Bank *of* Zambia

WP/2021/1

BoZ WORKING PAPER SERIES

The Determinants of Non-Performing Loans in Zambia: Impact of Bank-Specific and Macroeconomic Variables

By
Teddy K. Funyina
Isaac Muhanga

WP/2021/1

Bank of Zambia Working Paper Series

The Determinants of Non-Performing Loans in Zambia: Impact of Bank-Specific and Macroeconomic Variables

By

Teddy K. Funyina[1]

Isaac Muhanga

Bank of Zambia

September 2021

Abstract

This study investigates the key bank-specific and macroeconomic determinants of non-performing loans (NPLs) in the banking sector in Zambia for the period 2010Q1 – 2019Q3. The study uses a dynamic panel data approach of cointegration and fully modified ordinary least square (FMOLS) model across 16 banks. Results reveal that NPLs can be attributed to both bank-specific and macroeconomic conditions, though the latter set of factors was found to have a relatively higher explanatory power. Nonetheless, some influences vary across different bank categories. Specific results indicate that depreciation of the Kwacha significantly increases NPLs in all, big and foreign bank categories, however, it lowers NPLs in small and domestic bank categories. This result seems to imply that big and foreign bank categories might be vulnerable to heightened credit default risk when the Kwacha depreciates as, they are more inclined to lend in foreign currency. Besides, while changes in inflation seem to matter in all, small and domestic bank categories, it is not a factor in big and foreign bank categories. The results suggest that banks pay extra attention to the adoption of effective risk management policies that use rigorous loan screening and assessment of the macroeconomic conditions to mitigate the financial instabilities derived from changes in macroeconomic conditions and enhance asset quality. The results further provide basis for credit risk modeling often used by central banks within the stress test methodology.

Keywords: Non-performing loans, bank-specific determinants, macroeconomic determinants, panel data, FMOLS.

[1] Corresponding author: tfunyina@boz.zm. Bank of Zambia, P.O. Box 30080, Lusaka, 10101. Zambia. The study benefitted from comments received from the research seminar discussions held with Bank of Zambia staff. The findings and opinions expressed in this paper are entirely those of the authors and do not in any way represent the views or position of the Bank of Zambia. The authors remain responsible for all the errors and omissions.

Table of Contents

1.0 Introduction

It has become apparent that the global financial crisis of 2007/2008 has sparked a growing discussion among economists on the effects of banking sector instability on the wider economy (Louzis et al., 2012; Gosh, 2015; Chaibi and Ftiti, 2015). This has motivated academic researchers, policy makers and financial regulators to explore, in further detail, the factors that could possibly cause a banking crisis. In this regard, exploring the factors that lead to bad loans is paramount for financial regulatory authorities to maintain financial stability by allowing banks to pursue responsible management and play a vital intermediation role. Thus, the stability of the banking system is fundamental to sustainable growth prospects as it enhances the confidence of businesses and the public at large.

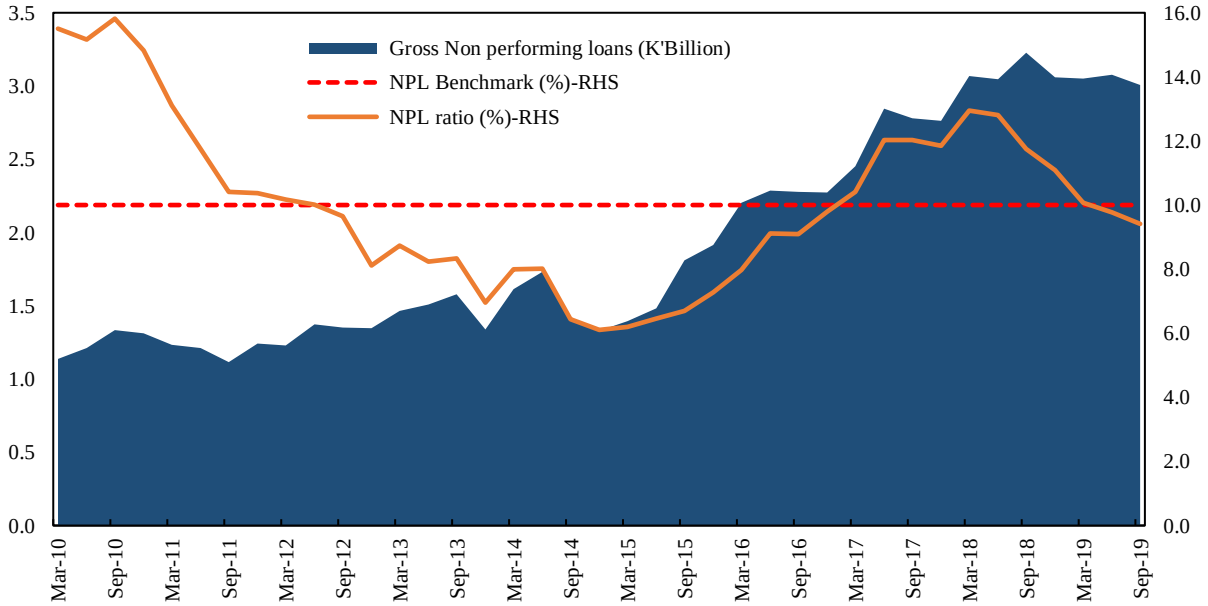
Literature has established that an increase in credit risk on the back of huge accumulated non-performing loans (NPLs) tends to increase the probability of a banking crisis. Nkusu (2011), Louzis et al. (2012), and Chaibi and Ftiti (2015) argue that a banking crisis could be triggered by fragilities in the macroeconomic environment manifesting in the form of declining growth, increased unemployment levels, rising interest rates, and high inflation, which heighten credit default risk. Others have argued that, among other concerns, banking crises have been preceded by the buildup of structural weaknesses in the economy and the financial system, risky banking practices, incentive structures, and moral hazard (Chaibi and Ftiti, 2015). Nonetheless, Reinhart and Rogoff (2010) argued that a prolonged deterioration in asset quality, as indicated by a large increase in NPLs could be used to mark the onset of the banking crisis and economic downturn. Thus, a banking crisis is imminent if NPLs are not held in constant check (Gulati et al., 2019). It is in this regard that Castro (2013) underscores the need to examine credit risk problems in the banking sector that take the form of non-performing loans prior to delving into the triggers of a banking system crisis.

The NPL ratio in the Zambian banking sector has fluctuated overtime, ranging from 15.8 percent in September-2010 to 6.1 percent in December-2014 to 12.9 percent in March-2018 and to 9.4 percent in September-2019 (Figure 1). The fluctuation in the ratio has largely reflected the cyclical movement in macroeconomic conditions between 2010 and 2019. The NPL ratio rose to 15.8 percent in September-2010 as a consequence of the reeling effects of the 2007/2008 global financial crisis which shored up on banks' balance sheets a year later in 2009 and continued in 2010. However, the favorable macroeconomic environment in 2010-2014 characterised by robust GDP growth and a surge in total loans, helped lower the NPL ratio. In the subsequent period, 2015-2019 when macroeconomic conditions weakened, increases in the stock of NPLs together with the slowdown loans growth, largely contributed to the deterioration in the NPL ratio.

The increasing NPLs and NPL ratio if left unaddressed can compound into financial crisis and constrain banks' balance sheet, with potential adverse effect on intermediation capacity. Since 2015 when macroeconomic fundamentals began to corrode, the NPLs stock increased, with the NPL ratio breaching the 10 percent prudential benchmark, hitting a peak of 12.9 percent in March-2018 from 6.1 percent in December-2014 (Figure 1). This dramatic turn in NPLs which began to rise in 2015 and continued in successive years raises systemic risk to financial stability with potential to degrade bank soundness, especially for individual banks

which appear vulnerable given their low capitalization (Table 1).[2] Moreover, the feedback effects from the banking system to economic activity have potential to undermine a sustained recovery and may pose significant vulnerabilities in future. Given the worrying upward trend in NPLs and the NPL ratio, there is need for an empirical investigation into the determinants of NPLs in the banking sector in Zambia.

Figure 1: Gross Non-Performing Loans and NPL Ratio in the Zambian Banking System, 2010 to 2019



Source: Authors construction using Bank of Zambia data

The surge in NPLs and the NPL ratio is widely spread across banks and sectors, revealing strong and negative co-movements with pace of economic recovery (Figure 1 and Table 1). The challenging macroeconomic conditions in the period 2015-2019 underpinned the rise in NPLs, in which real GDP growth rate declined to an average of 3.1 percent compared to 6.6 percent in 2010-2014. The local currency depreciated sharply from an average of K5.27/US$ to K10.37/US$, with the annual inflation rising from an average of 7.1 percent to 10.3 percent in the same period. This was accompanied by hikes in the monetary policy rate which led to increases in the general interest rates. The drought in the 2014/2015 farming season adversely affected agriculture production and electricity generation, which together with pre-existing fiscal and exchange rate pressures aggravated macroeconomic conditions in the country. Consequently, a combination of these multiple factors increased the cost of doing business thereby putting a strain on businesses and households and bolstering a rise in NPLs.

[2] The banks highlighted in red in Table 1, have quite elevated NPLs and this raises individual bank stability concerns with potential to erode the sector overall stability.

Table 1: Trends in the Capital Adequacy Ratio (CAR) and NPL Ratio

Bank ID	Bank Size	Dec-14		Dec-15		Dec-16		Dec-17		Dec-18		Sep-19	
		CAR	NPL Ratio	CAR	NPL Ratio	CAR	NPL Ratio	CAR	NPL Ratio	CAR	NPL Ratio	CAR	NPL Ratio
1	Small	18.8	1.7	33.6	2.4	15.9	1.8	30.7	2.6	28.0	3.5	43.1	4.0
2	Small	12.0	24.5	3.7	25.7	15.1	37.1	5.3	65.7	10.2	64.5	19.0	60.7
3	Small	36.4	8.8	27.6	7.3	30.9	10.0	40.1	5.6	40.9	7.5	40.5	7.7
4	Small	45.5	11.2	28.9	11.9	29.1	6.8	24.3	10.5	18.4	9.1	20.3	6.3
5	Small	19.6	8.3	17.0	14.3	15.0	13.5	19.7	17.2	15.9	13.1	11.8	13.8
6	Small	27.6	5.6	19.5	17.8	25.3	40.9	35	37.5	39.1	32.3	31.0	19.7
7	Small	59.7	10.7	46.4	14.4	54.8	19.4	69.6	3.3	21.6	3.9	27.2	2.4
8	Small	49.9	0.2	34.1	0.1	92.8	0.2	79.9	0.3	42.2	0.0	41.2	0.2
9	Small	33.6	12.5	26.0	2.2	34.9	3.0	50.2	24.4	52.5	18.0	61.2	1.1
10	Big	60.6	2.5	50.8	3.7	58.6	2.6	49.7	2.5	41.7	6.4	37.8	5.4
11	Big	40.0	12.4	38.7	23.0	30.2	23.6	13.8	19.7	18.6	17.0	18.8	16.5
12	Big	25.9	3.6	20.4	5.4	22.8	10.4	20.8	19.2	23.6	29.3	27.8	25.6
13	Big	90.3	0.0	64.9	0.0	57.7	0.0	42.6	0.0	17.4	0.0	19.2	0.0
14	Big	18.7	1.5	13.3	2.6	16.6	4.4	27.6	5.2	14.8	5.3	15.7	5.0
15	Big	20.5	9.1	18.9	11.3	16.8	16.9	16.8	19.0	12.8	8.5	14.2	7.6
16	Big	14.7	5.5	13.3	5.2	25.5	9.0	28.7	8.2	28.0	7.8	21.2	7.2
17	Big	23.5	4.6	13.9	5.3	18.5	4.2	19.1	5.8	18.3	6.6	20.6	5.2
Banking Sector Average		**27.0**	**6.1**	**21.0**	**7.3**	**26.2**	**9.7**	**26.5**	**11.5**	**22.1**	**11.0**	**22.6**	**9.4**

Source: Authors construction using Bank of Zambia data

In the period under review, the rising trend in NPLs and NPL ratio reflected in part the consequences of heightened unemployment across various economic sectors which, together with depreciated currency and tight financial conditions, weakened borrowers' repayment capacity. While this trend analysis seems to suggest that macroeconomic factors explain movements in NPLs in Zambia, high NPL ratio variations within individual banks, implies that bank-specific variables could also have a role to play. Thus, to the extent that the occurrence of banking crises is related to increases in NPLs, understanding the determinants of NPLs could be critical to enhancing the soundness of banks.

