CENTRAL BANK OF NIGERIA

AN ECONOMETRIC ANALYSIS OF THE IMPACT OF MACRO-PRUDENTIAL INSTRUMENTS ON THE NIGERIAN ECONOMY

Research Department
Central Bank of Nigeria
Abuja

OCTOBER, 2016

Central Bank of Nigeria
33 Tafawa Balewa Way
Central Business district
P.M.B. 0187, Garki
Abuja, Nigeria.

Website:www.cbn.gov.ng
Tel:+234(0)946235900

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CONTRIBUTORS

Charles N. O. Mordi

Michael A. Adebiyi

Adeniyi O. Adenuga

Magnus O. Abeng

Adeyemi A. Adeboye

Emmanuel T. Adamgbe

Michael C. Ononugbo

Harrison O. Okafor

Osaretin O. Evbuomwan

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Chapter One

1. Introduction

The global economy has endured several decades of intermittent financial disruptions which come with increasing sophistication of financial markets due to the growing market capitalism, rapid globalisation and innovation. Some of these notable crises were the Pes. crisis, 1994-1995; the Asian financial crisis of 1997-1998; the collapse of the Long-term Capital Management (LTCM) in late 1990s, the US speculative hedge fund in 1998; the Russian financial crisis of 1998, the Argentine crisis, 2000-02; and more recently, the global economic and financial crises, 2007-2009. All these have brought to question the efficacy of the free market doctrine in economic stability; the issue of financial stability within the framework of global boom and burst cycles; and the overt concentration of central banks on price stability as the singular objective of monetary policy.

Though the existence of macroeconomic risks for a financial system has long been documented, the depth of its ramifications was not entirely appreciated until the occurrence of the recent global financial crisis. Authorities in many countries concurred that early warning signs, which could have been gleaned from macroeconomic indicators, were ignored or entirely missed. Deteriorating financial instability from the crisis dragged the macroeconomy in many countries into crunching recessions. thus not only brought to prominence the link between macroeconomic performance and financial system stability, but also highlighted the pertinence of a macro-prudential framework that aimed at lowering the risks and the macroeconomic costs of financial instability. In Nigeria, the financial system is strategically dominated by the banking industry which accounts for over 75 per cent of all financial transactions in the country. This underscores the need to ensure that the industry remains vibrant enough to achieve economic and financial stability.

As a consequence of the weakness in financial stability, the financial system was subjected to extreme vulnerabilities and failed to effectively perform its traditional roles. Instability, therefore, connotes the inability to: efficiently and smoothly facilitate inter-temporal allocation of resources from savers to investors and the allocation of economic resources generally; assess financial risks in a forward-looking manner, price them accurately and manage them relatively well; absorb financial and real economic surprises and shocks with ease, if not smoothly (Schinasi (2006). Citing the Bank of England interim Financial Policy Committee reports, Fic (2012) broadly categorised these systemic risks into time-varying (cyclical) and structural (cross-sectional) with identified macroprudential instruments to address them.

Over the years, individual countries have introduced different macroprudential tools such as credit, liquidity and capital-related measures to dampen business cycles volatility as well as potentially enhance welfare. According to Lim *et al.,* (2011), factors such as the level of economic and financial sophistication, exchange rate regime and the economy's exposure or vulnerability to certain shocks are significant determinants of the choice of instruments. Since the instruments are not mutually exclusive and cannot be implemented on a stand-alone basis, they are optimally mixed in a way as to complement existing macroeconomic policies, influencing them to behave counter-cyclically as well as serve as "automatic stabilizers". Generally, a menu of approaches had been adopted by various countries in the implementation of macroprudential instruments. These approaches include the single versus multiple, broad-based versus targeted, fixed versus time-varying, risks versus discretion, and coordination with other policies with their accompanying merits and demerits.

Small open economies are generally susceptible to both domestic and external shocks arising from the financial system's failure to perform its functions. For example, Nigeria has suffered from spates of banking failures, volatility in financial markets, currency misalignment and

macroeconomic instability. These have resulted in the design and implementation of several reform policies, including the consolidation ofthe banking industry, 2004-2005; the expanded discount window facility; establishment of the Asset Management Company of Nigeria (AMCON) in the aftermath of the global financial crisis; and other regulatory reforms with a view to mitigating the impact of disruptions to the domestic economy.

While these developments are ongoing, there is little understanding of the channels of transmission mechanism, potential dynamic and long-run impact of these macro-prudential interventions on Nigeria's domestic economy, and, possibly, the role of monetary policy. This was a core issue as countries attempted to determine the size of quantitative easing and fiscal stimuli adopted following the global financial crisis. First, the channels of transmission to the domestic economy and timing of such policies were uncleared; second, the new direction of regulatory reforms and whether, they were capable of undermining the financial markets and strangulating recovery and growth; third, the possible spill-over effects to emerging market and developing countries was uncertain with the instance of creating overheating and a second round recession.

