NON-PERFORMING LOANS, BANKING SYSTEM AND MACROECONOMY

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Abstract: The study builds on previous studies of the consequences of non-performing loans on an economy. Using a seven-by-seven matrix in the impulse response function (IRF) of the structural autoregressive model, we find a long-run impact of an impulse to non-performing loans on the banking system and the macroeconomy in Nigeria. Conversely, non-performing loans also respond to the innovation of all macro-banking variables aside from the exchange rate and the growth rate to GDP. Also, the level of non-performing loans grows in influence in relation to the changes to the exchange rate using the variance decomposition tool of Structural VAR. Hence, a prominent role is assigned to the level of NPLs in linking the friction in the credit market to the susceptibility of both the banking system and the macroeconomy. This study passes the serial correlation tests and the three tests of normality.

JEL classification: E51, G21, O47

Keywords: SVAR, non-performing loans, impulse response function, variance decomposition, macro-banking.

1. Introduction

A major challenge facing the banking sector is the prevalence of non-performing loans (NPLs). The high incidence of such loans has been identified as a factor that limits the effectiveness of the banking sector in promoting economic growth in many countries (Boudriga, Taktak, Jellouli, 2010). In corroborating this view, Schumpeter (1969) writes that a healthy financial system promotes economic growth, but a weak financial system grappling with non-performing loans and insufficient

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capital could undermine growth. Hence, at the heart of credit market friction (Bernanke Gertler, 1989; Guerrieri, Lorenzoni, 2017) are non-performing loans (NPLs), which are viewed as a source of financial pollution that negates social utility in an economy Zeng (2012).Studying the extent of the effect of non-performing loans is of particular importance in developing and emerging market economies such as Nigeria. The significance of non-performing loans is mainly due to the vulnerability of these usually non-diversified economies to external shocks and macroeconomic instability. At a micro level, bank bankruptcy is usually preceded by a build-up of non-performing loans at a systemic level, and banking crises are also preceded by a substantial accumulation of non-performing loans (Jiménez, Ongena, Peydró, Saurina, 2017). This vulnerability can be further exacerbated by the structure of the banking system in sub-Saharan Africa (and Nigeria is not exempted), which is dominated by a few large banks. Bankruptcy or insolvency involving even one major player can have a spiral effect on the entire system in the country.

While the definition of non-performing loans (NPLs) is not uniform across countries, in the global financial stability report of the International Monetary Fund (IMF), a general definition encompasses several formulations (IMF, 2004). According to the IMF definition, a loan is deemed to be non-performing if payments (principal and/or interest) due have not been paid for at least 90 days.

A major challenge confronting the banking sector in Nigeria is the prevalence of NPLs. Nigeria has experienced financial sector problems in the past and NPLs were identified as the main cause of these (Adeyemi, 2011; Bebeji, 2013; Somoye, 2010). The average growth rate of NPLs in Nigeria since 1999 is about 46%. This figure, however, which seems to have declined in recent times is due to the fact that a chunk of it is no longer accounted for by the banking sector. In 2010, the on-going concern regarding NPLs resulted in the Nigerian government opting for a bailout solution; the National Assembly established the Asset Management Corporation of Nigeria (AMCON) to buy from banks, some non-performing loans with an estimated value of five trillion Naira (Kolapo, Ayeni, Oke, 2012). As Kolapo *et al.* (2012) write, these toxic loans (estimated at about $33.3billion) were taken off the balance sheet of banks with public funds in 2010. However, in spite of the depressed official figures, in the preceding three years ending in 2014, the magnitude has grown by 22%. This trend has continued to give the monetary authorities in Nigeria a serious cause for concern as different measures were employed in recent times to rein in the severely increasing trend of non-performing loans. It is commendable that governments in Nigeria have acknowledged this problem, but noteworthy is the fact that policy initiatives have failed to contain NPLs, which have continued to increase in absolute terms between 2011 and 2014 by about 122% in Nigeria as against a 5% maximum benchmark of an annual growth of NPLs (Anderson et al., 2011).Therefore, central to this study is the assessment of the susceptibility of the Nigerian banking system and macroeconomy (referred to in this paper as macro-banking) to the scourge of non-performing loans. This study will help to extend the validation of the serious attention paid by the country's monetary authorities to the broad implications of the growth of NPLs in Nigeria.

But, limited attention has been accorded NPLs in empirical studies as regards to its macro-banking effects in the literature. The disorder that NPLs are capable of orchestrating in relation to the macroeconomy of a country (Barseghyan, 2010), particularly in Nigeria, is the core motivation of this study. The focus on Nigeria stems

from her being regarded both as a regional power in Africa and a middle power in international affairs, has the largest economy in Africa and is ranked within the ten Big Emerging Market (BEM). Also, Nigeria could grow at an average minimum of 5% over the next 35years up to 2050 while established emerging economies such as China is expected to moderate to between 3% and 4% over the same period (PWC, 2015). Their model predicts Nigeria having the highest GDP growth rate over the same period of 5.4% in domestic currency. Given the trend of NPLs in Nigeria, her potential and future role in global economy can be put in jeopardy, hence requiring attention.

Our objective in this paper, therefore, is to investigate how a long and drawn-out dysfunction in the credit market impacts both the banking system and the Nigerian macroeconomy. Identifying responses to systemic shocks will also guide policy, and forecasting future levels will be useful for pre-emptive policies and actions. This study contributes to existing knowledge in this regard and is the first empirical study in Nigeria, as far as we are aware. Therefore, this study will be useful for policy-makers and support future work by researchers.

2. Literature Review

The context of this section, shaped by the three research questions to be answered under the main objective of this paper, which address the feedback dynamics between NPLs levels and some macro-banking indicators in Nigeria; the central nature or otherwise of NPLs to influencing some macro-banking indicators in Nigeria, and the time-nature of this influence, if so; and the reaction of the level of NPLs to sharp movements in the selected macro-banking indicators in Nigeria. These three research questions, encapsulated in the main objective covered in this study, are defined by the theory of money creation (McLeay, Radia, Thomas, 2014) which is key to the understanding of how non-performing loans arise and its consequences on an economy. The concept of money creation (or credit creation) describes a situation of increase in the money supply of a defined geographical location through lending activities.