Given that the stability of the financial system and the likelihood of bank distress depend largely on the share of the NPLs as this serve as an indicator of credit default risk in the banking sector. The risk of default on loans has become prevalent in the Zambian banking sector based on the elevated stock of gross NPLs. The widespread of NPLs in the sector has potential to impede bank's ability to settle liabilities at the required time (Figure 1 and Table 1). Though total loans and advances began to rise gradually in mid-2018 with the NPL ratio on the declining path reaching 9.4 percent in Q3 2019 below the prudential benchmark of 10 percent, the elevated stock of NPLs still poses a potential negative impact on the overall performance - profitability, funding and liquidity of the banking sector. Considering that excessive credit expansion generally precedes financial crises and given Zambia's sluggish credit growth in light of the country's bad macroeconomic climate since 2015, the rising stock of gross NPLs appears to be denting the banking sector's loan book.

The preceding has motivated us to explore the factors that trigger problem loans in the Zambian banking sector. Broadly, the objective of this study is to explore the key determinants of non-performing loans in the banking sector using bank-level data over the period 2010Q1-2019Q3. The period 2010-2019 is considered as it gives relatively more consistent data on the cross-section and time series observations used in this study. Second, the period encompasses both the boom-and-bust cycles (i.e. the boom periods (2010-2014) and the bust cycle (2015-2019), with GDP growth rates averaging 6.6 percent and 3.1 percent, respectively). This helps to avert the challenge of estimation results being solely influenced by the boom or bust thereby making the results useful in both normal and abnormal times.

Extant literature highlights that both bank-specific and macroeconomic variables play a pivotal role in influencing NPLs (Nkusu, 2011; Louzis et al., 2012; Gosh, 2015; Chaibi and Ftiti, 2015; Waqas et al., 2017) though with a bias towards advanced economies and a limited focus on sub-Saharan Africa. Chileshe (2017) and Mbao (2017) are the only studies in Zambia that focus on the topic. However, they only looked at a limited number of bank-specific and macroeconomic variables. In view of the foregoing, further research on Zambia remains imperative to augment existing literature. Therefore, this study takes the topic of "credit risk determinants in Zambia" further by including a comprehensive number of bank-specific and macroeconomic variables with banks disaggregated into five categories (i.e. all-banks, small-banks, big-banks, domestic-banks and foreign-banks) in line with the contemporary literature using a dynamic panel data approach of cointegration and fully modified ordinary least squares (FMOLS). Specifically, the study asks the questions: What bank-specific variables influence NPLs in Zambia? What macroeconomic variables influence NPLs in Zambia? Are the determinants of NPLs different for all banks, small banks, big banks, domestic banks and foreign banks?

This study is of great importance for regulatory and supervisory authority charged with the responsibility of financial stability in Zambia, as the study not only identifies the key macroeconomic and bank-specific variables that could potentially be responsible for the rise in NPLs in the banking sector, but also quantifies the degree of persistence in the occurrence of problem loans. Banks play an important role in the financial system, controlling more than 80 percent of the market share in credit supply and deposit mobilization. Consequently, any shock to banks ultimately impacts the entire economy (Demirguc-Kunt and Levine, 1999). The results of this study provide basis for credit risk modeling often used by central banks within the stress test methodology (Gosh, 2015). Thus, from a prudential perspective in terms of restoring both financial stability as well as confidence in the financial system in Zambia, the results from this study bear relevance for stress tests of loan quality.

The results broadly confirm that NPLs are affected by both bank-specific and macroeconomic variables. Among the macroeconomic determinants, results suggest that higher fiscal deficits and interest rates contribute to higher NPLs while higher GDP growth, copper prices, credit-to-GDP ratio and inflation results in lower NPLs. Exchange rate depreciation was found to increase NPLs in all, big and foreign bank categories, but lower NPLs in small and domestic bank categories. The impact of bank-specific factors is indeed in line with the literature. Bank capitalisation, non-interest income ratio (diversification) and net interest margin ratio (NIMR) are positively correlated with NPLs while bank size leads

to lower NPLs. While bank-specific variables have a significant impact on NPLs, the explanatory power of macroeconomic variables seem to weigh more.

This paper is divided into five sections. Section 2 reviews the literature. In section 3, the model specification, estimation and methodology are described. Section 4 presents and discusses the empirical results. Finally, the conclusion and policy implications are provided in Section 5.

2.0 Literature Review

Literature on the determinants of non-performing loans is widespread. The literature categorizes two sets of factors to explain the evolution of NPLs over time. The first group focuses on the variability of NPLs across banks and links NPL levels to bank-specific variables. The second group focuses on external events such as general macroeconomic conditions, which are expected to affect borrowers' ability to repay debts.

Related work on bank-specific variables and NPLs is entrenched in Berger and DeYoung (1997) who studied the link between NPLs, cost efficiency, and capitalisation in US commercial banks for the period 1985-1994. They developed four hypotheses (i.e. bad luck, bad management, skimping and moral hazard) that describe the inter temporal relationship between NPLs and cost efficiency. They find a bi-directional relationship between NPLs and cost efficiency. They explain the causality from NPLs to cost efficiency driven mainly by worsening macroeconomic conditions as "bad luck'' while the causality running from cost efficiency to NPLs due to poor management practices, which bring about poor loan underwriting, monitoring and control and thus an increase in NPLs as "bad management''. Podpiera and Weill (2008) and Louzis et al. (2012) who examined the relationship between loan quality and cost efficiency in European countries offer support for the bad management hypothesis.

In an alternative "skimping" hypothesis, Berger and DeYoung (1997) submit that there is a possible positive relationship between high-cost efficiency and NPLs. A bank wishing to maximize long-run profits can rationally opt to have lower costs in the short-run by skimping on the resources assigned to underwriting and monitoring loans but bear the consequences of greater volume of NPLs and the probable costs of dealing with these bad loans in the future. Thus, under the skimping hypothesis, banks that prefer high-cost efficiency devote less effort in ensuring quality of loans, but this tends to result in higher NPLs in future.

Further, in the "moral hazard" hypothesis, Keeton and Morris (1987) argued that banks with relatively low capital would respond to moral hazard incentives by increasing the riskiness of their loan portfolio, which consequently grows into bad loans in future. They indicate that excess loss rates were prominent among banks that had relatively low equity-to-assets ratio. Besides, the authors contend that banks that tend to take on more risks, in the form of excess lending eventually incurred higher losses. The negative association between the capital ratio and NPLs postulated by the authors was also corroborated in Berger and DeYoung (1997) and Jimenez and Saurina (2005). Thus, under the moral hazard hypothesis, it is expected that low capital banks would tend to take on excess risk lending thereby leading to higher NPLs.

In a risky state, all the four hypotheses could manifest and affect a bank at the same time. As a case in point, bad luck could hit a poorly managed bank that might be skimping on loan monitoring expenses. A bank experiencing capital loss due to the bad luck, bad management and skimping may be pushed to respond to moral hazard incentives by taking on additional risks. Similarly, banks responding to moral hazard incentives may resort to taking on increased risks by skimping (Berger and DeYoung, 1997).

Business diversification efforts by banks might also have consequences for loan quality. Researchers use either bank size or non-interest income as a share of total income to proxy diversification opportunities. Salas and Saurina (2002) and Megginson (2005), using bank size as a proxy for diversification opportunities, found a negative relation between bank size and NPLs and argued that bigger size allows for more diversification opportunities. Thus, the loans of the banks are likely to be dispersed among different sectors thereby increasing chances of NPLs to decline compared to concentrated loans.[3]

Conversely, Louzis et al. (2012) infers that the moral hazard of too-big-to-fail (TBTF) banks represents another channel relating bank-specific factors to NPLs. They argue that TBTF banks may resort to excessive risk-taking behaviour since market discipline is not imposed by its creditors who anticipate government protection in case of a bank failure. As a result, this causes them to end up with higher NPLs. Thus, large banks may increase leverage too much and extend loans to lower quality borrowers which is likely to culminate into elevated NPLs.

Distinct from the preceding, there is also literature on the link between macroeconomic conditions and loan quality. Generally, it has been hypothesized that higher real GDP growth in the expansionary phase of the economy translates into sufficient stream of revenues and income for the private sector which improves capacity to service debts thereby eliciting low NPLs. Conversely, as the booming period continues, credit is extended to lower quality debtors and consequently, when a recession sets in, NPLs increase.[4] Salas and Saurina (2002) explain that in a recession, the levels of NPLs increase as unemployment rises and borrowers face reduced income stream to repay their debt. According to Carey (1998), the state of the economy is the crucial systematic factor influencing NPLs.

Lawrence (1995) as cited by Louzis et al. (2012) and Farhan et al. (2012) examine life cycle consumption model and introduces explicitly the probability of default. He argues that the probability of default depends on the current income and unemployment rate, which is correlated with the uncertainty of the future income and lending rates. Further, Reinhart and Rogoff (2010) present bounteous empirical evidence that link sovereign debt crises and banking crises after the 2007/2008 financial crisis and the subsequent sovereign debt events that sparked some of the Eurozone countries. They argue that a causal chain from sovereign debt crisis to banking crisis cannot be dismissed lightly. The latter temporary sequence has taken place in Greece, but also in other countries that entered the financial crisis while in a fragile fiscal condition (BIS Annual Report, 2010).

[3] Increased returns to scale in information processing is another way via which size might affect NPLs. According to Hu et al. (2004), large banks have better loan review and processing capacities due to their ability to allocate more resources.

[4] The inability of lower-quality debtors to service their loans in a recession is also caused by the decrease in asset values which serve as collateral and the subsequent contraction of credit as banks become more risk-averse (Geanakoplos, 2009).