Globally, economies began to view macro-prudential arrangements as an essential part of monetary policy and the need to make financial stability an explicit objective. In advanced economies, a number of studies have been carried out to determine the role of macro-prudential policies as well as pre-empt their impact for purposes of putting in place optimal strategies towards minimising the damage of stringent prudential requirements and to set-up early warning signals for prompt corrective action by central banks (see Lim et al., 2011; Galati and Moessner 2014; Sinclair and Sun 2014, Angelini et al., 2012). These studies enhanced our understanding of vulnerability signals, the trigger factors that could lead to financial instability and the length of impact.

While many countries are coming to terms with the use of macro-prudential policy to address risks to financial stability, as Lim et al., (2011: p.7) notes,"the analytical and operational underpinnings of a macro prudential framework are not fully understood and the effectiveness of the instruments is uncertain".

In Nigeria, the jury is yet to be out on the trickle down path of the application of macroprudential instruments, neither are the magnitudes of impact clearly understood making the policy framework rather contingent on the prevailing conditions. Several studies such as CBN (2010) have examined the traditional channels of monetary policy transmission in Nigeria. However, given the combined use of monetary policy and macroprudential policy in recent times to achieve key objectives of monetary policy, it is quite imperative to shed light on the transmission path of macroprudential policy. This study provides a pioneering effort in this direction given the country's susceptibility to shocks such as capital flows and exchange rate volatility.

To help our understanding of the channels of transmission of macro-prudential policies and their impact, this study asks the following questions: how do macro-prudential policies transmit to the economy? What is the size of the short-and long-run impact of these policies? Does the domestic economic respond symmetrically or otherwise to positive or negative macro-prudential shocks? What can we learn for the design of monetary and financial stability measures/policies?.

In order to answer these questions, this study is focused on: i) identifying the channels of macro-prudential shocks to the domestic economy; ii) determining the size of impact through the determination of short- and long-run multipliers; iii) establishing whether or not positive and negative macro-prudential shocks have asymmetric effects; and iv) identifying key response variables that will help the design of forward-looking monetary and financial stability policies.

This study is structured into six sections. Following the introduction, section two reviews the theoretical and empirical issues related to macro-prudential policies while section three examines relevant stylised facts on macro-prudential issues in the Nigerian economy. In section four, methodology premised on structural vector autoregression framework are presented. Empirical results are discussed in Section five, while policy implications and recommendations are the focus of section six. section seven concludes the study.

Chapter Two

2. Theoretical and Empirical Literature

Grace, Hallissey and Woods (2015), highlighted the critical role of macro-prudential policy or measures in mitigating systemic risk. It was revealed that macro-prudential policies largely aim to complement regulatory oversight of individual firms and build resilience, primarily in the banking sector. It helps to dampen the volatility of the financial cycle and reduce the potential for destabilising imbalances within the financial system.

Fic (2012), considered various macroprudential policy tools and targets, and proposed a stylised framework for macroprudential policy rules. In the empirical work, two macroprudential policy rules on a countercyclical capital buffer and a loan-to-income ratio were estimated. An attempt was made to estimate pre-crisis rules that could potentially address risks emanating from the structure of bank balance sheets and the terms and conditions in which financial institutions operate.

The paper used quarterly data from the NIGEM UK banking sector model covering 1991 to 2011. A countercyclical buffer and the loan-to-income rules using error correction modeling technique were constructed. As for the countercyclical buffer rule, there was no long-run relationship between the two variables and the equation was augmented with a new variable - the rate of return on equity. A structural break was also introduced in 2007Q3 to allow for a structural change, reflecting pre-crisis period and post-crisis period, which covers the resultant increased regulation. In case of the loan-to-income ratio, a long-run relationship between the loan-to-income, real house prices and the output gap were estimated. The preliminary results posited that before the crisis, banks probably extended their capital buffers in response to higher profitability. Post crisis period, the new regulation which takes into account the

credit-to-GDP ratio as one of the important risk indicators would force banks to increase their capital levels.

In quantifying financial instability and systemic risk, which are part of the ultimate targets that macro-prudential policy attempts to address, Galati and Moessner (2011) adopted a variety of empirical approaches to quantify financial instability, which so far have had more limited value in informing policy decisions. These tools can be broadly classified into four categories: indicators of financial distress based on balance sheet and market indicators, early warning indicators, indicators based on Vector Autoregression Models (VARs), and macro stress tests.

