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Macroeconomic and Bank Specific Determinants of Non-performing Loans in Ghanaian Banking Sector

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Abstract: Banks play an important role in the creation of capital for economic growth of a nation and their reliability is very critical for financial system stability. Nevertheless, banks face risks such as credit risk, which seem to have an impact on banks profitability. To determine credit risk, the ratio of Non-Performing Loans (NPLs) to total bank loans is the most common indicator used. Non-Performing Loans are loans that do not produce interest and principal amount for a minimum of 90 days and fundamentally reflects the performance of a bank. A high ratio indicates a greater risk of loss while a small ratio presents a low risk to the bank. NPLs systematically affects the whole banking system and if care is not taken will disturb its future development. The study examined the determinants of NPLs in the banking industry of Ghana using bank specific and macroeconomic variables. The study was based on monthly data covering the period January 2007 to December 2019 and employed the ARDL bounds test of co-integration to estimate the evidence of short run and long run relationship among the variables. The study results revealed that, bank's lending rate, bank's profitability, Cost to Income Ratio, Capital Adequacy Ratio and Net Interest Margin are the bank specific factors influencing non-performing loans. At the macroeconomic level, inflation and economic growth reduces non-performing loans. Furthermore, previous year's non-performing loans and net interest margin depresses Current NPLs whereas credit adequacy ratio promotes Current NPLs in the short-run. The study recommends a firm policy reform that pays attention to credit appraisal mechanisms to improve the quality of bank loan portfolios through tougher regulations and guidelines to support healthier investment. Thus, management of banks should do well to cut interest rate on loans to make them less expensive for borrower's to meet their commitments, whiles regulators undertake policies that can ensure efficiency in bank's operations. Furthermore, Policymakers must consider GDP growth carefully by implementing a set of policies geared towards improving investment and finally profitability.

Keywords: Non Performing Loans, Bank Specific, Macroeconomic, ARDL Bounds Test, Co-integration

1. Introduction

Banks operate by accepting deposits, or by borrowing funds in the money market. The source of borrowing are from individuals, businesses, financial institutions, etc. These funds are then given out as loans to those who need the funds for investments or other purposes. In the process of making loans by the banks, interest rates are used as price signals and by this the banking system helps channel funds from savers to borrowers efficiently for investment opportunities in productive sectors. Banks therefore play an important role in the creation of capital for economic growth of a nation. Thus, the reliability of the banking institutions is very critical for financial system stability. However, banks face risks and one of them is credit risk which seem to have more impact on profitability of banks [1]. The most common indicator being used to determine credit risk is the ratio of Non-Performing Loans (NPLs) to total bank loans.

NPL fundamentally reflects the performance standards of a bank, a high ratio indicates a greater risk of loss while a small ratio presents a low risk to the bank. NPLs

systematically affects the whole banking system and if care is not taken will disturb its future development. This can reduce bank's profitability as well as threaten business models. NPLs also can influence bank's liquidity and may lead to asset eroding of banks and capital loss. As a result, banking industry becomes insubstantial due to the less capacity to lend. Saunders and Cornet [2] orate that, the ratio measures the risk that underlying cash flows from loans and securities held by financial institutions will not be paid in whole. NPL is seen as one of the basic causes of banking crises [3, 4]. ECB and European supervisors defined non-performing loan (NPLs) as a loan with the indication that the borrower will not repay the loan due to financial difficulties or it is more than 90 months late [5].

International Monetary Fund (IMF, 2004) stated that loans would be considered NPLs if they do not produce interest and principal amount for minimum of 90 days. Thus, advances that remained unpaid together with its interest on the maturity date and are not expected in the forthcoming dates are called Non Performing Loans.

In Ghana, industry's exposure to credit risk somewhat heightened during 2020 relative to 2019 due to the challenging operating environment occasioned by COVID-19. The non-performing loans ratio inched up for most part of 2020 due largely to the COVID-19 pandemic-induced slowdown in credit growth. Secondly, higher loan loss provisions arising from repayment challenges also contributed to the increase in NPLs. Meanwhile, the amount of non-performing loans is one of the indicators of the performance of the economy and as a result a higher non–performing loan will lead to poor financial health and economic crisis.

Premised on the said facts, this study explore the determinants of NPLs in Ghana including both bank-specific and macro-economic level factors from previous literature. Considering the NPL as an endogenous variable, this study adds to a growing literature by determining the index through macroeconomic and bank specific factors using aggregate data of Ghanaian banking sector for the period 2007 to 2019. Again this study provides fresh evidence on the bank specific and macroeconomic impact on NPLs in Ghanaian banks.

The rest of the paper is organized as follows. Section 2 presents the existing literature on problem loans, its determinants and hypotheses, Section 3 describes the empirical methodology. Section 4 presents the results of the econometric analysis and Section 5 offers concluding remarks and policy stances.