In a study that solely focus on macroeconomic determinants of NPLs in BRICS[5] countries covering the period 2000-2016, Syed and Tripathi (2019), using the fully modified ordinary least square model (FMOLS), conclude that the main determinants of NPLs in BRICS are unemployment, GDP growth, inflation, households' saving rate and financial soundness of a country. In the same line of thought, Castro (2013) investigate the link between macroeconomic conditions and NPLs in GIPSI countries[6] and indicates that credit risk in the banking system is significantly influenced by GDP growth, unemployment rates, interest rates, real exchange rate, credit growth and the 2007/2008 financial crisis.

Numerous studies have examined both bank-specific and macroeconomic variables to understand the evolution of NPLs in the banking sector in recent years. In contrast to the studies above, Bercoff et al. (2002) provide empirical evidence after examining the instability of the Argentinean banking system over the period 1993-1996. Using the survival analysis technique, they revealed that NPLs are affected by both bank-specific and macroeconomic factors. Salas and Saurina (2002) also investigated the determinants of NPLs in Spanish commercial and saving banks using a dynamic model and a panel dataset covering the period 1985-1997. They revealed that growth in real GDP, rapid credit expansion, bank size, capital ratio, and market power explain variation in NPLs.

Similarly, Louzis et al. (2012), using dynamic panel data methods of GMM over the period 2003-2009, find empirical evidence supporting that both macroeconomic and bank-specific variables influence loan quality and that the effects vary between different loan categories (consumer loans, business loans and mortgages). They revealed that for all loan categories, NPLs in the Greek banking sector can be explained mainly by macroeconomic variables (GDP, unemployment rate, interest rates, public debt) and bank-specific variables reflecting management quality (i.e. performance and efficiency). These results are corroborated by Charalambakis et al. (2017) who also show that the deterioration in the macroeconomic conditions (captured by very high unemployment and inflation rates) and political uncertainty constitute key factors explaining the sharp rise of NPLs in the Greek banking sector after the first quarter of 2012.

Klein (2013) also considers both bank-specific and macroeconomic variables that are likely to influence NPLs in Central, Eastern and South-Eastern Europe (CESEE) for the period 1998-2011. Using the fixed effects, difference and system GMM methods, he finds that the level of NPLs can be ascribed to both macroeconomic conditions and bank-specific variables. However, the latter set of variables has a limited explanatory power. Chaibi and Ftiti (2014), using a dynamic panel data approach in the French and Germany banking systems, confirm that except for the inflation rate, all macroeconomic variables, (GDP growth, interest rate, unemployment rate, and exchange rate) influence the NPLs of both economies. In addition, they show that a larger number of bank-specific factors in France forms a higher risk to credit risk compared to Germany.

Makri et al. (2014), using aggregate data on a panel of 14 countries in the Eurozone and applying the difference GMM estimation, found strong correlations between NPLs and various macroeconomic and bank-specific factors. They reveal strong correlations between

[5] The BRICS group consists of Brazil, Russia, India, China, and South Africa.

[6] GIPSI stands for Greece, Ireland, Portugal, Spain and Italy.

NPLs and macroeconomic variables (public debt, unemployment rate, growth rate of GDP) and bank-specific variables (capital ratio, lag of NPLs and ROE) factors. Anastasiou et al. (2016) continues this line of research and investigate the bank-specific and macroeconomic determinants of NPLs in the banking system of the Euro area for the period 2003-2013 and distinguish between core and periphery country determinants. By employing both fully modified OLS (FMOLS) and Panel Cointegrated VAR, they show that NPLs are affected by the same macroeconomic and bank-specific conditions, but the responses are stronger in the periphery.

Waqas et al. (2017) also consider both bank-specific and macroeconomic variables to explain the dynamics of NPLs in Pakistan, India and Bangladesh. Using the GMM estimation technique and a sample of 105 unbalanced panel data over the period of 2000-2015, they reveal that both bank-specific factors (inefficiency, profitability, capital ratio, size and leverage) and macroeconomic variables (GDP growth, real interest rate, real effective exchange rate and unemployment rate) have significant impact on NPLs in the three economies.

Fofack (2005), in one of the few leading studies in Africa, investigates the causes of NPLs in sub-Saharan countries. Using a pseudo-panel based model and fixed effects estimation, he finds that GDP per capita, real exchange rate, real interest rate, money supply (M2) and net interest margin are significant determinants of NPLs in the sub-Saharan African countries. He also indicates that, while bank-specific variables seem not to influence NPLs significantly, macroeconomic variables take preeminence in explaining the accumulation of NPLs in these countries.

Zribi and Boujelbène (2011) and Abid et al. (2014), using the dynamic panel data methods, reveal that bad loans in Tunisian banks are explained not only by bank-specific variables (ROE, capital adequacy, inefficiency ratio and ownership), but also by macroeconomic conditions (GDP, inflation, interest rates and exchange rate). Similarly, Amuakwa-Mensah and Boakye-Adjei (2015), using fixed effects panel regression model, find that both bank-specific variables (i.e. previous year's NPLs, bank size, NIM, and current year's loan growth) and macroeconomic variables (i.e. previous year's inflation, real GDP per capita growth and real effective exchange rate) significantly influence NPLs in Ghana.

In Zambia, Chileshe (2017) and Mbao (2017), using dynamic panel data approaches, attempt to link bank-specific and macroeconomic variables to credit risk. They find that NPLs in the banking sector are explained by macroeconomic variables (copper prices, interest rate and real effective exchange rate) and bank-specific variables (capital ratio, market power, size and diversification).

In summary, it is evident from the literature that both bank-specific and macroeconomic variables significantly impact NPLs. It can also be noted that studies on the determinants of NPLs in the Zambian banking sector are scanty, thus this study contributes to literature by investigating into the subject matter. Further, this study considers the determinants of NPLs for a pooled sample of 16 banks and sub-samples of big banks, small banks, domestic banks and foreign banks. This provides relevant information to regulators in the design of appropriate macroprudential policies intended to limit the impact of systemic risk on banks.

3.0 Model Specification, Methodology and Data Description

3.1 Model Specification

In line with recent panel data studies (Espinoza and Prasad, 2010; Louzis et al., 2012; Klein, 2013; Abid et al., 2014; Chaibi and Ftiti, 2014; Makri et al., 2014; Chileshe, 2017 and Waqas et al., 2017), we adopt a dynamic approach to account for time persistence in the NPL structure. This dynamic panel model assumes that banks' non-performing loans are explained by past NPLs (lag of the dependent variable), bank-specific and macroeconomic variables. Thus, we formulate the empirical model as follows:

$$NPL_{it} = \alpha NPL_{it-1} + \beta X_{it} + \delta Mac_t + \varepsilon_{it}, |\alpha| < 1, i = 1, \dots, N; t = 1, \dots, T \quad \text{......................} (1)$$

where X_{it} and Mac_t are (k*1) bank-specific and macroeconomic determinants, respectively identified in the literature other than NPL_{it-1}; i = 1,..., N and t =1,...,T denote the cross-sectional and time dimension of the panel, respectively; $\alpha, \beta, and\ \delta$ are the (k*1) vector of estimators or coefficients; and ε_{it} is an error structure defined as

$$\varepsilon_{it} = v_i + \mu_{it} \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (2)$$

with v_i the unobserved bank-specific effect and μ_{it} the idiosyncratic error.

3.2 Estimation Procedure

In this study, the fully modified OLS (FMOLS) approach, as used by Cifter (2012), Anastasiou et al. (2016), Asiama and Amoah (2018) and Syed and Tripathi (2019), is adopted to build an empirical model that examines the relationship between non-performing loans, bank-specific variables and macroeconomic dynamics. For estimation, we contend that ordinary least squares (OLS) may not be the optimum method as it assumes stationarity (no unit root) in generating the individual series. However, this assumption may not hold for all macroeconomic time series models, which may render our regression spurious. Therefore, we go through some sequential steps as part of our identification strategy.

As a first step, we examine the unit root properties of the data series for stationarity. Given the two-dimensional nature of the dataset (time series and cross-section), we use first generation panel unit root tests due to Levin, Lin and Chu (LCC) test, and the Im, Pesaran and Shin (IPS) test proposed by Levin et al. (2002) and Im et al. (2003).

Once the order of integration is established from the panel unit root test, we apply cointegration test to ascertain whether there exists long run relationship among the variables. For panel cointegration, the Kao and Pedroni tests have been proposed (Kao, 1999 and Pedroni, 1999). The two cointegration tests use the null hypothesis of no cointegration and alternative hypothesis of cointegration and restrict the cointegrating vector to one. Nonetheless, the Kao test specifies cross-section specific intercepts and homogenous coefficients while the Pedroni tests allow for heterogenous intercepts and trend coefficients across cross-sections. While studies tend to favor Pedroni test results over Kao test results given the heterogeneity permissible in the Pedroni tests, the Pedroni test is only available for groups containing seven (7) or fewer series. Given that groups (banks) in this study contain more than seven series, to examine the long run equilibrium relationship among

variables, we use the Kao (1999) residual cointegration test, which is based on Engel-Granger two-step approach.

For the estimation of panel cointegration in this study, we make a choice between dynamic OLS (DOLS) and fully modified OLS (FMOLS). According to Kao and Chiang (2000), both the OLS and fully modified OLS (FMOLS) exhibit small sample bias and that the DOLS estimator seems to perform better than the two estimators. However, Pedroni (2000) showed that the DOLS estimator does not consider the cross-sectional heterogeneity problems, as such the FMOLS is the preferred estimator to use as it considers the cross-sectional heterogeneity, endogeneity, and serial correlation issues. The FMOLS estimator is judged to be consistent and efficient, even with a small sample size.[7] Given small samples like in our case, FMOLS is more trusted as it gives estimations that are more robust. In this study, we employ the fully modified OLS (FMOLS) as developed by Pedroni (2000).

Within FMOLS, we choose between the pooled, weighted, and group mean (average) FMOLS estimators. While the pooled estimation performs standard FMOLS on the pooled sample after eliminating the deterministic components from both the regressand and the regressors, the pooled (weighted) estimation accounts for heterogeneity by reweighting the data prior to computing pooled FMOLS using cross-section specific estimates of the long run covariances (Pedroni, 2000). On the other hand, group mean estimation computes the cross-section average of the individual cross-section FMOLS estimates. In the presence of heterogeneity in the cointegrating relationships, Pedroni (2000) argues that the grouped-mean estimator presents consistent estimates of the sample mean of the cointegrating vectors in contrast to the pooled and weighted estimators.

From the cointegration test, we chose to use the Kao test (which assumes homogeneity in the cointegrating relationships). Thus, a choice is only made between the pooled and weighted FMOLS. According to Pedroni (2000) and Kao and Chiang (2000), the weighted FMOLS estimator is superior to the pooled FMOLS estimator because it accounts for heterogeneity by reweighting the moments for each cross-section using cross-section specific estimates of the conditional long-run residual variances when computing the pooled FMOLS estimator.

