IV framework on securitization and performance of commercial banks in South Africa. *Banks and Bank Systems*, 15(3), 95-105.
47. Oyetade, D., Obalade, A. A., & Muzindutsi, P. F. (2021). Basel capital requirements, portfolio shift and bank lending in Africa. *ACRN Journal of Finance and Risk Perspectives* 10, 296-319.
48. Oyetade, D., Obalade, A. A., & Muzindutsi, P. F. (2022). The Impact of Changes in Basel Capital Requirements on the Resilience of African Commercial Banks. *Scientific Annals of Economics and Business*, 69(1), 111-132.
49. Peek, J., & Rosengren, E. S. (1995). *Bank lending and the transmission of monetary policy*. Paper presented at the Conference series-Federal Reserve Bank of Boston.
50. Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled Mean Group Estimation of Dynamic Heterogeneous Panels. *Journal of the American Statistical Association*, 94(446), 621-634. doi:10.1080/01621459.1999.10474156.
51. Psillaki, M., & Georgoulea, E. (2016). The Impact of Basel III Indexes of Leverage and Liquidity CRDIV/CRR on Bank Performance: Evidence from Greek Banks. SPOUDAI *Journal of Economics and Business*, 66(1-2), 79-

107. Retrieved from https://spoudai.unipi.gr/index.php/spoudai/article/viewFile/2541/2615.
52. Rizvi, N. U., Kashiramka, S., & Singh, S. (2018). Basel I to Basel III: Impact of Credit Risk and Interest Rate Risk of Banks in India. *Journal of Emerging Market Finance*, 17(1), S83-S111. doi:10.1177/0972652717751541.
53. Roodman, D. (2009). How to do Xtabond2: An Introduction to Difference and System GMM in Stata. *The Stata Journal*, 9(1), 86-136. doi:10.1177/1536867X0900900106
54. Ross, S. A., Westerfield, R., & Jordan, B. D. (2008). *Fundamentals of corporate finance*: Tata McGraw-Hill Education.
55. Roulet, C. (2018). Basel III: Effects of capital and liquidity regulations on European bank lending. *Journal of Economics and Business*, 95, 26-46. doi:https://doi.org/10.1016/j.jeconbus.2017.10.001.
56. Simões, M. C. N. (2011). Education Composition and Growth: A Pooled Mean Group Analysis of OECD Countries. *Panoeconomicus* 58, 1-18. doi:10.2298/PAN1104454S.
57. Slovik, P., & Cournède, B. (2011). Macroeconomic impact of Basel III. Working Paper 844 *OECD Economics Department*, 1-16.
58. Šutorova, B., & Teply, P. (2013). The Impact of Basel III on Lending Rates of EU Banks. *Finance a Uver: Czech Journal of Economics & Finance*, 63(3), 226-243. Retrieved from https://ukzn.idm.oclc.org/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=89800693&site=ehost-live&scope=site.
59. Swamy, V. (2018). Basel III capital regulations and bank profitability. *Review of Financial Economics*, 36(4), 307-320. doi:10.1002/rfe.1023.
60. Tan. (2009). A pooled mean group analysis on aid and growth. *Applied Economics Letters*, 16(16), 1597-1601. doi:10.1080/13504850701604128.
61. Waithaka, N. N. (2013). *The effect of Basel II requirement on Kenyan commercial banks' lending*. (MSc, Finance). University of Nairobi, Online. Retrieved from http://erepository.uonbi.ac.ke/handle/11295/63349.
62. World Bank. (2020). *Bank nonperforming loans to total gross loans (%)*. Retrieved from: https://data.worldbank.org/indicator/.
63. Žunić, A., Kozarić, K., & Dželihodžić, E. Ž. (2021). Non-performing loan determinants and impact of covid-19: Case of Bosnia and Herzegovina. *Journal of Central Banking Theory and Practice*, 10(3), 5-22.