2. Literature

Many studies have been carried out on the effects of various macroeconomic and bank specific factors on nonperforming loans [6-9]. Whereas macro-economic factors represent economic settings that are often not controllable but must be considered by policy makers in formulating policies [10]. The variables under consideration include GDP, Interest rates, Inflation rates, Return on Assets, CAR, cost to income ratio and return on equity.

2.1. Bank Specific Variables

The Capital Adequacy Ratio (CAR), measures the degree of banks' solvency, stability, soundness as well as their ability to absorb risk. According to some studies [9, 11], CAR is negatively related to NPL; Olarewaju [12] reported that, capital adequacy has a significant and indirect impact on the NPLs of the banks in Low Middle Income (LMI) economies. This means an increase in CAR will enable banks to keep more funds aside to meet liabilities and other obligations hence reducing the number of initial loans and resultant NPLs. On the contrary, the findings of a research by Alexandri and Santoso on Indonesian banks revealed a positive but insignificant effect of CA on NPLs. Other researchers like Cheng et al. [14] revealed CAR has an insignificant impact on NPL.

Hypothesis 1: This research expects Capital Adequacy Ratio (CAR) to have a negative effect on NPL.

Net Interest Margin (NIM) is a vital bank specific factor of NPLS. The net interest margin (NIM) is the difference between the income received on a bank's portfolio and the interest paid on deposits or borrowed funds. NIM has been used as a significant indicator of asset productivity in the literature because a high NIM indicates effective use of earning assets and a low NIM indicates inefficient use of earning assets. [15=17]. Some studies have found a positive association between NIM and NPL, thus the higher the NIM the greater the burden on interest [10, 16, 17]. This means that, an increase in the interest margin of a bank minimizes default risk and a better the performance. Using the dynamic panel model, Amuakwa-Mensah and Boakye-Adjei [18] studied the determinants of NPLs in the Ghanaian banking industry and realized that, net interest margin is one of the variables which negatively and significantly affects NPLs in the banking system. Dhar and Bashi [11] studied 27 Indian banks and also found that NPL and NIM are negatively related. Based on prior studies, this study is expecting the following relationship.

Hypothesis 2: NIM is significantly and positively related to NPLs.

The Lending interest rate is another important conditioning of the credit risk because it affects the debt burden. In order to survive when the interest rate is high, the company must create a higher rate of return. If the cost of capital exceeds the rate of return, the company will become financially insolvent or bankrupt. This suggests that the interest rate is projected to have a favorable impact on credit risk. A rise in interest rate shows an increase in the volume of borrowers debt and makes debt servicing more expensive and difficult [19]. Other findings on the other hand see NPLs diminishing by a reduction in interest rate, and consequentially, bank's earnings also decreases. In Malaysia a similar study done by [20] evidenced the negative association between interest rate and NPLs. these viewpoints, we are expecting the following relationship.

*Hypothesis 3: T*here is a significant positive impact between interest rate and NPLs.

Performance indicator (ROE) is found to be significant and negatively related to the NPLs for consumer loans [21]. The study implemented dynamic panel data methods to deal with the factors of household's NPLs in the Tunisian banking sector and found ROE as one of the variables having an effect on the level of NPLs.

ROA is the ratio of income to total assets and it is a measure of bank's profitability. It is an indication of the efficiency of a management of an organization in generating net income from all the resources it owns. ROE is also a measure of profitability of a bank except that the profit is related to equity and all the remaining assets. From literature, profitability is negatively associated with NPLs [8, 10, 21], indicating that as the profitability of a bank increases the lesser the incentive to engage in risky loans which reduces the amount of NPLs. Contrary to this assertion, [9, 11], in their studies found a positive but insignificant association of ROA with NPLs. Investigating the Euro area banking system for the period 1990Q1–2015Q2, using GMM, Anastasiou et al. [22] found that ROA and ROE negatively affect the NPLs, as well as the GDP growth and public debt. Singh et. al, [23] examined bank specific and macroeconomic determinants of nonperforming loans (NPLs) across 74 commercial banks in Nepal during the period 2015–2019. According to their multiple regression analysis, ROA and Inflation have a positive and significant effect on NPL. In this study, the hypothesis is that,

Hypothesis 4: ROE and ROA have a negative relationship with NPLs.

Cost to income ratio (CIR), which measure operational efficiency reflects the cost of running the banks as a percentage of income. Higher CIR implies the bank would be less efficient, which should adversely affect bank profits, depending on the degree of competition in the market. Olarewaju [12] in a study, explored the factors determining commercial banks' NPLs in Low Middle Income economies. The data collected was a bank level data which was a blend of bank specific and macroeconomic variables. Using system generalized method of moments, it was found out that lagged nonperforming loan, lending rate, capital adequacy, credit growth, cost income ratio, as well as real interest rate, were the significant factors affecting nonperforming loans in lower middle income countries' banking sector. The hypothesis then is that,

Null Hypothesis 5: There is a positive relationship between CIR and NPLs.