Given our panel dataset, we use the weighted FMOLS (where there is heterogenous long run variance of innovation vectors for each bank) as opposed to the pooled FMOLS (where there is homogeneous long run variance of innovation vectors for all banks). Using the notation from cointegration, the standard pooled OLS, then the weighted FMOLS estimator is given by:

$$\hat{\beta}_{FW} = \left[\sum_{i=1}^{N}\sum_{t=1}^{T} \widetilde{X}_{it}^{*}\widetilde{X}_{it}^{*\prime}\right]^{-1}\left[\sum_{i=1}^{N}\left(\sum_{t=1}^{T}(\widetilde{X}_{it}^{*}\,\tilde{y}_{it}^{*} + T\hat{\lambda}_{12i}^{*})\right)\right] \dots\dots\dots\dots\dots (3)$$

where $\tilde{y}_{it} = y_{it} - \bar{y}_i \; and \; \tilde{X}_{it} = X_{it} - \bar{X}_i$ are the demeaned variables; $\hat{\lambda}_{12i}^{*}$ is the serial correlation correction term, $\widetilde{X}_{it}^{*}$ and $\tilde{y}_{it}^{*}$ are the transformed variables of X_{it} and y_{it} to

[7] The FMOLS is popular in conventional time series econometrics because it is believed to be robust against endogeneity in the regressors and serial correlation in the errors (Bangake and Eggoh, 2011).

achieve the endogeneity correction. For cointegrating equation estimations, weighted FMOLS aim to estimate eq. (1) above while controlling for serial correlation and endogeneity as in eq. (3).

3.3 Data Sources and Description

This study uses quarterly panel data pooled from 16 commercial banks[8] over the period 2010Q1-2019Q3. To gain more insights, the study disaggregates banks into small and big[9] domestic and foreign (Appendix I). Due to data unavailability, particularly in the case of two small banks, we miss few data points at the start of the sample. For this reason, our panel data is unbalanced. The data on bank-specific variables relating to non-performing loans (NPLs), total loans, capitalisation, ROA, net interest margin, non-interest and interest incomes, and non-interest and interest expenses are obtained from the prudential returns submitted by all commercial banks to the Bank of Zambia. The prudential returns are submitted monthly and largely consist of comprehensive income statements and bank balance sheets. Data on macroeconomic variables were sourced from Zambia Statistics Agency (ZSA) and the Ministry of Finance (MoF). Data on quarterly interbank interest rate, exchange rate and copper prices were collected from the Bank of Zambia. Table 2 reports all the variables used in this study, their description, the sources and expected signs.

[8] While the industry consisted of 17 banks, our analysis is based on 16 banks. This is because one big foreign bank highlighted in appendix I was dropped from the sample as it had zero NPLs over the entire sample period considered.

[9] The decision rule regarding the bank being either big or small follows the approach by Mbao (2017). Therefore, if the average bank size is at least five percent (0.05) then such a bank is considered a big bank, otherwise it is a small bank. The big banks dominate the banking sector accounting for over 80 percent of the market share in terms of assets, loans and deposits.

Table 2: Variable Description

Variable symbol	Definition/Description	Source	Expected Sign
NPL Ratio	NPL ratio is defined as the sum of total loans and leases past due 90 days or more and non-accrual loans divided by total gross loans (Ghosh, 2015, p.97). The NPL ratio is our dependent variable and is a proxy variable for the credit risk exposure to a bank. An increase in the NPL ratio means a worsening of the credit quality and this could lead to increased bank provisioning and thus resulting into huge capital losses for banks.	BoZ	
Capitalisation	Capitalisation is represented by the ratio of total regulatory capital to risk weighted assets of bank i at time t. Bank capital is a measure of bank solvency and ability to absorb risk. It also reflects the ability to withstand or tolerate operational and abnormal losses. In the literature, there is no consensus about the sign on the relationship between capital adequacy and NPLs ratio.	BoZ	Negative/Positive
Bank Size	Bank size is proxied by the ratio of individual bank's total assets to industry total assets in this study (see appendix I). According to Stern and Feldman (2004), "too big to fail" has played a significant role in various global banking crises over the last few decades. While it is argued that big banks increase their leverage too much and extend loans to lower quality "bad" borrowers resulting in higher NPLs, big banks might be better placed to deal with NPLs due to better risk management systems and procedures, which lowers the default rate by ensuring proper screening of loan applications (Stern and Feldman, 2004; Salas and Saurina, 2002).	BoZ	Negative/Positive
ROA	Profitability is proxied by return on assets (ROA), which measures the profit a bank can generate given total assets. A higher ROA indicates better profit prospects for growth and resilience to shocks and should thus be associated with lower NPLs.	BoZ	Negative
Diversification	The bank's total income is the summation of interest and non-interest income. In recent years, non-interest income has become a more important component of bank earnings. Many banks have diversified and expanded into non-traditional businesses that pay fees rather than interest (such as investment banking, asset management, and insurance underwriting, fee-paying and commission-paying services, trading, and derivatives). Gosh (2015) argues that more diversification	BoZ	Negative

Variable symbol	Definition/Description	Source	Expected Sign
	in the bank's business model improves loan quality and reduces credit risk. As in previous studies (Louzis et al., 2012; Chaibi and Ftiti, 2015), we use the ratio of non-interest income to total income as proxy for income diversification. Thus, we expect a negative impact of bank diversification on NPLs.		
Inefficiency Ratio	Inefficiency is captured by the ratio of operating expenses to operating income (Louzis et al.,2012). In literature, the link between credit risk (NPLs) and inefficiency ratio is ambiguous. Following the skimping hypothesis of Berger and DeYoung (1997), banks which devote fewer resources to underwriting and monitoring loans will be more cost-efficient in the short run but bear the consequences of increasing NPLs in the future. This entails that efficiency has a negative impact on NPLs. In contrast, higher cost inefficiency would increase NPLs again following the 'bad management' hypothesis as bank managers without skills in credit scoring and monitoring borrowers increase costs and give out poor quality loans.	BoZ	Negative/Positive
NIMR	Net interest margin ratio (NIMR) denotes a good indicator of how optimal investment decisions that a bank makes turn out to be. A negative value denotes that a bank did not make an optimal decision. While Salas and Saurina (2002) show that this variable does not affect NPLs rate, Espinoza and Prasad (2010) found a significant relationship between NIMR and NPLs. A reduction in the NIMR may result in a shift in loan policy, making it riskier. The increased risk will result in a future loan portfolio with a larger default likelihood, which is why the variable has been lagged. For this reason, one and two lags of this variable are used in the literature. A negative or positive sign is expected for this variable.	BoZ	Negative/Positive
Credit-to-GDP	Defined as the ratio of total gross loans and advances to gross domestic product banks advance to the private sector (Klein, 2013). The trend in bank credit ratio thus captures the behaviour of banks' lending over time in response to GDP. Growth in bank credit has been considered an important determinant of NPLs as increases in loan growth may accelerate loan losses (Keeton, 1999). To attract new business, banks lower loan rates and loosen credit requirements resulting in an increase in loan losses. A priori, we expect a positive relationship between bank credit and NPLs.	BoZ /ZSA	Positive

Variable symbol	Definition/Description	Source	Expected Sign
Fiscal Deficit	Proxied by the ratio of total government expenditure to total tax revenue and grants. The nexus between NPLs and the government's fiscal position is equivocal. On the one hand, a greater fiscal surplus could signal a restrictive fiscal position raising NPLs. On the other hand, a higher fiscal surplus could be associated with lower NPLs due to the reduced country risk, cheaper financing and the development of expectations that the fiscal position is sustainable (Anastasiou et al., 2016; Makri et al., 2014).	MoF	Positive/Negative
Copper Prices	The use of copper price variable is justifiable for Zambia given that the mining industry is one of the major economic activities in the country with a substantial number of employees and contractors. Banking sector is vulnerable to this sector through salary backed and SME lending as well as a source of FX deposits (Nikolaidou and Vogiazas, 2017; Chileshe, 2017; Mbao, 2017). As a result, higher copper prices are allied with stronger economic performance, enhancing borrowers' ability to service debts. Apriori, we expect a negative relationship between copper prices and NPLs.	BoZ	Negative
Real GDP	We include real GDP to control for the macroeconomic cycle. During periods of economic expansion, borrowers tend to have higher incomes, which improves debt servicing, but during a recession, the ability to service debt declines. It is generally argued that NPLs increase when growth in GDP weakens (Nkusu, 2011; Louzis et al. 2012; Gosh, 2015). Apriori, we expect a negative relationship between real GDP and NPLs.	ZSA	Negative
Real Effective Exchange Rate (REER)	REER is used to reflect the transmission of external currency shocks to asset quality in the domestic economy. A depreciation in the exchange rate can have a mixed result on NPLs. Castro (2013) and Nkusu (2011) include this variable to control for external competitiveness. Fofack (2005) argues that the appreciation of this variable can weaken the competitiveness of export-oriented firms and make them unable to service their debt. Moreover, a real appreciation of the local currency results in higher prices for local goods and services. However, a rise in the exchange rate can help economic agents who borrow in foreign currency to better service their loans (Nkusu, 2011).	BoZ	Positive/Negative

Variable symbol	Definition/Description	Source	Expected Sign
	Literature indicates that the link between the REER and NPLs can be positive or negative.		
Inflation	Inflation is defined as a sustained increase in the price level of goods and services in an economy over time. An increase in inflation may raise interest rates and decrease loan demand. Literature does not provide a clear relationship between inflation rate and NPLs. While Klein (2013) found that an increase in the inflation rate reduces the real income and debt servicing capacity of borrowers resulting in increased NPLs, Khemraj and Pasha (2009) observe a reverse nexus, reporting that a rise in the inflation rate enhances the loan repayment capacity of the borrower by eroding the real value of outstanding loans. Thus, the relationship can be negative or positive.	ZSA	Negative/Positive
Interbank rate	Interbank rate is the interest rate charged on short-term borrowing among banks. This interest rate may be specified by the central bank of the country, while, at times it depends on the availability of liquidity in the market (Poudel, 2018). Espinoza and Prasad (2010) and Bajracharya (2015) confirm that this interest rate has a significant positive impact on NPLs. Thus, the relationship between interest rates and NPLs is expected to be positive. This variable has been chosen to reflect the policy stance of the monetary authority. Further, it is a target variable for the monetary authority considering that the bulky of the liquidity is transacted in the interbank market.	BoZ	Positive

4.0 Empirical Results and Discussion

Before proceeding to empirical analyses, unit root tests were conducted to check the stationarity properties of the variables. The stationarity properties of the panel data are tested based on Levin et al. (2002) who assume a common unit root process as well as the Im et al. (2003) that assume individual unit root process.[10] Appendix II presents the panel unit root results where the null hypothesis is non-stationarity. The tests point to a unit root in the bank capitalisation, bank size, credit-to-GDP ratio, copper prices, real effective exchange rate, inflation and interbank rate and stationarity in the non-performing loans ratio, inefficiency ratio, diversification, return on asset (ROA), net interest margin ratio (NIMR), fiscal deficit and real GDP. Variables that exhibited unit roots in level form were first differenced to attain stationarity. As a result, on their first order difference, all series are stationary. Having established the order of integration in the series, we checked whether there exists long-run relationship among the variables.

With the panel unit root test results revealing that all variables are stationary at first difference, we tested for cointegration or long-run relationship among the variables using the Kao cointegration test approach. The proposed panel cointegration test by Kao (1999) confirms the existence of a long-run relationship among the variables (Table 3). The t-statistic and p-value in Table 3 indicate that null hypothesis of no cointegrating relationship can be rejected at 1 percent level of significance. However, panel co-integration test only talks about the long-run association among variables but does not provide the exact information as to the direction of influence among the dependent and independent variables. To be more specific, cointegration analysis does not tell anything about the hypothesized signs and magnitudes of the coefficients the more reason fully modified ordinary least square (FMOLS) is used to get these estimates (Pedroni, 2000).