Drehmann *et al.*, (2006), Misina and Tessier, (2008) highlighted a set of tools such as VARs for measuring financial (in) stability and capturing financial distress. These empirical models are flexible tools for forecasting and allow tracing the transmission of shocks through the economy. A variant of this approach consists of modeling the underlying joint dynamics of output growth and indicators system-wide financial risk through a factor-augmented VAR (FAVAR) model (De Nicolo' and Lucchetta, 2009). Impulse responses to structural shocks were also be useful and these can be identified by standard macroeconomic and banking theory.

Macroeconomic Assessment Group (2010) - MAG and Basel Committee on Banking Supervision (2010) - BCBS studied the macroeconomic impact of stronger capital and liquidity requirements proposed under Basel III. MAG mainly considered macroeconomic models without a financial sector: the effect of stronger capital and liquidity requirements was mainly assessed by first modeling their effects on credit spreads, economy-wide lending capacities and lending standards, and then modeling the effect of these on macroeconomic outcomes using standard semi-structural macroeconometric models or DSGE models without a banking sector; some DSGE models in which financial

intermediaries and their balance sheets are modeled explicitly were also employed in the study. In BCBS, thirteen models were considered, of which eight models incorporated a role for bank capital, and five for both bank capital and bank liquidity. The result revealed how important it was to analyse the effect of a macroprudential overlay in the form of countercyclical capital buffers proposed under Basel III.

Angeloni and Faia (2009) overtly addressed macroprudential policy within a DSGE framework. They incorporated banks into a standard DSGE model and examined three important issues: the role of banks in the transmission of shocks; the effects of monetary policy when banks are exposed to runs; and the interplay between monetary policy and Basel-like capital ratios. They found that tighter monetary policy reduces bank leverage and risk, while a productivity or asset price boom increases it. They noted that procyclical capital ratios are highly destabilizing, regardless of how monetary policy is conducted. In their model, the optimal outcome is achieved by a combination of "mildly anticyclical" capital ratios and a monetary policy rule that responds to bank leverage or asset prices. Furthermore, Angelini et al., (2010) developed a DSGE model of the euro area that incorporates a banking sector and investigated whether a countercyclical capital requirements policy can usefully interact with monetary policy in achieving an inward shift of the output-inflation volatility trade-off. They found that based on supply or financial shocks that destroy bank capital; policymakers' active management of capital requirements would improve the stabilisation of economic activity.

Analysing the interactions between monetary and macro-prudential policies and the circumstances under which such interactions demand coordinated implementation, Beau, Clerc and Mojon (2012) used a DSGE model incorporating financial frictions, heterogeneous agents and housing, for the estimation to identify the circumstances under which monetary and macro-prudential policies may have compounding,

neutral or conflicting impacts on price stability for the Euro Area, for the period 1985 to 2010. It was viewed that the implementation of macro-prudential policies would impact upon, and alters the transmission mechanism of monetary policy. The adduced reason shows that macro-prudential policies would work through the same transmission channels as monetary policy, particularly through the bank lending and the balance sheet channels in order to modify private agents' behaviour.

Investigating the interactions between monetary and macro-prudential policies, the authors considered whether alternative policy regimes influence dynamics under various economic circumstances. The paper focused on four policy regimes, namely, a "plain vanilla" Taylor rule, lean against the financial wind, independent macro-prudential policy and an augmented Taylor rule. After estimating the behavioural parameters and the stochastic structure (i.e. the relative importance of shocks), the findings revealed that the dynamics of economic variables across the four policy regimes varied.

Choi (2013) presented a tentative empirical assessment of the impacts of two macro-prudential measures introduced in Korea since 2010 - the leverage cap on banks' foreign exchange derivative positions (leverage cap) and the levy on banks' non-deposit foreign currency liabilities otherwise known as macro-prudential levy. Adopting Bayesian VAR models, the impacts of these measures were examined using data from 2003 - 2011, and their effects on banks' foreign borrowings were quantified through counterfactual analysis based on conditional forecasts. The findings from this study suggest that both macro-prudential measures have contributed to boosting resilience in the banking system, in that they have extended the maturity structure of banks' foreign liabilities. It was also revealed that the estimates for banks as a whole showed that the leverage cap reduced short-term foreign borrowings

more than long-term foreign borrowings. In addition, the parameters when domestic banks and foreign bank branches were combined indicated that the macro-prudential levy reduced banks' short-term foreign borrowings largely, leaving their long-term borrowings almost unaffected. Taken together, their results suggested that both the leverage cap and the macro-prudential levy have helped to mitigate the vulnerabilities associated with procyclical capital flows, because of their abilities to reduce maturity mismatches in the banking system.