2.2. Macroeconomic Factors

Inflation is an increase in the general price level and is typically expressed as an annual percentage rate of change. A study by Ghosh [24] investigated the effect of NPLs on commercial banks and savings institutions in the USA and concluded that inflation has a significant and positive effect on NPLs. It is expected that a low inflation rate encourages savings and investment leading to economic stability, whereas a high rate of inflation reduces the ability of debtors servicing the loans and increases NPL. A study, reports that previous year's inflation negatively and significantly affects NPLs in the Ghanaian banking industry [18]. This study expects,

Hypothesis 5: There exists a positive relationship between inflation and NPL.

Another significant macroeconomic determinant of NPL is GDP growth rate. A higher economic growth will decrease the ratio of NPLs in a country, proving an inverse relationship between GDP growth rate and NPLs [25]. Mosharrof et al. [26], investigated bank specific and macroeconomic determinants of NPLs in Bangladesh over 2014 to 2018 period, using pooled ordinary leased square approach. The study found that, economic growth have an insignificant positive relationship towards NPL. However, empirical evidence shows there exists a significant but a negative relationship between the growth in real GDP and NPLs in Ghana [18]. Again, Foglia [27], investigated the relationship between NPLs and the macroeconomic environment in the Italian context in the period 2008–2020. An ARDL cointegration model analysis performed, found GPD and Public Debt have a strong (negative) impact on the level of NPLs. Based on the aforementioned, this study expects,

Hypothesis 6: GDP growth rate has a significant negative impact on NPLs.

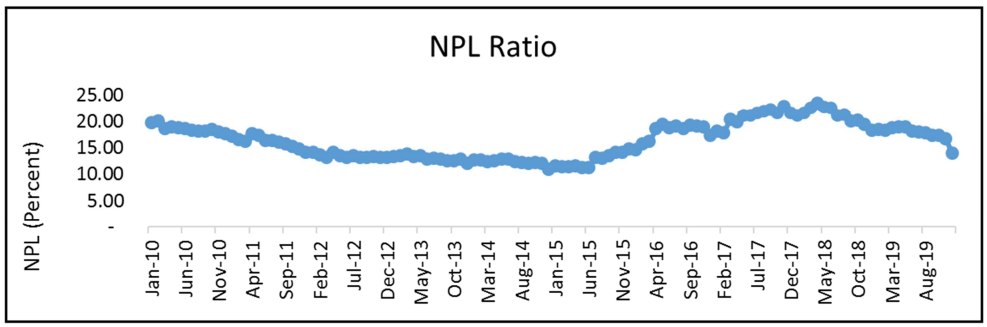

Figure 1. *Trends NPLs in Ghana, 2010 to 2019.*

The NPL ratio started from 19.7 per cent in January 2010 and ticked up to 20.2 per cent in February 2010 and trended downwards to 10.9 per cent in December 2014.

Banks in Ghana had 13.9 percent non-performing loans (NPLs) as of December 2019. The reduction is ascribed to Ghana's central bank's recent clean-up and recapitalization

effort. It also underscores the banking system's continuous progress, which has been on the mend since 2017.

Between 2017 and early 2019, Ghanaian banks were recapitalized as a result of greater capital requirements and increased minimum necessary paid-up capital, while seven insolvent banks were closed down. However, high NPLs have persisted. Because asset quality has deteriorated after 2014, asset risks remain the most significant credit problem for Ghanaian banks. The reduction in non-performing loans in Ghanaian banks, which came as a result of a recent clean-up and recapitalization effort, is credit positive for Ghana's banking sector and helps to maintain financial stability.

NPLs reached a high of 23.5 percent in April 2018 as a result of slow economic development and currency instability in 2015 and 2016, as well as vulnerabilities at the seven insolvent banks, which were preceded by fast loan growth and loose credit underwriting procedures. NPLs have been slowly improving since their high, dropping to 17.3% in October 2019 and 13.9 percent by December 2019, indicating a considerable acceleration in the downward trend.

Increased loan recoveries, write-offs, and higher credit growth could all contribute to the decrease in NPLs. We believe that the improvement is mostly due to the central bank's loan-loss write-off policy for nonperforming loans (NPLs) that have been fully funded for more than two years. New risk management regulatory mandates are likely to encourage this.