Table 3: Kao Residual Cointegration Test

	t-Statistic	Prob.
ADF	-12.15780	0.0000
Residual variance	16.86350	
HAC variance	4.923043	

Null Hypothesis: No cointegration

Further, before carrying out the empirical analyses, test for multicollinearity was conducted. The variables are both positively and negatively correlated with each other and the highest correlation among few variables is about 0.71 or 71 percent (Table 4). This is expected as is the case in Ozili (2018). In view of the perspective by Gujarati (2004) and Hair et al. (2006), who have expressed that multicollinearity problem exists if the correlations exceed 0.75, 0.80 and 0.90, we can safely confirm that multicollinearity is not a serious problem in this

[10] Maddala and Wu (1999) contend that the individual unit root tests for panel data performs best when compared with the test that assumes common unit roots, as it does not require a balanced panel data set. Thus, for the purposes of robustness checks we carried out both common and individual panel unit root tests on the variables.

study. In addition, as a robust test that "multicollinearity is not a serious problem" in this study, we perform variance inflation factor (VIF) test for each variable entering the regression model. Appendix III presents the results of the VIF and the tolerance (1/VIF) for our model. The results show that the average VIF for all the variables included in the analysis was 1.34 which is less than 10, suggesting that multicollinearity is not a problem (Gujarati, 2004). On the other hand, the average tolerance value of 0.767, which is closer to 1, also confirms that multicollinearity among explanatory variables is not a problem.[11]

Table 4: Correlation Matrix

	NPL Ratio (-1)	Capitalisation	Bank Size	Inefficiency Ratio	Diversification	ROA	NIMR	Credit -to- GDP Ratio	Fiscal Deficit	Copper Prices	Real GDP	Real Effective Rate	Inflation	Interbank Rate
NPL Ratio (-1)	1.000													
Capitalisation	-0.123	1.000												
Bank Size	-0.093	0.718	1.000											
Inefficiency Ratio	0.073	-0.285	-0.190	1.000										
Diversification	0.084	-0.036	0.078	0.000	1.000									
ROA	-0.120	0.567	0.340	-0.410	-0.062	1.000								
NIMR	-0.100	-0.017	-0.040	-0.105	-0.197	0.101	1.000							
Credit-to-GDP Ratio	-0.084	0.106	-0.025	-0.051	-0.070	-0.032	-0.096	1.000						
Fiscal Deficit	0.110	0.195	-0.006	-0.046	-0.103	0.084	0.095	0.111	1.000					
Copper Prices	-0.102	-0.301	0.018	0.055	0.188	-0.037	-0.060	-0.504	-0.337	1.000				
Real GDP	-0.234	-0.348	-0.001	0.108	0.184	-0.125	-0.178	0.140	-0.377	0.609	1.000			
Real Effective Rate	0.062	0.162	0.004	-0.064	-0.184	0.076	0.054	0.076	0.095	-0.469	-0.552	1.000		
Inflation	0.008	0.110	-0.013	0.011	-0.091	-0.014	-0.009	0.391	0.063	-0.693	-0.306	0.422	1.000	
Interbank Rate	0.051	0.248	-0.023	-0.061	-0.117	0.032	-0.001	0.661	0.279	-0.816	-0.404	0.259	0.708	1.000

Source: Authors computation

Having tested for stationarity, cointegrating relationship and multicollinearity, we proceeded to estimate the significance of the established long-run relationship among the variables. We used the FMOLS regression as suggested by Kao and Chang (2000) to answer our main question about the key determinants of non-performing loans in the Zambian banking sector. The main results presented in Table 5 largely confirm that both bank-specific and macroeconomic variables are important determinants of the NPL ratio.

The results in Table 5 show a high degree of persistence of NPLs, with the previous quarter NPLs influencing the current quarter. This result entails that NPLs are likely to increase when they have risen a quarter before. The implication of this finding is that a shock to NPLs will have a prolonged effect on the banking sector and it would take time to reduce NPLs. The positive effect of the lagged dependent variable is in line with Gulati et al. (2018), Chaibi and Ftiti (2015) and Amuakwa-Mensah and Boakye-Adjei (2015).

[11]Generally, some researchers tend to get concerned when a VIF is greater than 10, which corresponds to an R-squared exceeding 0.90 with the other variables. One could use tolerance as a measure of multicollinearity in view of its intimate connection with VIF. The closer is the tolerance (1/VIF) to zero, the greater the degree of collinearity of that variable with the other regressors. Contrarily, the closer tolerance is to 1, the greater the evidence that collinearity among regressors is not a problem (Gujarati, 2004; pp. 362-363).

Table 5: FMOLS Estimation Results

	Variables	(1) All Banks	(2) Small Banks	(3) Big Banks	(4) Domestic Banks	(5) Foreign Banks
Bank-Specific Variables	$NPL\ Ratio_{t-1}$	0.710***	0.647***	0.733***	0.631***	0.714***
		(0.031)	(0.051)	(0.044)	(0.071)	(0.036)
	Capitalisation	0.644***	0.669***	0.803***	3.234***	0.117***
		(0.030)	(0.047)	(0.043)	(0.064)	(0.039)
	Bank Size	-0.414***	-1.922***	-0.135***	-0.677***	-0.253***
		(0.033)	(0.046)	(0.049)	(0.066)	(0.042)
	Diversification	0.102**	0.058	0.107	-0.009	0.093
		(0.050)	(0.068)	(0.077)	(0.111)	(0.058)
	Inefficiency Ratio	-0.003	-0.053	-0.006	-0.036	-0.007
		(0.055)	(0.075)	(0.087)	(0.125)	(0.063)
	ROA	-0.064	-0.026	-0.019	-0.010	-0.030
		(0.039)	(0.053)	(0.066)	(0.086)	(0.051)
	$NIMR_{t-1}$	0.017	0.004	0.100**	0.292***	-0.016
		(0.029)	(0.038)	(0.049)	(0.073)	(0.033)
Macroeconomic Variables	Credit-to-GDP Ratio	-0.584***	-0.526***	-0.158***	-0.910***	-0.333***
		(0.025)	(0.032)	(0.045)	(0.054)	(0.030)
	Fiscal Deficit	0.846***	0.296***	1.118***	1.853***	0.627***
		(0.053)	(0.072)	(0.086)	(0.119)	(0.061)
	Log of Copper Prices	-3.348***	-4.032***	-1.725***	-2.334***	-3.152***
		(0.030)	(0.047)	(0.053)	(0.080)	(0.038)
	Log of Real GDP	-1.896***	-0.953***	-5.781***	-10.143***	-0.543***
		(0.047)	(0.065)	(0.074)	(0.096)	(0.057)
	Log of Real Effective Rate	0.576***	-5.012***	2.799***	-0.204***	0.556***
		(0.036)	(0.057)	(0.053)	(0.075)	(0.045)
	Inflation	-0.125***	-0.158***	-0.004	-0.346***	-0.056
		(0.039)	(0.054)	(0.058)	(0.088)	(0.044)
	Interbank Rate	14.150***	6.990***	3.499***	29.155***	4.105***
		(0.040)	(0.052)	(0.065)	(0.093)	(0.045)
	Observations	585	326	259	148	437
	Number of Banks	16	9	7	4	12
	R-squared	0.859	0.504	0.907	0.956	0.708
	Adjusted R-squared	0.847	0.452	0.897	0.949	0.681
	Durbin-Watson Statistic	2.056	2.039	2.033	2.044	2.053

Note: Standard errors are reported in parentheses. ***, ** and * indicates significance at the 1 percent, 5 percent and 10 percent level, respectively.

The solvency result indicates a positive relationship between bank capital and the NPL ratio across all bank types. This result speaks to the attitude of banks towards risk-taking behavior in times of excess capital adequacy. Banks with high capitalisation are likely to engage in high-risk lending leading to high NPLs. Motivated by the possibility of greater profits, banks with excess capital might engage in risk lending knowing that they have adequate capital, which is substantially above the regulatory required minimum. This finding is supportive of the 'too big to fail' hypothesis that banks with high capital adequacy tend to resort to lax credit screening and liberal lending policies that in turn culminate in rising NPLs. This result is corroborated by other studies (Ghosh, 2015; Radivojevic and Jovovic, 2017). However, this result contrasts Chileshe (2017) and Mbao (2017) and Abid et al. (2014) who found a negative and significant relationship. Thus, the 'moral hazard' hypothesis (Berger and

DeYoung, 1997) in which thinly capitalised banks tend to undertake on riskier lending, which potentially could increase NPLs does not find support in the Zambian banking sector.

Bank size is negatively associated with the NPL ratio, with the slope coefficient ranging from 0.135 percent to 1.922 percent. This result suggest that bigger banks implement better risk management systems and loan screening procedures, enabling them to deal more effectively with bad borrowers thereby lowering the default rate. In addition, a bigger size of the bank allows for more diversification of portfolio assets, which lower credit risk in the Zambian banking sector. This result is consistent with Waqas et al. (2017) and Chileshe (2017). However, our result contradicts the findings by Louzis et al. (2012) and Amuakwa-Mensah and Boakye-Adjei (2015) who reported a significant positive relation between bank size and NPLs suggesting that large banks take excessive risks by increasing their leverage under the "too big to fail" assumption, and thus eliciting more NPLs. Furthermore, our results lend support to the hypothesis of "diversification" using bank size to fully capture diversification in the Zambian banking sector.

Banks' diversification results, proxied by non-interest income, is positively related to the NPL ratio, with the slope coefficient statistically significant at 5 percent and 10 percent level of significance across all banks categories. This result indicates that greater diversification increases NPLs in the banking sector. The finding also raises doubts concerning the expectation that more diversification in the bank's business model reduces credit risk and stabilizes revenue and profitability. Thus, the "diversification" hypothesis using non-interest income as a proxy does not find support in this study. As in Louzis et al. (2012), Chileshe (2017) and Gulati et al. (2018), this result points to the potential "dark side" of diversification that as bank managers venture into a business, they lack experience, or in which the bank does not have comparative advantage, bank's credit risk increases. However, this empirical evidence is not consistent with the findings of Salas and Saurina (2002), who found a negative relation between bank diversification and NPLs.

Contrary to our apriori expectations, the slope coefficient on inefficiency ratio is negative, suggesting that inefficiency does not increase the NPL ratio. However, in statistical terms, the relationship is not significant, consistent with the findings by Chaibi and Ftiti (2015) in the case of Germany. Thus, the "skimping" hypothesis does not find support in this study. Further, our result contradicts the findings by Louzis et al. (2012) and Abid et al. (2014). Similarly, ROA though negatively related with NPLs and in line with literature (Louzis et al., 2012; Gosh, 2015), is, statistically insignificant in influencing NPLs in the Zambian banking sector. Thus, this result does not lend support to the presence of the "bad management" hypothesis in this study.