The early contribution by Angeloni and Faia (2013) found that, in a DSGE model where banks can be subject to runs, the optimal policy mix offers some role for monetary policy to lean against asset prices or bank leverage in combination with a counter-cyclical capital buffer rule. However, the specific calibration (design and magnitude) of the macro-prudential rule determines its effectiveness in contributing to macroeconomic stabilisation. Angelini et al., (2011) likewise found that the mutual interaction of monetary policy and macro-prudential policy can be beneficial, especially during times when the economy is subject to large shocks, while a lack of coordination between the two policy functions can lead to conflicts of interest. Beau et al., (2012) in turn emphasised that the extent to which monetary policy and macro-prudential oversight conflict largely depends on the nature of the underlying shocks affecting the economy at a given juncture. Moreover, Lambertini et al., (2011) suggested that using a lean-against-the-wind monetary policy or a counter-cyclical macro-prudential policy can have different welfare implications for different economic agents (e.g. borrowers vs. lenders). Darracq et al., (2011) found that macro-prudential policy can be more effective than monetary policy in addressing destabilising flctuations in the credit markets, thereby reducing somewhat the need for monetary policy to lean against the wind.

From a research perspective, the investigation of the transmission channels of macroeconomic stabilisation policies (i.e. macro-prudential and monetary policy) has been conducted by policy makers and academia, which have made use of series of methodologies over

country-specific and cross-country cases. Literature holds that both types of policies have overlapping transmission mechanism, since they primarily work through the financial system (Antipa and Matheron, 2014).

Agenor and da Silva (2011) investigated the interactions between macroprudential policies and the monetary transmission mechanism that eventually shape macroeconomic outcomes in Brazil. The study assumed a bank-dominated financial system that captures credit market imperfections fondly found in middle-income economies[1] . A simple dynamic macroeconomic model including four agents[2] was employed and the focus of the study was on two macro-prudential polices – reserve requirements and leverage ratio.

To this end, autonomous and permanent increases in the refinance rate as well as a permanent rise in the reserve requirement were considered. The study revealed that changes in the refinance rate instantaneously increased lending rate, thereby lowering investment which tends to lower volume of bank loans. Furthermore, an increase in reserve requirements lowers deposit rate and induces households' contemporaneous consumption, thereby increasing aggregate demand and inflationary pressures. It found that macro-prudential policies have a powerful impact on macroeconomic outcomes through the cost channel[3].

Rogers (2013) studied various transmission maps through which tightening or easing of macro-prudential policies (MPIs) can facilitate the achievement of statutory prudential policy objectives of the Reserve Bank in New Zealand. Four macro-prudential indicators (MPIs) were

1 These imperfections include weak/inadequate ssupervision and limited liability to enforce prudential regulations. Barth et al (2011) attributes these imperfections largely to excessive public sector involvement in the banking system as well as inadequate pay structure. Quite importantly, the model assumes that the bank engages in costly monitoring to reduce the credit risk in its loan portfolio. This led to an endogenous determination of the risk premium in loan rates, which was shown to vary inversely with the ratio of collateral values to bank borrowing

2 The agents are the firm, the household, the commercial banks and the central bank.

3 The cost channel explained in Agenor and da Silva (2011).

considered in the study namely, adjustments to the minimum core funding rate (CFR); counter-cyclical capital buffer (CCB); sectoral requirements and high loan-to-value ratio (LVR) residential mortgage lending. In addition, monetary and micro-prudential policy settings were assumed to be present but not altered.

The study revealed that most of the MPIs would have direct impact on the financial system resilience owing to high funding and/or capital buffers, with the credit/asset price cycle being indirectly affected as a result of banks' subsequent decisions regarding price and quantity of credit. On the other hand, high LVR lending directly affects flow of credit, but results in greater financial resilience of the financial system due to stronger household balance sheets and tighter risk management. The study further investigated expectation-based effects of MPIs given that expectation plays a vital role in liquidity and capital planning, risk management and lending decisions of banks. It found that the expectation channel also brings about enhanced resilience in the financial system.

Glocker and Towbin (2012) studied the macroeconomic effects of changes in reserve requirements on the Brazilian economy particularly, domestic credit conditions, external balance and exchange rate. From a theoretical standpoint, the study identified the bank lending channel of the macroprudential tool, stating that a reserve requirement increase reduces broad money and raises the interest rate level, which should lower inflation. Employing a Vector autoregression model and identifying interest rate and reserve requirement policy shocks, the study found that, although both policy variables result in a contraction in domestic credit, reserve requirements, specifically, brings about a peak increase in the spread between lending and deposit rates, exchange rate depreciation and an improvement in the current account, as well as increases prices. On the contrary, a discretionary interest rate hike was found to lower prices, but cause an exchange rate appreciation and a deterioration of the current account[4].