3. Methods

This empirical study postulates an association between NPL and the bank specific determinants, and macroeconomic determinants in Ghana. Secondary data were obtained from the Bank of Ghana for this study. The data used were monthly data for the period January 2007 to December 2019. The bank specific variables are Non-Performing Loans (NPLs), lending rate on all maturities (INT), Return on Equity (ROE), Return on Assets (ROA), Cost to Income Ratio (CIR), Capital Adequacy Ratio (CAR) and Net Interest Margin (NIM). The macroeconomic factors are inflation rates (INF) and Composite Index of Economic Activity (CIEA growth rate) which tracks short term dynamics in economic activity. The CIEA growth is the proxy for GDP.

Table 1. *The theoretical relationship between the independent variables and NPL.*

Variables related with NPLs	Direction of Relationship
INF	+
INT	+
ROE	-
ROA	-
NIM	-
CIR	+
CAR	-
CIEA_GTH	-

All the 32 commercial banks were used for analysis from January 2007 to December 2019. This time period is taken because it has never been considered in previous studies to assess the NPLs in the Ghanaian banking sector. Previous studies have considered the quarterly time series data over the period of 2008 to 2015 [17, 18, 28, 29] Studies on assessing NPLs considering data from recent years, to the best of our knowledge are lacking. Therefore, in this study, we attempted to assess the determinants of NPLs from the time period ranging from 2007 to 2019. This time period is well-thought-out due to the handiness of sufficient data for the analysis of variables. Secondly, literature provides very mixed support for several other bank-specific variables. Our selection of bank-specific variables is based on the support previous studies report for their inclusion.

The selection of variables comes from the most commonly studied variables, which are expected to have an impact on NPLs.

3.1. Unit Root Test

Generally, time series data contains unit root meaning that these series are not stationary. Augmented Dickey Fuller (ADF) test (1979), generally popular method, is being applied to test the unit root under the hypothesis series has unit root. Akaike criterion has been followed to lag selection. The model to check the unit root is:

$$\Delta X_t = \lambda_0 + \lambda_1 X_{t-1} + \lambda_2 T + \sum_{i=1}^{n} \varphi i \Delta X_{t-i} + \varepsilon \quad (1)$$

Where Δ is the difference operator, X is the natural logarithm of the series. T is the trend variable. λ and ψ are parameters to be estimated and ε is the error term.

3.2. Johansen Co-integration Test

Johansen co-integration test procedure consists of estimating a vector autoregressive (VAR) models which includes difference as well as the levels of the non-stationary variables. The equation for Johansen co-integration test is given by

$$\Delta X_t = \tau_1 \Delta X_{t-1} + \cdots + \tau_{k-1} \Delta X_{t-k+1} + \pi X_{t-k} + \varepsilon \quad (2)$$

Where ε is Gaussian random variable τ_1 and π are matrices of parameters estimated using ordinary least squares. The component πX_{t-k} produces different linear combinations of levels of the time series X_t as such the matrix π contains information about the long run properties of the system describe by the model. For instance, if the rank of the matrix π is 0, then then no series of the variables can be expressed as a linear combination of the remaining series. This indicates that there does not exists a long run relationship among the series of the VAR model as a test of co-integration a rank of 0 means integration is rejected. On the other hand, if the rank of the coefficient matrix π is 1, or greater than 1 then there exists 1 or more co-integrating vectors. This indicates a long run relationship or that the series exhibits significant evidence or behaving as a co-integrated system. Johansen [30] and Engle and Granger [31] proposed two statistics which can be used to evaluate the rank of the coefficient matrix or the number of co-integrating vectors. The one used here is the likelihood ratio test of the null hypothesis that the number of is r versus the alternative r+1 vectors. In this case Ho is that the number of co-integrating vectors equals 0.

3.3. Vector Error Correction Model (VECM)

The vector error correction model (VECM) restricts the long-run behaviour of the endogenous variables to converge to their cointegrating relationships while allowing for short-run adjustment dynamics. In this case, the cointegration terms are the correction terms since a series of partial short-run adjustments correct gradually the deviation from long-run equilibrium. The VECM corresponds to a restricted VAR of order k-1 for the first differenced series, with the inclusion of error-correction terms for the cointegrating vectors.

$$\Delta X_t = \sum_i^{k-1} \Gamma_i \Delta X_{t-i} + \Pi X_{t-1} + \mu + \varepsilon_t, t = 1, \dots T \quad (3)$$

Where X_t is the set of $I(1)$ variables discuss above; $\varepsilon_t \backsim \text{niid}(0, \Sigma)$; μ is a drift parameter, and $\Pi = \alpha\beta'$ where α and β are both $(p \times r)$ matrices of full rank, with β containing the r cointegrating vectors and α carrying the corresponding loadings in each of the r vectors. The adjustment coefficients in a matrix α refer to the coefficients of the Error Correction (ECM) terms.