The lag of net interest margin ratio (NIMR) is positively associated with the NPL ratio but only statistically significant in the big and domestic bank categories. This result could suggest that when borrowers' creditworthiness deteriorates, they are still able to borrow from banks but only at higher lending rates, which in turn adds to the increase in NIMR and NPLs. This finding corroborates with Espinoza and Prasad (2010) and Radivojevic and Jovovic (2017) but contradicts Amuakwa-Mensah and Boakye-Adjei (2015) and Fofack (2005) whose findings show that NIMR has a negative and significant impact on NPLs in Ghana and some selected sub-Saharan African countries.

For all macroeconomic variables, the estimated coefficients are statistically significant at all conventional levels of significance and the results are compatible with both empirical and theoretical arguments. The only exception is the inflation rate for big and foreign banks categories.

As expected, credit growth, proxied by credit-to-GDP ratio, has negative influence on the NPL ratio with the slope coefficient ranging from 0.158 percent change to 0.910 percent change. This finding seems to suggest that the deterioration in credit quality follows a cyclical pattern regarding credit growth in the Zambian banking sector. Notably, during the period 2013Q1 - 2015Q3, commercial banks' lending increased significantly while NPLs were on a declining path supported by previous years' strong economic growth. However, when the Zambian economy's growth weakened in 2015Q4, NPLs rose rapidly and reached new highs and credit quality became severe (Appendix IV). This result also seems to demonstrate that rapid credit growth today might elicit lower credit standards which may be due to poor screening that ultimately bring about higher problem loans in future. The result is consistent with Gulati et al. (2018) who found negative and statistically significant relationship between loan growth and NPLs.

Fiscal deficit is positively related with the NPL ratio. Though the relationship is significant across all bank categories, it is more elastic for domestic and big bank categories. This highlights that fiscal problems in Zambia might lead to a significant rise in NPLs in the banking sector. Therefore, an increase in government borrowing (resulting from budget deficit) depresses available loanable funds to the private sector through increased borrowing costs, which makes it costly for the private sector to service loans thereby bolstering an increase in NPLs.[12] This result lend support to the "banking and sovereign debt crisis" hypothesis via fiscal deficit and is corroborated by Louzis et al. (2012), Makri et al. (2014) and Gosh (2015) in the Euro zone nations and the United States, respectively.

Estimation results on copper prices is negative across all bank categories, indicative of the importance of the mining sector to the banking sector in Zambia. A one percent increase in copper price leads to a significant decrease in the NPL ratio, with the slope coefficient ranging from 1.725 percent to 4.032 percent. This result validates the importance of copper prices to the country's economic fortunes, particularly the copper mining sector and foreign exchange earnings.[13] Indeed, periods of high copper prices have tended to coincide with high growth rates and lower NPLs in Zambia while periods of falling or low copper prices have been associated with low growth rates and high NPLs (See Appendix V). Thus, consistent with Chileshe (2017) and Mbao (2017), higher copper prices tend to be associated with better economic growth prospects thereby improving borrowers' incomes and their ability to service bank loans.

[12] Though debt has not been used in this study due to higher correlation with other independent variables, this result could be pointing to strong evidence in favor of the sovereign debt hypothesis. This is because higher fiscal deficits have coincided with higher debt levels in Zambia in the recent past.

[13] Higher copper prices improve export earnings and its dominance manifest through the trade and finance channels by providing liquidity to the banking system via the sale of forex. While the supply of forex does in turn affect the exchange rate, it augments liquidity in the banks for further lending to take place and help reduce NPLs.

Real GDP, as expected, has a negative impact on the NPL ratio. This implies that the NPL ratio is negatively affected by a slowdown in the Zambia's growth prospects (i.e. a prolonged economic recession and downturns coupled with falling private sector incomes is likely to increase the scope of default on loans, especially in the most depressed sectors of the economy). The result points to a strong dependence of the private sector's ability to repay loans on the phase of the economic cycle. Overall, the effect of real GDP growth on NPLs is found to be stronger (or highly elastic) for big and domestic bank categories. Besides, in line with Louzis et al. (2012) and Chaibi and Ftiti (2015), the small average size of Zambia's private sector (generating lesser non-interest income for the banks) could perhaps be another contributing factor to this effect as they tend to be less diversified and thus more exposed to adverse macroeconomic shocks. This finding is consistent with empirical investigation of Louzis et al. (2012), Chaibi and Ftiti (2015) and Waqas et al. (2017).

On the real effective exchange rate, results show that depreciation in the local currency has a positive impact on the NPL ratio in the three bank sub-categories (i.e. all banks, big banks and foreign banks). This is consistent with Chaibi and Ftiti (2015), Waqas et al. (2017) and Mbao (2017) in the case of France, India and Zambia, respectively, whose studies established that a depreciation in the local currency contributes to an increase in NPLs. The result suggests that, on the one hand, currency depreciation affects foreign currency denominated loans by increasing the servicing burden for borrowers with a currency mismatch. On the other hand, a currency depreciation, causes inflationary pressures and thus interest rates hikes, affecting loans denominated in local currency. The result also entails that the local currency depreciation heightens credit default risk more for big and foreign banks categories that might be inclined to lend in foreign currency. On the contrary, a depreciation in the local currency contributes to lower the NPL ratio for small and domestic bank categories, perhaps these banks could have less or no lending in foreign currency. This result supports the view that a worsening (depreciation) of the local currency makes it difficult to serve debt denominated in a foreign currency, and thus induces instability in the banking sector (Amuakwa-Mensah and Boakye-Adjei, 2015).

Inflation is negatively related with the NPL ratio, signifying low probability of default during periods of inflation in the Zambian banking sector. Perhaps, this result could suggest that inflation affects credit risk via the real interest rate as espoused in the 'Fisher effect'. For instance, an increase in inflation reduces the real interest rate[14] thereby lowering debt-servicing burden for borrowers. This results also entails that credit default rate in the Zambian banking sector depends on real interest rates rather than nominal interest rates. Surprisingly, this result is only significant for all banks, domestic banks and small banks categories. Moreover, this finding corroborates with Chaibi and Ftiti (2015), Amuakwa-Mensah and Boakye-Adjei (2015) but contradicts Radivojevic and Jovovic (2017) who found a positive and significant relationship between inflation and NPLs in 25 emerging countries.

The coefficient on interbank rate is positive[15] as expected and is statistically significant across all bank categories. This result entails that an increase in interest rates triggers a rise

[14] Though this could only hold if nominal interest rates remain unchanged.
[15] The interbank rate was divided by 100, so the large coefficients are interpreted in basis points (bps) terms.

in the debt burden, and subsequently weakens borrowers' debt servicing capacity leading to a higher NPLs in the banking sector. High interest rates make it harder to repay loans for borrowers and thus increase their bankruptcy risk (Castro, 2013; Louzis et al., 2012; Nkusu, 2011; Mbao, 2017). The finding is in line with Bajracharya (2015) who established that the interbank rate has a significant positive impact on credit risk in Nepali commercial banks.

5.0 Conclusion

This study investigated the key bank-specific and macroeconomic determinants of non-performing loans in the Zambian banking sector. Using a sample of 16 commercial banks disaggregated into five sub-categories for the period 2010Q1-2019Q3, results from a dynamic panel data approach of cointegration and fully modified OLS (FMOLS) method show that both bank-specific and macroeconomic variables significantly influence non-performing loans. However, there are some variations in the influences of these variables on non-performing loans across different bank categories.

Results provide evidence that previous quarter's NPLs, greater capitalisation, more diversification in bank business, net interest margin, higher fiscal deficit and interbank interest rate, increase NPLs. Conversely, bank size, credit growth, higher copper prices, real GDP and inflation lower NPLs. The results also indicate that while a depreciation of the Kwacha increases NPLs for all banks, big banks and foreign banks categories, it contributes to lower NPLs for small and domestic bank categories. Moreover, inflation seem to matter for all banks, small banks and domestic banks categories only.

On a comparative basis, macroeconomic variables weigh more in accounting for highly significant and elastic variations in the NPL ratio than bank-specific variables, underscoring its countercyclical nature and unveiling that the state of the economy is clearly linked to loan portfolio quality (Louzis et al., 2012; Klein, 2013). Thus, improved economic health is imperative to reduce NPLs in the banking sector. On the other hand, fiscal consolidation efforts that endeavor to lessen the government's fiscal deficit would tremendously help lower NPLs in Zambia.

Given our results, several implications in terms of regulation and policy arise. This study indicates that there is need for structural processes and measures that endeavors to boost productivity, support growth and employment, and develop external competitiveness in the economy. Commercial banks need to take into account the external competitiveness of the Zambian economy since this has potential to impair the ability of borrowers in the export-led sectors to service their loans, which in turn would culminate in higher NPLs. The stability of the macroeconomic environment is paramount as empirical evidence demonstrates that banking credit default risk in Zambia is significantly affected by macroeconomic variables. Thus, polices that guarantee macroeconomic stability should be implemented as this could bring significant benefits to the banking sector by reducing the probability of defaults on loans, and the possibility of banking crises and the resultant damaging effects on the entire economy. Regulatory and supervisory authorities should strengthen macroprudential

regulations to prevent excessive risk-taking behavior by banks during economic boom periods.

The study also shows that asset quality, as reflected in NPLs for a commodity-exporting and dependent country like Zambia, can be vulnerable to global demand slowdown and volatile commodity prices. Thus, a slowdown in China's economic activities, given the existing trade linkages, could dent the loan books of Zambian commercial banks. This entails that a slowdown in one economy can transmit instabilities to the financial sectors of the linked economies (Nikolaidou and Vogiazas, 2017). As a recommendation, instability to the Zambian banking sector emanating from external shocks will only be addressed if strategies and policies aimed at diversifying the economy away from copper are adopted and fully implemented. In this respect, diversification of the economy is imperative for the banking sector to become resilient to external shocks emanating from global growth and copper prices.

Further, there is evidence that bank-specific variables might serve as leading indicators for bad loans. To deal with the problem of rising bad loans, regulators should direct efforts more on risk management systems, managerial performance, and loan screening procedures adopted by banks and measures to identify banks with potential impaired loans to avoid future financial instability. Business diversification efforts by banks, especially those that increase the likelihood of default, should be kept in constant check by the regulatory authorities to reduce the incidence of credit risk. On the other hand, while higher capital position reflects well on the banks' ability to withstand financial stress, regulatory authorities need to be extra vigilant as regards the urge for banks with higher capital venturing into risky lending which has potential to heighten the risk of default and thus erode bank soundness.

Overall, these results can play a crucial part in bank stress tests for credit risk assessment and have further implications on macro-prudential policy. The implication here is that the statistically significant bank-specific and macroeconomic variables identified in the study can be incorporated when calibrating the impact of shocks on the banking system's financial health and resilience.

This study can be extended on many fronts such as disaggregating the dependent variable (NPLs) into specific types such as mortgages, consumer and business or NPLs by sector i.e. agricultural, mining and quarrying, construction, retail and wholesale. This is because the use of aggregate NPLs, while useful, can mask important relationships between bank-specific, macroeconomic environment and NPLs on different types of loans. On the other hand, other econometrics methods of analysis deemed more robust such as GMM, dynamic stochastic general equilibrium (DSGE) and structural equation modelling can be employed. It would also be thought-provoking to explore the potential output effects of credit market frictions, which could be nonlinear using threshold effects. Lastly, provisioning for bad loans can have serious implications on banks' ability to withstand financial stress to the quality of loans and their ability to continue extending credit after such shocks. In this regard, an analysis of the relationships between bank-specific and macroeconomic variables and NPLs less provisioning for bad loans (i.e. net NPLs) could deepen the knowledge on the macro-financial linkages.