Various theories have been advanced to explain why NPLs arise. In discussing the agency theory, Jensen and Meckling (1976) refer to the conflict of interest that occurs between the agent and the principal and the tendency for the agent to work in his/her own best interests rather than those of the shareholders. This may occur when managers offer loans with the primary goal of earning bonuses. Moral hazards refer to the practice of engaging in additional risks after an exchange on the understanding that the consequences of the risks taken in terms of financial burden reside with another party (Mishkin, 2011; Zhang, Cai, Dickinson, Kutan, 2016)

The literature suggests that there is an impact on macroeconomic factors by non-performing loans. For instance, the 2008 global financial crises originated from a sharp increase in mortgage loan defaults in the United States of America (Purnanandam, 2011).

The importance of credit to an economy cannot be over-emphasized. While most macroeconomists examine the impact of assets on aggregate demand by using models similar to the Investment Savings-Liquidity Preference (IS/LM), the LM curve treats money as a special asset, but in the bond market lumps all debt instruments

together. However, since loans granted in an economy are a special case, as its growth or decline can affect aggregate demand and supply (Hicks, 1937). However, loans granted in an economy are a special case as their growth or decline can affect aggregate demand and supply (Bernanke, Blinder, 1988). In their model, Bernanke and Blinder focus on three assets (loans, bonds and money) to analyse equilibrium in the credit market as a major driver of aggregate demand. Friedman (1994) argues that a measure of credit is associated with nominal gross domestic product (GDP), while Stiglitz (1989) maintains that money is important because of its relationship with credit. The institutional link between money and credit is enabled by the development of fractional reserve banking, which combines loans with deposits (Cochran, Call, 2000).

Moinescu (2012) argues that strong increases and decreases in credit are the transmission channels of the dynamics of non-performing loans. This view corroborates the work of Jakubik and Moinescu (2015) who link contracting credit to the growth of NPLs, likening it to inefficient resource allocation by banks. Moinescu further links the dynamics of NPLs to the difference in banks' credit to the private sector, which is measured as a percentage of GDP. He argues that some macroeconomic variables as well as market variables determine the number of NPLs. In his opinion, macroeconomic variables such as economic growth enhance the capacity to repay. Conversely, financial market variables such as the exchange rate and interest rates lower capacity for repayment.

The study of business cycles, which play a role in the theoretical framework of this study, dates back to such empirical works by Mills (1927) and Kuznets (1940). There was a proliferation of studies on business cycles in the early 1930s, particularly after the Great Depression, which was motivated by the aim to avoid future re-occurrence of the depression's consequences.

Later, studies were focussed on investigating the causes of business cycles. Some researchers formulated equilibrium business cycle models that suggest that monetary shocks occur within an environment of economic agents with information asymmetry that cause business cycles (Lucas 1972, 1975). Conversely, the opposite position in the literature is that stochastic disturbances to technologies of production cause 'real' business cycles and that economic agents' willingness to substitute on an intertemporal basis propagate these shocks. But in the real business-cycle world, there is either no role for monetary factors and financial intermediation or monetary factors merely play a production role (that is of transaction services), such as explained in the work of King and Plosser (1984). In their study, real disturbances drive co-movements among money, credit and price level and other real variables in a business cycle. They suggest that correlation between money and output occurs as the endogenous banking system responds to disturbances.

King and Plosser's (1984) model generates co-movements among money, credit, the price level, and other real variables in a business cycle driven by real disturbances and explains observed money-output correlations through the endogenous response of the banking system to these disturbances (Williamson 1987). Considering a business cycle model that explicitly has a role for financial intermediation gives a good foundation for non-performing loans. This is so because it emphasizes the countercyclical nature of credit risk and business failures (Williamson, 1987). Williamson finds that intermediation plays a role in the business cycle.

The consequences of NPLs, which form the fulcrum of this study as it addresses the research questions, are captured in the financial accelerator theory (FAT) developed by Bernanke and Gertler (1989). The FAT is a condition where the initial shocks brought about by changes in credit market conditions extend into the economy (Bernanke, Gertler, Gilchrist, 1996; Kiyotaki, Moore, 1997). The concern of the FAT lies in the puzzle that small shocks bring about large cycles. The framework used to rationalize the FAT is the "principal-agency" view of the credit market, which has been extensively developed. The principal represents the lender and the agent represents the borrower. The main implication of the FAT is that in an economic downturn, a borrower, whose agency cost is significant in the credit market will likely face bigger hardships in his/her quest for access to credit as he/she suffers reduced economic activities relative to others. This is referred to as the "flight to safety" by Bernanke *et al.,* (1996).

The robust results emerging from the extensive literature on features, structures and functioning of the credit market, with diverse findings, depending on assumptions about relevant informational frictions in the market, form the foundation for the FAT. By loosely applying the work of Kiyotaki and Moore (1997) within a two-period two-factor assumption, the purchase of variable input, x_1, and new borrowing, b_1, is linked in an accounting identity:

$$x_1 = a_0f(x_0) + b_1 - r_0b_0 \text{ where } a_0f(x_0)$$

is the entrepreneur's gross cash flow from production in period 0 (or output of that period), r_0b_0 represents period 0 debt obligation with b_0 and r_0 being the borrowing and the gross interest rate on the borrowing, respectively. Even though this model assumes that every external borrowing is collateralized, unsecured lending can also be accommodated in equilibrium. Work such as that of Townsend (1979), with the costly state verification (CSV) arrangement whereby a corporate audit is undertaken, imposes discipline that helps to guard against default. Under the assumption of equality, substituting for $b_1 = \left(q_1/r_1\right)K$, we have

$$x_1 = a_0f(x_0) + \left(q_1/r_1\right)K - r_0b_0 \tag{1}$$

This means that spending on variable input x_1 is a function of gross cash flow, $a_0f(x_0)$ and the net discounted asset of $\left(q_1/r_1\right)K - r_0b_0$. This implies that the net worth of the borrower, given by his/her liquid assets and the collateral value of his/her illiquid assets, ultimately determines the spending capacity of the borrower (to expend on variable input) and production. This situation, in which fluctuations in the net worth of borrowers cause fluctuation in real activities, is referred to as the financial accelerator. Mises (1971) argues that economic crises are usually the outcome of 'credit creation'.