Table 2. *Descriptive Statistics.*

	NPL	INF	INT	ROE	ROA	NIM	CIR	CAR	CIEA_GTH
Mean	14.60139	12.91026	16.84085	23.09838	4.33565	6.683641	56.33501	17.16624	12.03316
Median	13.88825	11.79699	15.71705	22.50489	4.09057	6.715751	57.53464	17.41186	7.36065
Maximum	23.45170	20.74254	25.22200	34.01074	6.91991	13.80163	70.12316	21.94531	73.39080
Minimum	6.14247	7.60000	9.43800	7.324318	2.26755	0.835494	48.45000	13.19254	-4.52072
Std. Dev.	4.52018	3.79258	5.053323	5.222354	1.06838	3.695851	5.035386	1.824742	14.07342

4. Empirical Results

Table 2, shows the descriptive statistics for the main variables. The table shows that CIR has the biggest mean of 56.34 and a standard deviation of 5.04 followed by ROE with the mean of 23.10 and standard deviation of 5.22. CIEA-GTH has a mean of 12.03 and the highest standard deviation of 14.07. The descriptive statistics of the bank specific performance yardsticks and macro-economic determinants of NPLs are also reported,

Table 3. *ADF Unit Root Test Results.*

Variable	I(0)			I(1)		
	Test Statistics	Critical value at 5%	P Value	Test Statistics	critical value at 5%	P Value
NPL	-1.656226	-2.880088	0.4515	-10.55698	-1.94291	0.0000
CAR	-0.203894	-1.942896	0.6113	-13.25986	-1.94291	0.0000
NIM	-0.334529	-1.943074	0.5632	-4.5094	-1.943074	0.0000
INF	-0.572161	-1.942924	0.468	-5.9886116	-1.942924	0.0000
INT	-0.620392	-1.94291	0.4472	-5.414603	-1.94291	0.0000
CIEA_GTH	-2.167349	-3.441777	0.5036	-4.806475	-3.441777	0.0000
ROA	-0.361771	-1.942924	0.553	-20.71712	-1.942924	0.0000
CIR	-0.555273	-1.942924	0.4752	-13.68251	-1.942924	0.0000
ROE	-0.725231	1.942924	0.401	-13.3576	1.942924	0.0000

Table 3 presents the unit root test results with the null hypothesis being that all variables contain unit roots in level against the alternative of stationarity. The variables, which exhibit non-stationarity in their levels form, are first differenced to be made stationary. The results indicate that all variables were non-stationary in level but stationary at first difference.

Table 4. *Lag-Order Selection Criteria.*

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-3231.96	NA	84804353	43.79675	43.97901	43.87080
1	-2133.51	2048.455	90.77884	30.04746	31.87009*	30.78799*
2	-2029.41	181.4804	67.16564*	29.73523*	33.19823	31.14224
3	-1965.04	104.3880	86.53591	29.95993	35.06329	32.03341
4	-1914.83	75.30653	138.7429	30.37609	37.11981	33.11605
5	-1869.84	62.01167	247.9439	30.86272	39.24682	34.26916
6	-1787.49	103.5010*	281.4005	30.84440	40.86886	34.91732
7	-1696.87	102.8658	305.4093	30.71441	42.37923	35.45380
8	-1603.50	94.62906	348.6533	30.54728	43.85247	35.95315

The Autoregressive model is sensitive to the selection of lag length, and therefore it is necessary to determine, prior to the estimate, the appropriate amount of lagged difference terms P should be used. When there are too few lags, the test's power to reject the null hypothesis is reduced, and when there are too many lags, the test's power to reject the null is reduced. In time series analysis, there are several methods for determining the right lag duration.

The commonly used techniques are Akaike Information Criterion (AIC), the Schwarz Bayesian Information Criterion

(SBIC) and the Hannan-Quinn Information Criterion (HQC) and hence this study determined the optimal lag length based on these criteria. In the case that there were contradicting results from the three criteria, the SBIC criterion is preferred, since the SBIC will select the correct model with few lags, while on the average the AIC will choose the model with too many lag orders. Lag of order 2 is selected according to AIC as shown in Table 4.

4.1. Johansen Co-integration Test

After the test of stationarity, this study uses Johansen (1991, 1995) co-integration test to identify the existence of any co-integrating relationship between CAR and NPL and the economic variables.

Johansen proposes two different likelihood ratio test of significance named as trace test and maximum eigenvalue test, which are represented by following equations.

$$Q_{trace} = -T\sum_{i=r+1}^{k}\log(1-\lambda_i) \quad (4)$$

$$Q_{max} = -Tlog(1-\lambda_{r+1}) = Q_r - Q_{r+1} \quad (5)$$

Where T the sample is size and λ_i is the $i-th$ largest eigenvalue. The trace statistic tests the null hypothesis of r co-integrating vectors against the alternative hypothesis of k co-integrating vectors. Whereas in the maximum eigenvalue statistic tests the null hypothesis of r co-integrating vectors against the alternative of r+1 co-integrating vectors. There was one cointegration relationship among the variables as seen in table 5.