References

Abid, L., Ouertani, M. N. and Zouari-Ghorbel, S. (2014), "Macroeconomic and Bank-Specific Determinants of Household's Non-Performing Loans in Tunisia: A Dynamic Panel Data", Procedia Economics and Finance, 13:58-68.

Amuakwa–Mensah, F. and Boakye–Adjei, A. (2014), "Determinants of Non–Performing Loans in Ghana Banking Industry", International Journal of Computational Economics and Econometrics, 5(1), pp.35-54.

Anastasiou, D., Louri, H. and Tsionas, M. (2016), "Determinants of Non-Performing Loans: Evidence from Euro-area countries", Finance Research Letters, Vol. 18, pp. 116 .119.

Asiama, R. and Amoah, A. (2019), "Non-Performing Loans and Monetary Policy Dynamics in Ghana", African Journal of Economic and Management Studies, Vol. 10 No. 2, pp. 169-184.

Bajracharya, J.B. (2015), "Assessment of Banks' Profitability Under the Influence of Credit Risk and Its Determinants: Nepali Evidence", Kathmandu University, Unpublished M.Phil. Dissertation.

BIS (2010), "Annual Report", Bank for International Settlements, Basel.

Bangake, C. and Eggoh, J.C. (2011), "Further Evidence on Finance-Growth Causality: A Panel Data Analysis," Economic Systems, Elsevier, Vol. 35(2), pages 176-188, June.

Bercoff, Jose., Julian Giovanni, and Franque Grimard. (2002), "Argentinean Banks, Credit Growth and the Tequila Crisis: A Duration Analysis", Unpublished.

Berger, A., and DeYoung, R. (1997), "Problem Loans and Cost Efficiency in Commercial Banks", Journal of Banking and Finance (21), 849–870.

Castro, V. (2013), "Macroeconomic Determinants of the Credit Risk in the Banking System: The Case of the GIPSI", Journal of Economic Modelling, 31 (C), 672–683.

Carey, M. (1998), "Credit Risk in Private Debt Portfolios", Journal of Finance, 53, 1363–1387.

Chaibi, H. and Ftiti, Z. (2015), "Credit Risk Determinants: Evidence from a Cross-Country Study", Research in International Business and Finance, 33, pp.1-16.

Charalambakis, E., Dendramis, Y. and Tzavalis, E. (2017), "On the Determinants of NPLs: Lessons from Greece", Journal of Political Economy Perspectives on the Greek Crisis: Debt, Austerity and Unemployment. Month (11)., page 289-309.

Chen, B., McCoskey, S. and Kao, C. (1999), "Estimation and Inference of a Cointegrated Regression in Panel Data: A Monte Carlo Study", American Journal of Mathematical and Management Sciences, 19, 75-114.

Chileshe, P. (2017), "Bank Competition and Financial System Stability in a Developing Economy: Does Bank Capitalization and Size Matter?", MPRA Paper No. 82758, posted 23 November 2017 11:15 UTC.

Cifter, A., Yilmazer, S. and Cifter, E. (2009), "Analysis of Sectoral Credit Default Cycle Dependency with Wavelet Networks: Evidence from Turkey", Econ. Modell. 26, 1382–1388.

Demirguc-Kunt, A. and Levine, R. (1999), "Bank-Based and Market-Based Financial System: Cross-Country Comparisons", World Bank Policy Research Working Paper Series No. 2143.

Engle, R. F. and Granger, C. W. J. (1987), "Co-integration and Error Correction: Representation, Estimation, and Testing", Econometrica, 55, 251–276.

Espinoza, R.C. and Prasad, A. (2010), "Nonperforming Loans in the GCC Banking System and their Macroeconomic Effects'', IMF Working Paper No.10/224.

Farhan, M., Sattar, A., Chaudhry, A. H., and Khalil, F. (2012), "Economic Determinants of Non-Performing Loans: Perception of Pakistan Bankers'', European Journal of Business and Management, 4(19), 87-99

Fofack, H. (2005), "Non-Performing Loans in Sub-Saharan Africa: Causal Analysis and Macroeconomic Implications'', World Bank Policy Research Working Paper 3769, November.

Geanakoplos, J. (2009), "The Leverage Cycle'', Cowles Foundation Discussion Paper No. 1715.

Ghosh, A. (2015), "Banking-Industry Specific and Regional Economic Determinants of Non-Performing Loans: Evidence from U.S. Journal of Financial Stability, 20 (C), 93–104.

Gujarati D.N. (2004) "Basic Econometrics" 4th edition, McGraw Hill.

Gulati, R., Goswami, A., and Kumar, S. (2019), "What Drives Credit Risk in the Indian Banking Industry? An Empirical Investigation", Economic Systems, Vol: 43, Issue: 1, Page: 42-62.

Guo, K. and Stepanyan, V. (2011), "Determinants of Bank Credit in Emerging Market Economies", IMF Working Paper No. 11/51.

Hair, J F., Black, W.C., Babin, B. J., Anderson, R. E. and Tatham, R. L. (2006) "Multivariate Data Analysis'' 6th edition., New Jersey: Pearson Education.

Hu, J., Yang, Li. and Yung-Ho, C. (2004), "Ownership and Non-Performing Loans: Evidence from Taiwan's Banks'', Developing Economies, 42, 405–420.

Im, K.S., Pesaran, M.H. and Shin, Y. (2003), "Testing for Unit Roots in Heterogeneous Panels'', Journal of Econometrics. 115, 53–74.

Jimenez, G. and Saurina, J. (2005), "Credit Cycles, Credit Risk, and Prudential Regulation'', International Journal of Central Banking, 2(2), 65-98.

Kao, C. D. (1999), "Spurious Regression and Residual-Based Tests for Cointegration in Panel Data'', Journal of Econometrics, 90, 1–44.

Kao, C. and Chiang, M.H. (2000), "On the Estimation and Inference of a Cointegrated Regression in Panel Data'', In Baltagi, B. H. et al. eds., Nonstationary Panels, Panel Cointegration and Dynamic Panels 15. Amsterdam: Elsevier, 179–222.

Keeton, W.R. and Morris, C.S. (1987), "Why Do Banks' Loan Losses Differ?'', Federal Reserve Bank of Kansas City, Economic Review, pp. 3–21.

Keeton, W. (1999), “Does Faster Loan Growth Lead to Higher Loan Losses? Federal Reserve Bank of Kansa City”, Second Quarter. pp. 57–75.

Khemraj, T. and Pasha, S. (2009), “The Determinants of Non-Performing Loans: An Econometric Case Study of Guyana’’, MPRA Paper, No. 53128.

Klein, N. (2013), “Non-Performing Loans in CESEE: Determinants and Impact on Macroeconomic Performance’’, IMF Working Paper No.13/72.

Lawrence, E. (1995), “Default and the Life Cycle Model’’, Journal of Money, Credit and Banking, 27, 939–954.

Levin, A., Lin, C. and Chu, C.J. (2002), “Unit Root Tests in Panel Data: Asymptotic and Finite Sample Properties’’, Journal of Econometrics, 108, 1–24.

Louzis, D., Vouldis, A. and Metaxas, V. (2012), “Macroeconomic and Bank-Specific Determinants of Non-Performing Loans in Greece: A Comparative Study of Mortgage, Business and Consumer Loan Portfolios’’, Journal of Banking and Finance, Elsevier, Vol. 36(4), pages 1012-1027.

Maddala, G.S. and Wu, S. (1999), “A Comparative Study of Unit Root Tests with Panel Data and New Simple Test’’, Oxford Bull. Econ. Statist. 61 (S1), 631–652.

Makri, V., Tsagkanos, A. and Bellas, A. (2014), “Determinants of non-performing loans: The case of Eurozone’’, Panoeconomicus, 61 (2), 193–206.

Mbao, F.Z. (2017), “The Determinants of Credit Default Risk in Zambia: Does Bank Size Matter?”, Bank of Zambia Working Paper.

Megginson, W. (2005), “The Financial Economics of Privatization’’, Journal of Banking & Finance, 2005, Vol. 29, issue 8-9, 1931-1980.

Mpofu, T.R. and Nikolaidou, E. (2018), "Determinants of Credit Risk in the Banking System in Sub-Saharan Africa", School of Economics Macroeconomic Discussion Paper Series 2018-04, School of Economics, University of Cape Town.

Nkusu, M. (2011), “Non-Performing Loans and Macro Financial Vulnerabilities in Advanced Economies’’, IMF Working Paper 11/161.

Othman, A.N. and Masih, M. (2015), “Do Profit and Loss Sharing (PLS) Deposits also Affect PLS Financing? Evidence from Malaysia Based On DOLS, FMOLS And System GMM Techniques’’, MPRA Paper No. 65224.

Ozili, P.K. (2018), "Banking Stability Determinants in Africa", International Journal of Managerial Finance, Vol. 14. Issue: 4, pp.462-483,

Pedroni, P. (1999), “Critical Values for Cointegration Tests in Heterogeneous Panels with Multiple Regressors’’, Oxford Bulletin of Economics and Statistics 61, 653–70.

Pedroni, P. (2000), "Fully Modified OLS for Heterogeneous Cointegrated Panels", in Baltagi, B.H., Fomby, T.B. and Hill, R.C. (Eds), "Nonstationary Panels, Panel Cointegration, and Dynamic Panels, Advances in Econometrics'', Vol. 15, Emerald Group Publishing.

Pedroni, P. (2004), "Panel Cointegration: Asymptotic and Finite Sample Properties of Pooled Time Series Tests with an Application to the PPP Hypothesis'', Econometric Theory, 20, 597–625.

Phillips, P. C. B. and Hansen, B. E. (1990), "Statistical Inference in Instrumental Variables Regression with I (1) Processes", Review of Economics Studies, 57, 99-125.

Phillips, P. C. B. and Moon, H. R. (1999), "Linear Regression Limit Theory for Nonstationary Panel Data'', Econometrica, 67, 1057–1111.

Podpiera, J. and Weill, L. (2008), "Bad Luck or Bad Management? Emerging Banking Market Experience'', Journal of Financial Stability, 4, 135–148.

Poudel, S.R. (2018), "Assessment of Credit Risk in Nepali Commercial Banks'', Journal of Applied and Advanced Research, 2018: 3(3) 65-72.

Radivojevic, N. and Jovovic, J. (2017), "Examining of Determinants of Non-Performing Loans", Prague Economic Papers, University of Economics, Prague, Vol. 2017(3), pages 300-316.

Nikolaidou, E. and Vogiazas, S. (2017), "Credit Risk Determinants in Sub-Saharan Banking Systems: Evidence from Five Countries and Lessons Learnt from Central East and South East European Countries'', Review of Development Finance, 7, 52–63.

Reinhart, C. and Rogoff, K. (2010), "From financial crash to debt crisis'', NBER Working Paper 15795.

Salas, V. and Saurina, J. (2002), "Credit Risk in Two Institutional Regimes: Spanish Commercial and Savings Banks", Journal of Financial Services Research, 22(3): 203-224.