Thus macrofinancial linkages, explained by the financial accelerator theory (FAT), models NPLs and their direct interlink with macroeconomic performance (Nkusu, 2011), and even though the theory basically assumes aggregate credit and collateralized lending, uncollateralized lending and default can be accommodated within the model (Bernanke and Gilchrist, 1999).

The relevant empirical literature links non-performing loans with macrofinancial conditions, emphasizing the positive impact of non-performing loans on the probability of crises. For instance, Kaminsky and Reinhart (1999) suggest that a sizeable increase in non-performing loans can signal the onset of the crises. Here, non-performing loans are used to explore macrofinancial vulnerability, which may in turn predict crises (Caprio and Klingebiel, 1996; Drees and Pazarbasioglu, 1998). Related to this aspect is the literature that links non-performing loans to macroeconomic performance and how NPLs may be linked to financial vulnerabilities or fragility. The scope of study may focus on one country (Erjavec, Cota, Jakšić, 2012) or a group of countries (Espinoza, Prasad, 2010; Klein, 2013). Even though NPLs may not be the only explanation, they play a role in financial system vulnerabilities (Caprio, Klingebiel. 1996; Drees, Pazarbasioglu, 1998; Kaminsky, Reinhart, 1999).

The vector autoregression (VAR) approach has been used in many financial stability analyses, linking credit quality and macroeconomic conditions, which lends credence to the financial acceleration theory. In their analysis of the Malaysian financial system, Ahmad and Ahmad (2004) reported a significant relationship between credit risk and financial crises and concluded that credit risk had already started to build up before the onset of the 1997 Asian financial crisis, and only deteriorated as NPLs increased.

Marcucci and Quagliariello (2009) rely on the VAR approach to highlight the feedback loop between non-performing loans and macroeconomic performance. They find feedback from the banking sector to macroeconomic performance via the capital channel. In Espinoza and Prasad (2010), non-performing loans worsen as economic growth slows down and the interest rate increases. Nkusu (2011) suggests a nexus between frictions in the credit market and macro-financial vulnerability with NPLs playing a critical role. In order to study interrelationships among variables, a panel vector autoregressive (PVAR) model was used to explore the feedback between shocks to variables, including NPLs and their macro-financial determinants. The work of Nkusu (2011) is found useful in addressing the objective of this study, which seeks to investigate how the banking sector and the Nigerian economy react to changes in NPLs. For instance, as NPLs increased by 100%, macroeconomic conditions, as measured by the GDP growth rate, fall by 18% and 16% using the ordinary least square and generalized method of moments, respectively.

Turning to specific country studies similar to our study, Erjavec et al. (2012) in their study on how the banking system reacts to macroeconomic shocks, in order to stress-test the banking system in Croatia, they used the vector autoregression (VAR) model. Two banking sector variables, the non-performing loans (NPL) and the return on equity (ROE) were used. The four macroeconomic variables used were the Croatian real GDP, the interest rate and the inflation rate and the real GDP of the European Union. Their results suggest that the banking sector in Croatia is sensitive to macroeconomic shocks. Also, in their study on how vulnerable the banking sector is to the Egyptian economy, Love and Ariss (2014) observed the reaction of bank loans to macroeconomic shocks and the feedback effect of bank loans' shocks on the Egyptian macroeconomy.. Using the panel variance autoregression (PVAR) model, they combined a panel of state banks, domestic private banks and foreign banks, utilising the GDP growth rate, the domestic credit to the private sector as a ratio of GDP, lending rate, the exchange rate, and capital inflows as macroeconomic variables. On the other hand, loans to assets, loans growth rate and return on equity (ROE) were

employed as banking sector variables. They find that shocks in the macroeconomy are transmitted to the Egyptian banking system via the credit channel. Finally, Wong, Choi, and Fong (2006), in their study, which set out to analyse the reaction of aggregate loans and mortgage loans on plausible shocks from the macroeconomy of Hong Kong, rates of default in bank loans were found to be significantly sensitive to sudden movements of interest rate, GDP and property prices. The study adopted a framework of Monte Carlo simulation in which different possible combinations of stressed macroeconomic values are obtained given some unfavourable macroeconomic scenarios, from a Monte Carlo simulation. This method allows, under some specific shocks, the generation of distributions for possible bank loans' default rates.

Overall, previous studies have suggested the vulnerability of banking sectors to shocks emanating from the macroeconomy. Major differences have, however, arisen from the use of different proxies used as bank-level and macroeconomic variables.

3. Methodology

Our objectives are addressed using the structural vector autoregressive (SVAR) model. The reasons for the choice of SVAR are:

- The literature has identified structural VAR (SVAR) as a good estimating technique that can help achieve an objective such as in this study (Tang, Nasiopoulos, Ward, 2008).

- Empirical studies of this nature have effectively utilized this approach (Erjavec et al., 2012; Nkusu, 2011) making use of the impulse response function and variance decomposition characteristics of SVAR.

SVAR Approach

The structure of the SVAR for the study combines selected endogenous variables. It incorporates the NPLs, bank credit to the economy, GDP growth rate, lending rate, exchange rate and two other bank-specific variables, namely, the return on assets and the bank liquidity ratio.