Table 5. *Maximal Eigenvalue and trace test results for cointegration.*

Hypothesized	Trace Test		Max-Eigenvalue Test	
No. of CE(s)	Statistic	Prob.**	Statistic	Prob.**
None *	280.5629	0.0000	65.79505	0.0081
At most 1 *	214.7679	0.0000	64.45846	0.0019
At most 2 *	150.3094	0.0007	38.20357	0.2778
At most 3 *	112.1058	0.0023	31.56523	0.3273
At most 4 *	80.54062	0.0055	29.80320	0.1420
At most 5 *	50.73741	0.0261	20.91581	0.2814
At most 6 *	29.82161	0.0497	16.13682	0.2170
At most 7	13.68479	0.0920	8.967956	0.2888
At most 8 *	4.716835	0.0299	4.716835	0.0299

4.2. Vector Error Correction Model (VECM)

Since the model contains cointegration relationship among the variables, we proceed to VECM and the long-term equations. We specify the Vector Error Correction model as:

$$\Delta X_t = \beta_0 + \sum_{i=1}^{n}\beta_i\Delta X_{t-i} + \sum_{i=0}^{n}\delta_i\Delta Y_{t-i} + \pi Z_{t-1} + \mu_t \quad (6)$$

Where π is the coefficient of the Error Correction Term (ECT) Z_{t-1}. π is also the speed of adjustment, because it measures the speed at which X returns to equilibrium after a change in the endogenous variable Y.

4.2.1. Long Run Model

The cointegrating equation (Long- run model) is given as:

$$\mathrm{ECT_{t-1}} = \mathrm{NPL_{t-1}} - 2.027\mathrm{CAR_{t-1}} + 0.9924\mathrm{NIM_{t-1}} - 1.1267\mathrm{INF_{t-1}} + 1.0576\mathrm{INT_{t-1}} - 0.1900\mathrm{CIEA\_GTH_{t-1}} - 12.8035\mathrm{ROA_{t-1}} - 1.2991\mathrm{CIR_{t-1}} + 1.6296\mathrm{ROE_{t-1}} + \mathrm{C}$$

The long-run impact of some bank specific and macroeconomic factors on Non-performing loans is presented in Table 6 with the corresponding standard errors. The results show a significantly long run relation between NPL, the dependent variable, and D(NPL), D(CAR), D(INF), D(NIM), D(INT), D(CIEA_GHT), D(ROA), D(CIR) and D(ROE). Capital adequacy is a negative and significant determinant of NPLs such that a 1% increase in capital adequacy ratio is likely to decrease NPL by 2.027% in the long-run holding all other factors constant. Then hypothesis that Capital Adequacy Ratio (CAR) has a negative effect on NPL is supported and in line with some previous studies [12]. A positive and significant association between NIM and NPLs was revealed by the current results. This supports the hypothesis "NIM is significantly and positively related to NPLs", suggesting that a higher NIM holding all other factors constant is inclined to increase NPL and this is consistent with [15-18]. In addition, it was found that interest rates have a significant influence on NPLs, hence supporting hypothesis 3, "Interest rates have a positive impact on NPL". This result is not in line with earlier study by Ozili and Outa [20]. Besides, the study revealed a negative relationship between ROA and NPLs in Ghana, showing that profitable banks are less likely to have higher NPLs and supports previous studies [8, 10, 15, 21] but contrary to Singh et. al. [23]. The association between ROE and NPLs, on the other hand, was determined to be positive and significant. The results again revealed CIR as a negative and significant determinant of NPLs. An increase in operating cost to income implies the bank would be less efficient, which should adversely affect bank profits leading to decline in NPLs and this in line with the hypothesis and some earlier studies [7, 10, 22].

The macroeconomic variables in the study were found to have negative significant influence on NPLs. The findings indicated that higher GDP growth rate is more likely to decrease banks NPLs [18, 15, 27] and supports hypothesis 6. The study also found that higher inflation rate will result in less NPL which is contrary to the research hypothesis 7. However a study by Amuakwa-Mensah and Boakye-Adjei [18] supports this result outcome.

4.2.2. Short-Run Model

The error correcting factors in the over-identified model are employed to capture the model's short-run dynamics. The error correction term must be negative and statistically significant, according to existing theory. The speed of adjustment toward the long-run equilibrium relationship is measured by the coefficient of the error correction term. In model 6, the error correction term ($\mathrm{Z_{t-1}}$) carries a negative sign (-0.03075) and is significant (t-stat -2.3663). This

implies that there is adjustment in NPL in the long run, any shock in the dependent variables in the short run can be corrected by adjustment in other factors. The factors that are important for short-run variation in NPL are NPL_{-1} and CAR, refer to table 6. The results indicate that a 1% increase in CAR increases NPL by 0.061% whiles NPL_{-1} will decrease NPL by 0.031% all factors remaining constant in the short run.