Stern, G. and Feldman, R. (2004), "Too Big to Fail: The Hazards of Bank Bailouts'', The Brookings Institution Press, Washington, DC.

Syed, A. and Tripathi, R. (2019), "Non-Performing Loans in BRICS Nations: Determinants and Macroeconomic Impact", Indian Journal of Finance, 11(2),22-35.

Waqas, M., Fatima, N., Khan, A. and Arif, M. (2017), "Determinants of Non-Performing Loans: A Comparative Study of Pakistan, India, and Bangladesh'', International Journal of Finance & Banking Studies, Vol. 6 No 1, 2017 ISSN: 2147- 4486.

Zribi, N. and Boujelbène, Y. (2011), "The Factors Influencing Bank Credit Risk: The Case of Tunisia'', Journal of Accounting and Taxation, Vol. 3(4) PP. 70-78.

APPENDIX

Appendix I: Bank Size and Type

Bank ID.	Bank Size	Bank Type	Percentage of Assets	Percentage of Loans	Percentage of Deposits
1	Small	Foreign	0.4	0.7	0.2
2	Small	Domestic	1.1	1.4	1.2
3	Small	Domestic	1.2	1.5	1.2
4	Small	Foreign	1.5	2.2	1.4
5	Small	Foreign	1.5	2.4	1.4
6	Small	Foreign	1.6	0.2	1.6
7	Small	Foreign	1.7	2.9	1.2
8	Small	Foreign	3.1	2.2	2.7
9	Small	Foreign	3.4	1.5	2.5
10	Big	Domestic	5.7	6.6	5.4
11	Big	Foreign	7.4	6.8	6.7
12	Big	Foreign	8.0	8.0	7.7
13	Big	Foreign	10.1	3.7	11.4
14	Big	Foreign	11.2	10.5	12.4
15	Big	Domestic	12.3	14.3	13.2
16	Big	Foreign	14.6	16.0	14.8
17	Big	Foreign	15.1	19.0	15.2
		Total	100.0	100.0	100.0

Source: Authors construction using Bank of Zambia data

Appendix II: Unit Root Test Results

	Level			
Variable	Levin, Lin and Chu t*	P-Values	Im, Pesaran and Shin W-stat	P-Values
NPL Ratio	-2.674	0.004	-2.502	0.006
Capitalisation	-1.192	0.117	0.323	0.627
Bank Size	0.342	0.634	0.317	0.624
Inefficiency	-14.134	0.000	-12.082	0.000
Diversification	-6.023	0.000	-8.417	0.000
ROA	-2.611	0.005	-5.948	0.000
NIMR	-3.228	0.001	-5.408	0.000
Credit-to-GDP Ratio	0.468	0.680	3.314	1.000
Fiscal Deficit	-12.344	0.000	-12.236	0.000
Log of Copper Prices	0.883	0.811	0.350	0.637
Log of Real GDP	-10.273	0.000	-7.587	0.000
Log of Real Effective Rate	3.130	0.999	0.048	0.519
Inflation	-0.670	0.252	-5.077	0.000
Interbank Rate	-2.139	0.016	0.763	0.777

First Difference

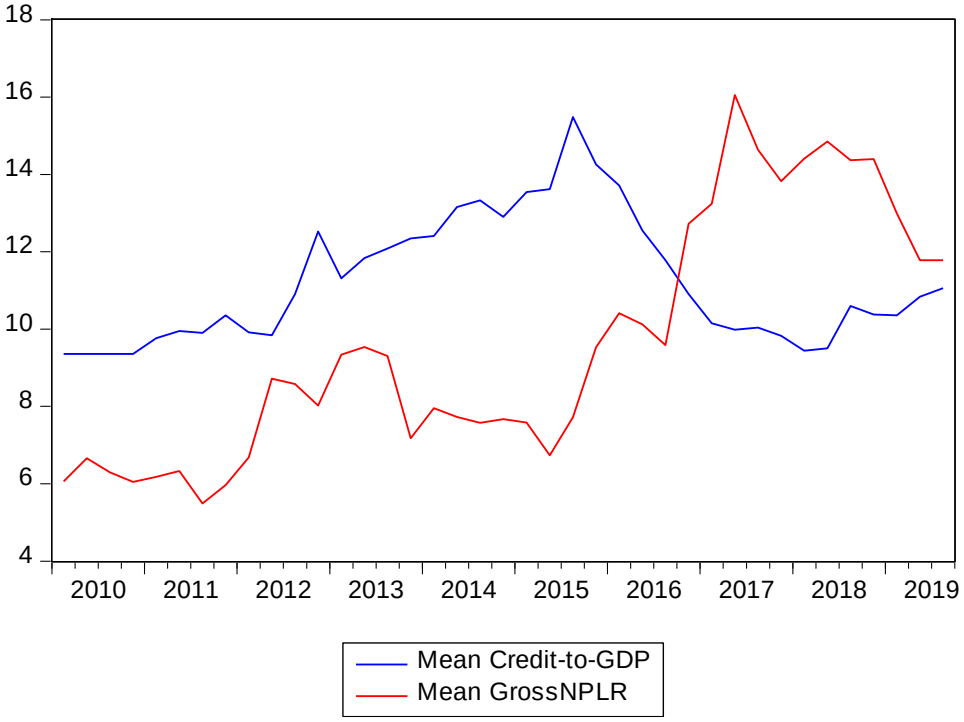
Variable	Levin, Lin and Chu t*	P-Values	Im, Pesaran and Shin W-stat	P-Values
NPL Ratio	-12.167	0.000	-14.893	0.000
Capitalisation	-12.717	0.000	-14.830	0.000
Bank Size	-9.808	0.000	-15.565	0.000
Inefficiency	-19.969	0.000	-23.960	0.000
Diversification	-13.261	0.000	-23.225	0.000
ROA	-12.287	0.000	-17.305	0.000
NIMR	-3.694	0.000	-6.026	0.000
Credit-to-GDP Ratio	-9.892	0.000	-9.128	0.000
Fiscal Deficit	-22.656	0.000	-22.656	0.000
Log of Copper Prices	-8.594	0.000	-8.868	0.000
Log of Real GDP	-24.091	0.000	-25.450	0.000
Log of Real Effective Rate	-13.220	0.000	-13.589	0.000
Inflation	-8.193	0.000	-9.243	0.000
Interbank Rate	-19.070	0.000	-15.878	0.000

Note: Both constant and trend terms are included in the tests of level variables while only the constant term is included in the tests of first difference variables.

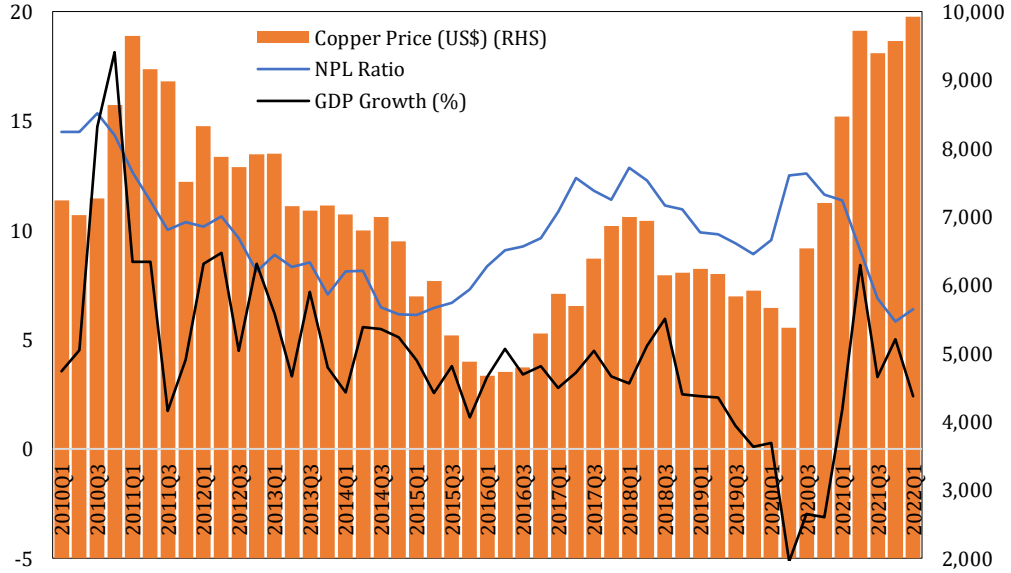
Appendix III: Variance Inflation Factor (VIF)

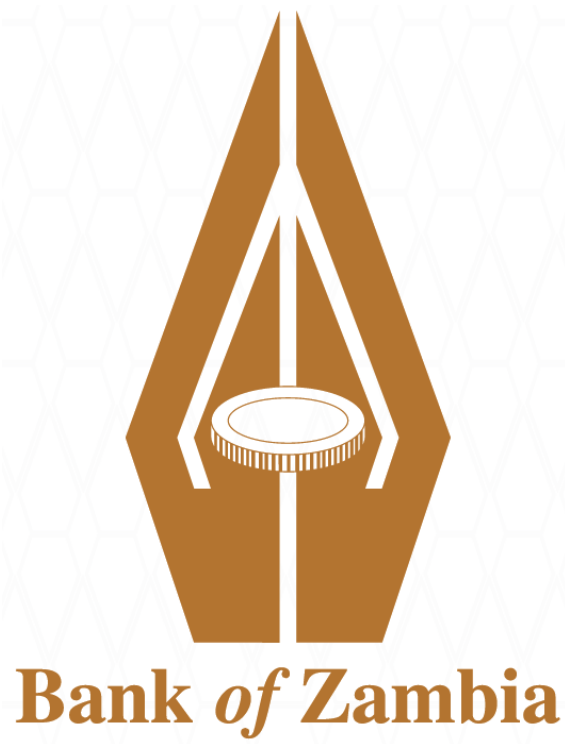
Variable	VIF	1/VIF
NPL Ratio (-1)	1.273585	0.785185
Capitalisation	1.333477	0.749919
Bank Size	1.172203	0.853095
Inefficiency Ratio	1.159236	0.862637
Diversification	1.175919	0.850399
ROA	1.235453	0.80942
NIMR	1.118807	0.893809
Credit-to-GDP Ratio	1.98362	0.504129
Fiscal Deficit	1.187951	0.841786
Log of Copper Prices	1.472472	0.67913
Log of Real GDP	1.301826	0.768152
Log of Real Effective Rate	1.919316	0.521019
Inflation	1.308775	0.764073
Interbank Rate	1.167622	0.856442
Average	**1.34359**	**0.767085**

Appendix IV: Credit-to-GDP Ratio and Gross NPL Ratio, 2010 - 2019



Appendix V: Evolution of Copper Prices, GDP Growth and NPL Ratio in Zambia





REGISTERED OFFICES

Head Office
Bank of Zambia, Bank Square, Cairo Road
P.O. Box 30080, Lusaka, 10101, Zambia
Tel: +260 211 399 300
E-mail: info@boz.zm, Website: www.boz.zm

Regional Office
Bank of Zambia, Buteko Avenue,
P.O. Box 71511, Ndola, Zambia
Tel: +260 212 399 600
E-mail: info@boz.zm, Website: www.boz.zm