Generally, the structural equation for the MINT economy is given as:

$$AY_t = C_0 + \sum_{l=1}^{p} B_l Y_{t-l} + D u_t \qquad (3.1)$$

where A represents an (n x n) invertible matrix, which describes the contemporaneous relationship amongst the variables in the model, B_l represents the (nx1) vector of the coefficient of lagged endogenous variables, Co is the (nx1) vector of constants, p is the lag length, Y_t represents the (nx1) vector of endogenous variables divided into two blocks for vector of non-policy variables and vector of policy variables (assumed to be controlled by the Central Bank), and u_t represents an uncorrelated vector of error term. u_t, which is the white noise, is assumed to follow a Gaussian distribution with E(u_t| Y1, ..., Yt−1) = 0 and E($u_t u^1_t$| Y1, ..., Yt−1) = I and $E(u_{t-i} u'_{t-j})$ is the sum for i=j and $E(u_{t-i} u'_{t-j})$ for i≠j representing the structural economic shock.

As a result of the contemporaneousness inherent in the VAR process (Enders, Hurn, 2007), and the resultant effect of parameters that are unidentified due to unknown coefficients in the model, equation 3.1 cannot be directly estimated. Studying the impulse

response functions of economic shocks is the aim of a structural analysis, but the problem is that u_t is not observed and needs to be estimated or derived. Therefore, we derive these by estimating a reduced form VAR that is implicit in equation 3.1 (Gujarati, 2009; Ngalawa, Viegi, 2011). Multiplying equation 3.1 by A^{-1} gives us

$$Y_t = A^{-1}C_0 + \sum_{l=1}^{p} A^{-1}(B_l\,Y_{t-l}) + A^{-1}Du_t \qquad (3.2)$$

Given that $A^{-1}C_0$ = μ and $A^{-1}B_l$= σ_i for all l= 1 p, $A^{-1}\rho_i = \alpha_i$ and $A^{-1}Du_t = \pi_t$ then equation 3.2 can be re-written as

$$Y_t = \mu + \sum_{i=1}^{p} \sigma_i\,Y_{t-i} + \pi_t \qquad (3.3)$$

The short form of equation 3.3 is given as:

$$Y_t = B(\text{L})Y_t + \pi_t \qquad (3.4)$$

Where
Y_t represents the vector of bank non-performing loans, significant macroeconomic variables and other bank-specific variables of interest. This can be denoted:

$$Y_t = (GDPGR, BNPL, BTCR, ROA, BLR, LEDR, EXR) \qquad (3.5)$$

From $\pi_t = A^{-1}Du_t$, we find that the VAR residuals π_t and structural shocks are related by

$$Du_t = A\pi_t \qquad (3.6)$$

Indicating a full variance-covariance matrix $\sum = \text{E}(\pi_t\pi'_t)$.

Equation 3.1 differs from equation 3.4 in that while the former is referred to as the primitive system, the latter is referred to as the reduced or standard-form SVAR. Further, while variables have a contemporaneous relationship in equation 3.1, there is no such relationship amongst variables in equation 3.4.

There are different ways to estimate the parameters in the structural-form equation. However, some restrictions should be imposed on the elements of the matrix in the estimation of structural parameters. Previous studies of VAR models have used various restriction methods based on model preferences and existing theory. In one tranche of literature, the Cholesky decomposition of orthogonalized reduced-form disturbances (Sims, 1980) was used to identify the model. However, only the recursive method is used in this identification approach in which the estimation results obtained change in the ordering of variables. The other tranche of literature uses a non-recursive method, which only imposes restrictions on structural parameters that are contemporaneous in nature. This generalized method has been used by (Sims, 1986); Blanchard and Watson (1986); Bernanke (1986); and Kim and Roubini (2000) in empirical studies.

Using the maximum likelihood estimation technique, we can generate consistent estimates of the structural form parameters contained in equation 3.3 through equation 3.6 by imposing sufficient restrictions on matrices A and D. However, the minimum restriction required on these matrices for system identification is $2n^2 - \lfloor n \times (n-1)/2 \rfloor$ (Giannini, 1991). These restrictions are imposed on the basis of economic

theory and previous empirical findings. For our contemporaneous matrix specifically, we impose restrictions on the structural parameters using the work of Kim and Roubini (2000) as a guide. Using the tools provided by the impulse response function (IRF) and the variance decomposition, we will then be able to answer the research questions posed under this objective.

As against a larger SVAR model, which allows for richer interaction, a 7-variable model such as that adopted in this study is likely to be more stable and parsimonious as it utilizes more degrees of freedom (Berkelmans, 2005). The non-zero coefficients 'bij' in equation 3.6 connote an instantaneous effect of variable 'j' on 'i'. From equation 3.6, the matrices formed are in line with the work of Ngalawa and Viegi (2011) and shown below as:

$$
\begin{bmatrix}
1 & 0 & 0 & 0 & 0 & 0 & 0 \\
a_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\
a_{31} & a_{32} & 1 & a_{34} & a_{35} & a_{36} & a_{37} \\
a_{41} & a_{42} & 0 & 1 & 0 & 0 & 0 \\
a_{51} & a_{52} & 0 & 0 & 1 & a_{56} & 0 \\
0 & 0 & 0 & a_{64} & 0 & 1 & 0 \\
0 & 0 & a_{73} & a_{74} & a_{75} & a_{76} & 1
\end{bmatrix}
\begin{bmatrix}
\pi_t^{GDPGR} \\
\pi_t^{BNPL} \\
\pi_t^{BTCR} \\
\pi_t^{ROA} \\
\pi_t^{BLR} \\
\pi_t^{LEDR} \\
\pi_t^{EXR}
\end{bmatrix}
=
\begin{bmatrix}
d_1 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & d_2 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & d_3 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & d_4 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & d_5 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & d_6 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & d_7
\end{bmatrix}
\begin{bmatrix}
u_t^{GDPGR} \\
u_t^{BNPL} \\
u_t^{BTCR} \\
u_t^{ROA} \\
u_t^{BLR} \\
u_t^{LEDR} \\
u_t^{EXR}
\end{bmatrix}
\quad (3.7)
$$

3.1. Variables definition

Bank-specific variables

- $bnpl$ is the total bank non-performing loans, which is the total of non-performing loans by banks measured as a percentage of gross loans;
- $btcr$ is the banks' total credit to the private sector and comprises the financial loans to the private sector of the economy by banks, which is measured as a percentage of the gross domestic product (GDP);
- roa is the banks' return on assets measured as an average period percentage;
- blr is the annual banks' liquidity reserve as a percentage of bank assets.