Table 6. *Estimate of VECM.*

Variable	NPL	CAR	NIIM	INF	INT	CIEA	ROA	CIR	ROE	C
Long term										
	1.000	-2.027 (0.6355)*	0.9924 (0.2349)*	-1.1267 (0.4015)*	1.0576 (0.2737)*	-0.19 (0.0713)*	-12.8035 (1.9704)*	-1.2991 (0.3624)*	1.6296 (0.3080)*	103.4287
Short Run										
	-0.0307 (-0.0130)*	0.0609 (0.0116)*	-0.1300 (0.0525)*	-0.0090 (0.0095)	-0.0110 (0.0107)	-0.0512 (0.1216)	0.0039 (0.0083)	0.0760 (0.0483)	-0.0585 (0.0543)	

Bank specific factors such as previous year's non-performing loans and net interest margin have negative but significant short-run relationship with Current NPLs, whereas credit adequacy ratio has positive significant short-run relationship with Current NPLs. Similar study by Fajar and Umanto [32] employed dynamic panel data techniques (systems GMM) in the analysis and found past value of non-performing loans positively contribute to the current value.

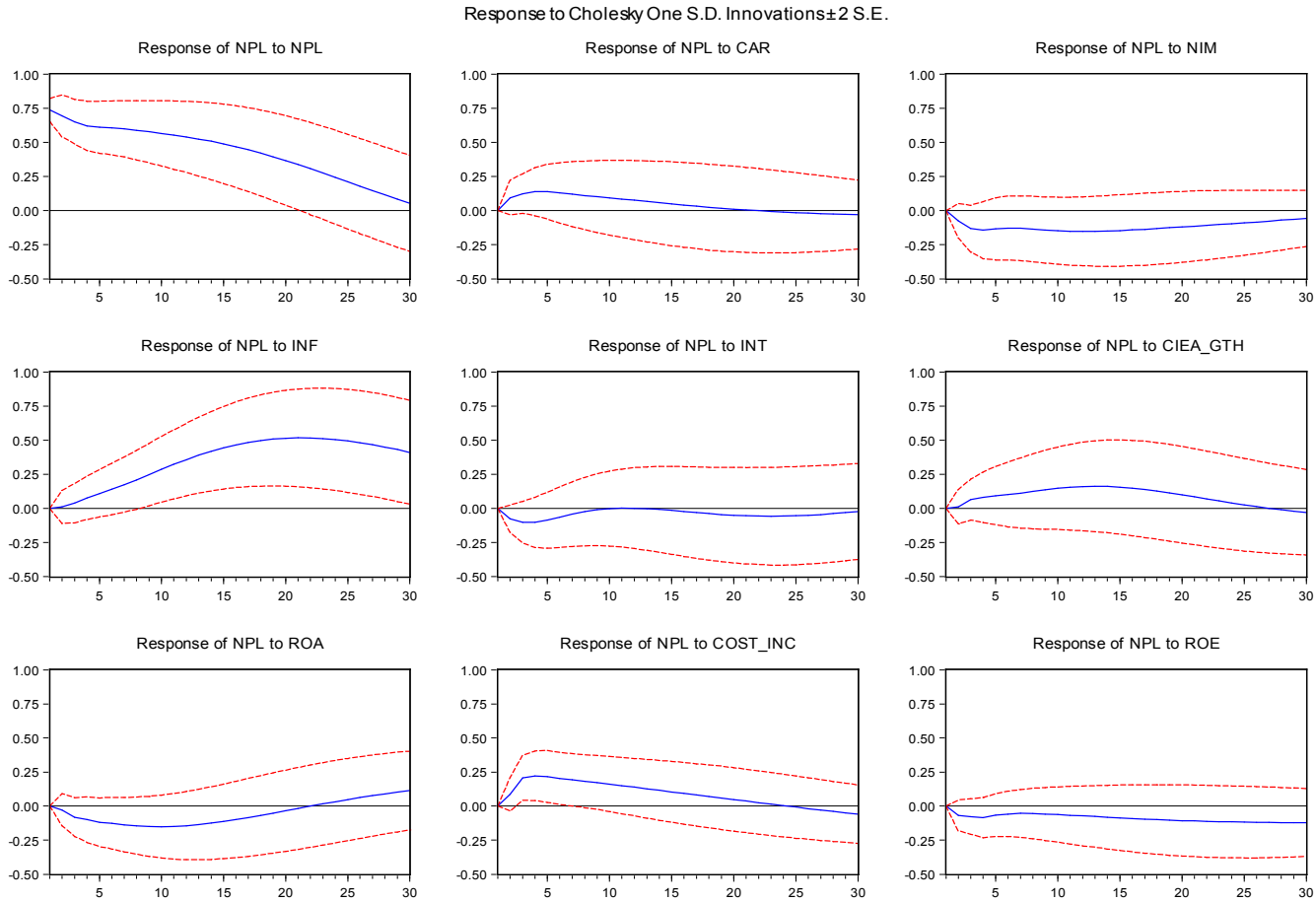

Figure 2. *Impulse-Responses of NPL to Shocks in Bank-Specific and Macroeconomic Variables.*