Macroeconomic variables

- $gdpgr$ is the real GDP per capita expressed in United States (US) dollars and measured in an average period, which is logged in the model to capture percentage changes;
- $ledr$ is the lending rate measured in average period percentage;
- exr is the official exchange rate measured in local currency per US$, period average.

3.2. Data Sources and Scope

Data on the Nigerian banking sector's NPLs, GDP growth rate, total bank credit to the domestic economy, return on assets, the bank liquidity ratio, lending rate and exchange rate are sourced from the World Bank Tables 2014 edition and the Central Bank of Nigeria. The scope of data is 17 years (1998-2014. This period was selected because data were available. The data were captured on a quarterly basis and data available annually were interpolated, as in Chow and Lin (1971) and Tang et al. (2008), to quarterly data for data uniformity. Thus, we have a total of 68 quarters.

4. Empirical Findings and Discussions

Lag Length

This study tested various lag lengths for different selection criteria. These include the final prediction error (FP), Akaike information criterion (AIC), Schwarz information criterion (SIC), Hannan-Quinn information criterion (HIC) and the sequential modified LR test statistic with each test at 5% level.

In line with Table 1, all the lag selection criteria selected lag length 5 as the ideal, which is utilized in the following analyses.

Table 1. Lag Length selection

VAR Lag Order Selection Criteria
Endogenous variables: GDPGR BNPL BTCR ROA BLR LEDR EXR
Exogenous variables: C
Date: 06/24/16 Time: 09:26
Sample: 1998Q1 2014Q4
Included observations: 63

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1357.52	NA	1.53e+10	43.318	43.556	43.412
1	-759.237	1044.615	413.659	25.880	27.786	26.630
2	-656.165	157.063	78.573	24.164	27.736	25.569
3	-627.423	37.450	173.575	24.807	30.046	26.868
4	-581.518	49.549	260.794	24.905	31.811	27.621
5	-245.632	287.902*	0.051*	15.798*	24.370*	19.169*

indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

5. Findings

Impulse Response Function

Response of BNPL (Bank Non-performing Loans)

We find that the GDP growth rate and exchange rate do not result in a significant response of non-performing loans. Shocks to bank total credit, return on assets, bank liquidity ratio and lending rate, however, evoke a significant response from NPLs. Similarly, the innovation to return on assets (ROA) significantly reduces the level of NPLs. Turning to the shock to the bank liquidity ratio, this evokes a significantly flat response of NPLs Finally, a lending rate shock initially significantly reduces non-performing loans before reversing again.

Response of Macro-banking Indicators to NPLs' Shock

We find that the shock to non-performing loans significantly impacts other macro-banking indicators but with varying trends. Also, the shock to NPLs did not show a significant impact on bank credit until later in the time horizon. Further, an innovation to non-performing loans has a significant impact on ROA for only a period. However, a non-performing loans' shock increases bank liquidity over a period. In addition, a shock to NPLs slowly but significantly reduces the lending rate but reverses later in the time horizon covered by our study. Finally, a shock to NPLs significantly reduces the exchange rate at a later stage of the time covered.

Variance Decomposition of BNPL (Bank Non-Performing Loans)

Under the variance decomposition of the banks' non-performing loans in Nigeria, we find that in the third quarter, it is observed that 68.8% of the variation in the level of NPLs is explained by itself. Also, the other top two variables in explaining variations in the level of NPLs are the bank total credit to the private sector and the return on assets. This influence, however, wanes in the long run.

Variance Decomposition of Exchange Rate

Conversely, we observed the variance decomposition of the exchange rate within the context of other selected variables in Nigeria. In the third quarter, it can be observed that about 11% of the variations in the exchange rate can be explained by a shock to itself. Also, shocks to the GDP growth rate, the bank non-performing loans, the bank liquidity ratio and lending rate had lower levels of explanation of the variations in the exchange rate. However, there are higher levels of explanation to the variations in the exchange rate by shocks to the bank total credit to the private sector and ROA. We also find that the impact of ROA has grown even bigger of the variations in the exchange rate, while that of NPLs and the bank liquidity ratio have also grown to the second and third highest respectively. Lending rate, exchange rate and the bank total credit have reduced in impact over the twelve quarters covered in this study. Also, the impact of the growth rate of GDP grows marginally in explaining

the variations to the exchange rate over a long-term horizon. In all, ROA consistently has the highest singular impact in the explanation of the fluctuations in the exchange rate in both the short run and the long run. In Nigeria, among the selected variables, it is the most closely related to the exchange rate.

6. Discussion

Impulse Response Function

Figures 1 and 2 represent the response of each of the variables when there is a shock from each of the other variables in the model.

Response of BNPL (Bank Non-performing Loans)

Figure 1 shows that shocks to the GDP growth rate and exchange rate do not result in a significant response of non-performing loans. This contrasts with the more popular findings such as those of Klein (2013) and Balgova, Nies, Plekhanov (2016). In his study of Central and Eastern and South-Eastern Europe (CESEE), he finds that the rise in NPLs culminates in the slowdown of the economy. Shocks to bank total credit, return on assets, bank liquidity ratio and lending rate, however, evoke a significant response from NPLs. For instance, a shock to bank total credit significantly reduces NPLs for one quarter to the second quarter when they bottom-out and start increasing significantly. This trend also slows down around the eighth quarter when it starts to flatten out. This may imply that after the initial very short-term reduction of NPLs for two quarters, from the shock to bank total credit, non-performing loans begin to increase. Over time, as the impact of the shock transmits to NPLs, non-performing loans begin to rise. A shock to the bank credit to the private sector may actually signal a boom and a lowering of lending standards, which will adversely affect the trend of NPLs in the future (Rajan, Dhal, 2003). Similarly, the innovation to return on assets (ROA) significantly reduces the level of NPLs up until the third quarter when it bottoms out and begins to increase over the period of the observation. Turning to the shock to the bank liquidity ratio, this evokes a significantly flat response of NPLs up to the fourth quarter when they begin to fall until about the eighth quarter when they start rising slowly. In theory, when the liquidity ratio rises, loanable funds receive a boost (Schnabl, 2012), which may increase NPLs. Finally, a lending rate shock initially significantly reduces non-performing loans until the second quarter when they begin to rise to the eighth quarter before reversing again. This aligns with empirical evidence that lending rate impulses tend to worsen loan repayment capacity and increase the economic burden, which makes it increasingly difficult to service obligations (Cecchetti, Kharroubi, 2015).
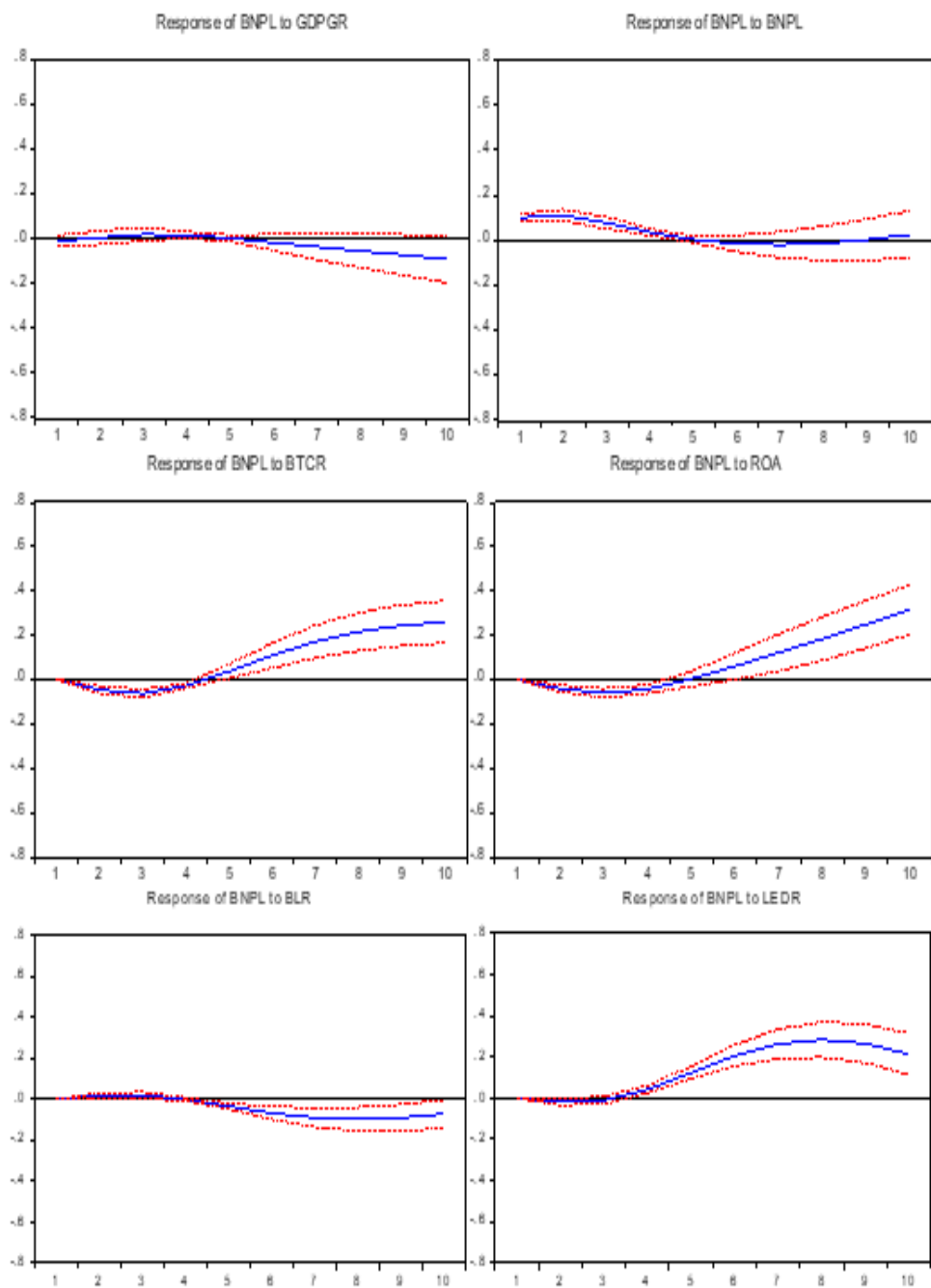
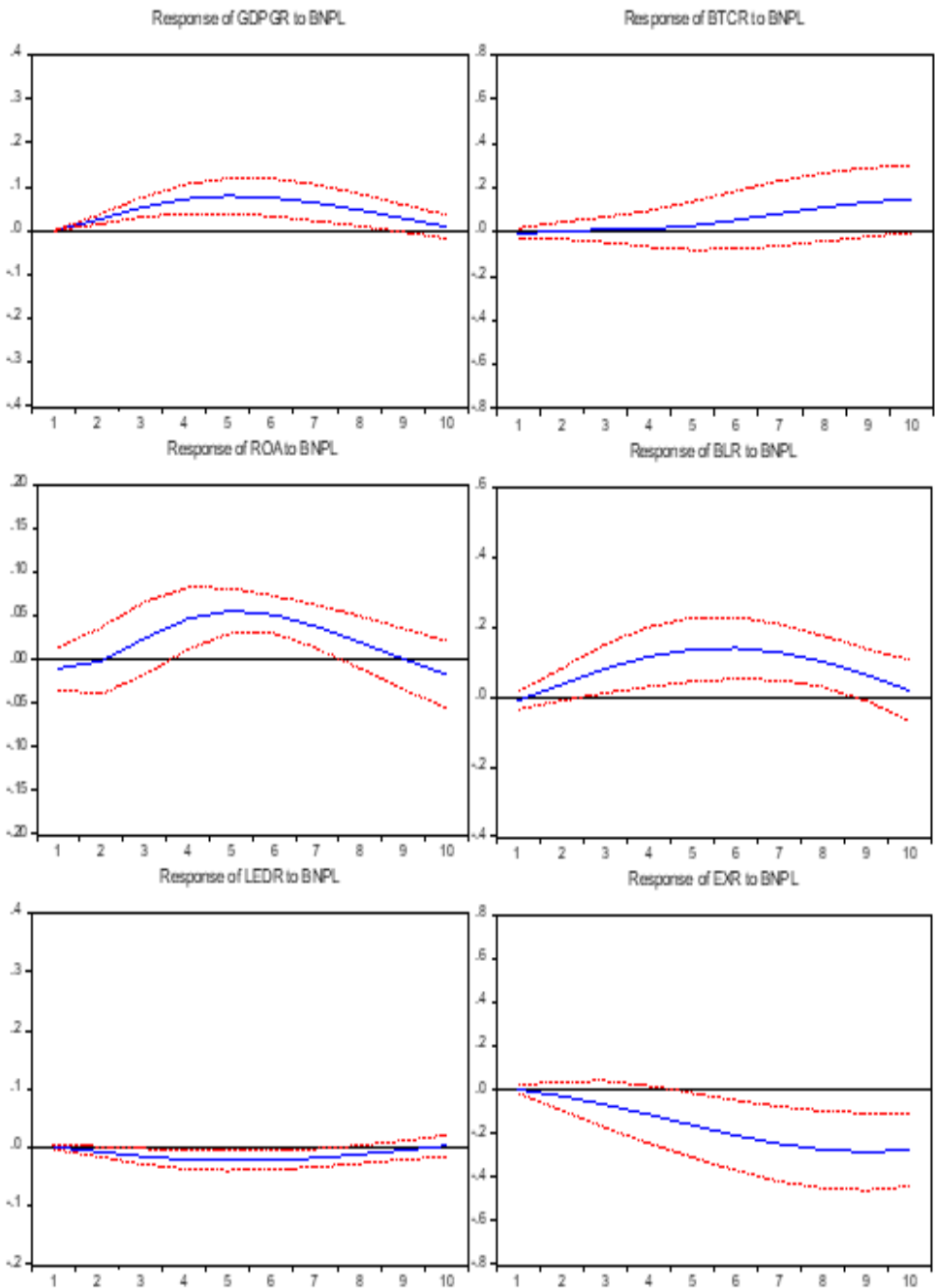Fig. 1. Response of BNPL (Bank Non-performing loans)