4.3. Impulse Response Functions

The graphs on figure 2 show that the response of NPL to its own shocks is contemporaneously strong and positive for the initial periods before it subsides to zero towards the end of the period. This means that any unanticipated increase in the NPL consistently reduces the deviation between the short-term value of the NPL and its long-run equilibrium values. One standard deviation shock from CAR to NPL causes NPL to increase but subsides to zero after Twenty (20) months. One standard deviation shock from NIM to NPL causes NPL to fall and persist. One standard deviation shock from INF to NPL causes NPL to increase and persist. One standard deviation shock from INT to NPL is negative for a short run and return to equilibrium after ten (10) months. One standard deviation shock from CIEA_GTH to NPL causes NPL to rise for a while and gradually returns to equilibrium

after thirty (30) months. One standard deviation shock from ROA to NPL causes NPL to decline initially and then subsides to zero after 24 months. One standard deviation shock from CIR to NPL causes NPL to rise and subsides to zero after 25 months. One standard deviation shock from ROE to NPL causes NPL to fall and persist.

4.4. Checking Model Stability

The model was also checked for stability diagnostics using CUSUM test and it was found to be stable since the estimated parameters have not gone outside the critical lines or remains within the 5% significance level.

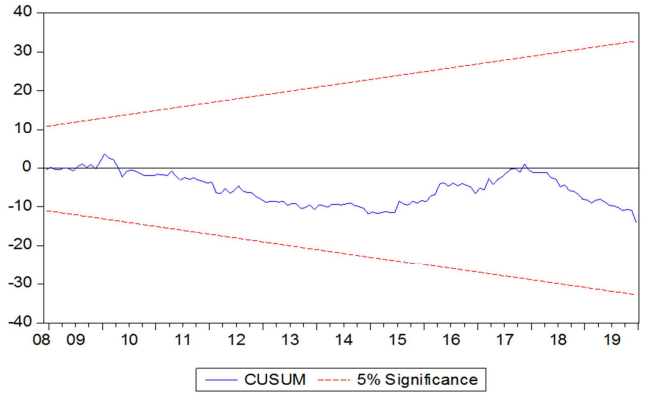

Figure 3. *Estimated coefficients using cumulative sum of recursive residuals.*

4.5. Serial Correlation Test

A Breusch-Godfrey Lagrange multiplier (LM) for serial correlation based on F-statistic test along with its associated probability value indicated that there was no serial correlation. Thus, the null hypothesis of no serial correlation in the residual could not be rejected. The null hypothesis is accepted because of low F-statistics and its attendant high probability value.

Table 7. *Breusch-Godfrey Serial Correlation LM Test.*

F-statistic	**1.489935**	**Prob. F(2,131)**	**0.2292**
Obs*R-squared	3.4029	Prob. Chi-Square (2)	0.1824

5. Conclusions

The banking industry plays a key role in an economy of a country and as such considered as the backbone in the financial transaction of a country. This study examined the determinants of NPLs in the banking industry of Ghana, using both bank-specific variables (that is, NPLs, INT, NIM, ROE, ROA, CIR, CAR), and macroeconomic variables (that is, INF and CIEA_GTH) as independent or explanatory variables. Results from the study revealed that there is a long-run relationship between NPLs and the bank-specific and macroeconomic variables. Also there is a short-run variation between NPLs and CAR.

This paper has shown that in Ghana, like other economies of the World, experienced a significant but negative relationship between real GDP and NPLs. An improvement in the real economy is likely to see an instantaneous reduction in the NPLs, therefore management of the banks should see to the fact that credit facilities obtained from the banks are properly utilized in productive activities. Policymakers must consider GDP growth carefully by implementing a set of policies geared towards improving investment. It was also shown that profitability of banks have a strong influence on NPLs, indicating management employ proper loan management processes to check on the credibility of the creditors and also to invest in useful ventures to reduce the chances of loss and increase profits. The results also presented an effect of operating efficiency on NPLs. For a better financial position, top management must put in measures to reduce expenses compared to revenue for a higher overall profit to reduce NPLs. The study also found interest rate having a significant influence on NPLs, henceforth, it should be controlled to reflect the supply and demand of the money market and also strengthen the bank lending channel. Policy makers should endeavour to keep a low inflation environment that will also render the Bank of Ghana to revise downward the policy rate.

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