Response of GDPGR to BNPL

Response of BTCR to BNPL

Response of ROA to BNPL

Response of BLR to BNPL

Response of LEDR to BNPL

Response of EXR to BNPL

Fig. 2. Impulse Response of BNPL (Bank Non-performing loans)

Response of Macro-banking Indicators to NPLs' Shock

In Figure 2, we find that the shock to non-performing loans significantly impacts other macro-banking indicators but with varying trends. For instance, a 1% standard deviation shock to non-performing loans increases the GDP growth rate slowly until the fourth quarter when it begins to return to equilibrium. Previous empirical evidence and theory align with this result (Balgova, Nies, Plekhanov (2016).

Also, the shock to NPLs only shows a significant impact on bank credit (Louhichi, Boujelbene, 2016) from the tenth period by increasing it. This may occur in a situation where bank management creates more loans to cover up for the adverse impact on the profitability of previous NPLs. In the literature, when the Central Bank allows the flow concept in dealing with the treatment of NPLs, forbearance over time allows management to realize profit over time to neutralize the effect of toxic loans on the capital of the bank. In this situation, more loans are booked to realize more profit, which helps the bottom line of banks.

Also, an innovation to non-performing loans has a significant impact on ROA between the fourth and the eighth quarter but no impact in the very short and long run. An increase for a quarter, up until the fourth quarter, and a decrease thereafter towards equilibrium is the outcome of NPLs' shock on ROA. The decline is more prolonged than the increase and this may imply that ROA decreases when there is a standard deviation innovation to NPLs. This is expected since a growth in NPLs translates into a reduction in ROA, which is a function of profitability (Anastasiou, Louri, Tsionas, 2016).

However, a non-performing loans' shock increases bank liquidity from the second to the sixth quarter when it begins to decline. Also, a shock to NPLs slowly but significantly reduces the lending rate up until the fifth quarter when it begins to increase towards equilibrium. This reduction occurs in the short run and increases from the medium term to the long run. This may imply that a drop in interest is an outcome of an innovation to NPLs, which may also signal a trough in the business cycle. This situation, however, reverses in the long run. Finally, a shock to NPLs significantly reduces the exchange rate from the fifth quarter. This may imply that the domestic currency appreciates as a result of a shock to NPLs. Indeed, a growth in NPLs may signal economic hardship and this is expected to lead to currency appreciation as the demand for foreign goods falls.

Variance Decomposition of BNPL (Bank Non-Performing Loans)

Table 2 depicts the variance decomposition of the banks' non-performing loans in Nigeria. In the third quarter, it is observed that 68.8% of the variation in the level of NPLs is explained by itself. Also, the other top two variables in explaining variations in the level of NPLs are the bank total credit to the private sector (Konstantakis, Michaelides, Vouldis, 2016) and the return on assets, which account for 14.36% and 12.7%, respectively. This may imply that these variables exert influence in the variation in the level of NPLs in the short run. However, the GDP growth rate, the bank liquidity ratio, lending rate and exchange rate account for 1.27%, 1.33%, 1.2% and 0.29% of fluctuations in the level of NPLs, respectively. This may imply that the level of toxic loans in Nigeria may not be seriously influenced by these variables in the short run. By the medium term in the sixth quarter, the

lending rate has become the individual most influential variable in the explanation of fluctuations in the level of NPLs. For instance, while the NPLs level explains 23% of its own variation, the lending rate explains about 46% of the fluctuations in the level of NPLs. This influence, however, wanes in the long run since by the twelfth quarter, while 24.6% of the variations in the level of problem loans are explained by the lending rate, about 40% of the variations are then explained by the return on assets. By this period, the bank total credit to the private sector, which is one of the variables that grows in influence over the period, now accounts for about 26% in the explanation of fluctuations in the level of NPLs.

Table 2: Variance decomposition of BNPL

Period	S.E	GDPGR	BNPL	BTCR	ROA	BLR	LEDR	EXR
3	0.203	1.271	68.850	14.357	12.697	1.332	1.205	0.288
6	0.360	0.848	22.999	15.648	8.316	4.926	46.349	0.915
9	0.800	1.647	4.751	24.568	19.137	5.141	43.822	0.935
12	1.191	3.217	2.949	25.691	39.887	2.830	24.634	0.792

Source: Author's computation

Variance Decomposition of Exchange Rate

Table 3 shows the variance decomposition of the exchange rate within the context of other selected variables in Nigeria. In the third quarter, it can be observed that about 11% of the variations in the exchange rate can be explained by a shock to itself. Also, shocks to the GDP growth rate, the bank non-performing loans, the bank liquidity ratio and lending rate explain about 4.5%, 1.5%, 3.7% and 10%, respectively, of the variations in the exchange rate (Maigua, Mouni, 2016). However, there are higher levels of explanation of 23.4% and 46% to the variations in the exchange rate by shocks to the bank total credit to the private sector and ROA, respectively. It can then be inferred that in the short run, all of the selected variables explain more than 1%. By the twelfth quarter, however, the impact of ROA has grown even bigger to over 61% of the variations in the exchange rate, while that of NPLs and the bank liquidity ratio have also grown to the second and third highest of about 11% and 8%, respectively. Lending rate, exchange rate and the bank total credit have reduced in impact over the twelve quarters covered in this study. Also, the impact of the growth rate of GDP grows marginally to over 5% in explaining the variations to the exchange rate in the long run. In all, ROA consistently has the highest singular impact in the explanation of the fluctuations in the exchange rate in both the short run and the long run. In Nigeria, among the selected variables, it is the most closely related to the exchange rate.

Table 3: Exchange rate (EXR)

Period	S.E	GDPGR	BNPL	BTCR	ROA	BLR	LEDR	EXR
3	0.579	4.458	1.516	23.414	45.994	3.742	9.979	10.896
6	1.234	5.638	5.701	16.758	63.535	1.366	3.398	3.604
9	1.811	5.668	9.232	9.723	64.586	3.976	4.977	1.839
12	2.113	5.586	10.873	7.257	61.987	7.928	4.991	1.379

Source: Author's computation

7. Conclusion

This study investigates the role of non-performing loans (NPLs) in the Nigerian banking system and macroeconomy. Using a seven-by-seven matrix in the structural autoregressive model, the impulse response function (IRF) shows a long-run impact of an impulse to NPLs on the banking system and the macroeconomy. The Nigerian banking system and the economy seem to be very vulnerable to frictions in the credit market, which is occasioned by sudden movements in the level of non-performing loans as the effects of shocks on NPLs are prolonged on the banking system and the economy. Utilizing quarterly data spanning 17 years (1998-2014), results suggest the central nature of NPLs in influencing some macro-banking indicators in Nigeria. This is consistent with Nkusu (2011) and Bernanke and Gertler (1989) that a market dysfunction such as represented by NPLs can have a long-lasting effect on the macroeconomy. In Nigeria, these responses are either spontaneous or delayed. For instance, whereas responses are spontaneous in the growth rate of GDP, the liquidity ratio, and lending rate, they are delayed in the bank total credit to the private sector, return on assets and the exchange rate. Meanwhile, the NPLs' level does not significantly respond to an exchange rate shock, but responds to shocks to the GDP growth rate, the bank liquidity ratio, return on assets, lending rate and the bank total credit to the private sector. Turning to the variance decomposition, at least 5% variations in the bank liquidity ratio is consistently explained by NPLs. Similarly, only in the third quarter does the NPLs' level explain less than 5% in the variations of the return on assets and the exchange rate. In the twelfth quarter, the NPLs' level explains about 11% of the variations in the exchange rate. The impulse response and variance decomposition thus show the level of centrality of the level of NPLs in determining or influencing some macro-banking indicators employed in this study.

Hence, on policy, based on the observed importance of the lending rate, it is recommended that the effectively monitors and utilizes the Repo rate, which is the rate at which a country's central bank lends to her commercial banks and in turn, is the indicative rate for the lending rate. This occurs as the commercial banks, in turn, lend to their customers at a margin. Hence, the higher the Repo rate, the higher the lending rate. Policies should be geared towards sustaining low rates so that the economic burden of economic agents is moderated to create a scenario of enhanced ability to honour financial obligations. Households and manufacturing concerns should be encouraged to access loans at relatively low rates. Overall, the monetary authorities should assign a key role to the level of NPLs in linking the friction in the credit market to both the banking system and the macroeconomy in Nigeria.

The first limitation of this study relates to the reliability of data, particularly on NPLs arising from representative bias. This is so because BankScope publishes and aggregates for a country if data from at least four banks has been received (Breuer, 2006). Therefore, the most accurate data for NPLs are available from 1996 (Greenidge, Grosvenor, 2010; Hasan, Wall, 2004). The succor in our study, which helps mitigate this limitation, is that the data set employed starts from 1998. The second limitation relates to the use of structural variance autoregression (SVAR).The Structural VAR is the tool employed in this paper to show how variables in Nigeria behave in comparison to economic theories. Hence, the choice of apriori assumptions for the Nigerian economy may be a limitation of this study which requires further research. Further research should examine the 'true' model for Nigeria.

The main contribution of this paper is the inclusion of non-performing loans amongst variables focused on and the use of a structural variance autoregression (SVAR) model that observes how vulnerable the banking system is to the Nigerian macroeconomy.

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