4 Large and persistent current account deficits are therefore also often seen as a warning sign of building vulnerabilities (see Reinhart and Reinhart (2008)).

Building on the work of Orphanides and van Norden (2002) which assessed the reliability of real-time output gap estimates in the US, Edge and Meisenzahl (2011) questioned the reliability of the credit-to-GDP gap in real time. The study identified protecting the banking sector from periods of excess credit growth as the objective of countercyclical capital buffers and argues that excessive credit growth is well-captured by sizable deviations of the credit-to-GDP ratio above trend. Furthermore, they claimed that revisions to the underlying data used to calculate the credit-to-GDP ratio may lead to significant policy error, though they concluded that such revisions were not large in the case of the US.

Minsky (1972) and Kindleberger (1978) both argued that credit booms tend to sow the seeds of crises. In terms of empirical underpinning, several studies, including Alessi and Detken (2009), Borgy et al., (2009), Borio and Lowe (2002, 2004), Drehmann et al., (2010), Drehmann et al., (2011) and Schularick and Taylor (2012), have found that indicators of excess credit growth are powerful in providing advance signals of financial crises. Dell'Ariccia et al., (2012) found that a third of credit booms are followed by crises and three fifths are followed by a period of economic underperformance (measured by the difference between GDP growth relative to its long-run trend) in the six years following the end of the boom. And micro evidence in Mendoza and Terrones (2008) suggested that bank capital adequacy standards tend to fall during credit booms (at least in EMEs).

Capital inflows might lead to low (real) long-term interest rates which in turn might fuel excessive risk-taking via a search for yield. Borgy et al., (2009) found that a decrease in the long-term interest rate increases the probability of asset price booms. But real interest rates may also be driven by other developments, making them harder to interpret. While the real interest rate was low in the UK ahead of the current crisis, reflecting in part a global saving glut that may have contributed to the crisis

(see Bernanke (2005), Astley et al., (2009), King (2009)), this was not the case prior to the small banks' crisis.

Bank of England (2013) argued, however, that a downturn in the credit cycle alone is not sufficient for easing policy. In addition, information on banks' resilience in the form of capital adequacy and market-based indicators is required. While the former give the policymaker an understanding of banks' resilience against future losses, the latter give an indication on whether markets would allow banks to reduce their capital ratios to increase lending. Measures of banks' profitability may also be informative because profits allow banks to build capital and are their first line of defence to absorb losses.

Paoli and Paustian (2013) examined how monetary and macroprudential policies should be coordinated in the post-crisis era so as to minimize social costs of macroeconomic fluctuations with a view to shedding light on the implication of introducing a macroprudential (MP) tool. An endogenous macroprudential tool was introduced into a new Keynesian model with nominal rigidities, financial frictions, and endogenous monetary policy[5]. The findings of the study include the ability of macro-prudential policy (MP) tool to substantially improve welfare via the credit channel. Furthermore, the study concluded that the macroprudential instrument operate at a lower frequency and addresses mainly medium-term imbalances that build up slowly over time rather than shorter-term fluctuations that monetary policy typically responds to.

Lim *et al.*, (2011) analysed various macroprudential instruments frequently used in 49 selected countries with a view to identifying conditions under which macro-prudential policy would be most effective. Specifically, it identified 10 instruments[6]

5 The macroprudential tool was modeled as a cyclical tax on the borrowing of firms, thereby instigating an agency problem that captures the relationship between leverage and credit spreads as in Carlstrom and Fuerst (1997)

6 These are caps on loan-to-value (LTV) ratio, caps on the debt-to-income (DTI) ratio, caps on foreign currency lending and ceilings on credit or credit growth, limits on net open currency positions/currency mismatch (NOP), limits on maturity mismatch, reserve requirements, countercyclical/time-varying capital requirements, time-varying/dynamic provisioning, and restrictions on profit distribution.

(classified into credit-, liquidity-, and capital-relatedmeasures) frequently applied in mitigating four broad categories of risks[7], thereby, achieving macro-prudential objectives. Furthermore, it mentioned factors that influence the choice of instruments as the stage of economic and financial development, the exchange rate regime and the type of shock. Employing a panel regression technique using data from 49 countries over a 10-year period i.e. 2000 to 2010, the study revealed that the degree of economic and financial development, exchange rate regime, and size of the financial sector did not affect the effectiveness of the instruments used. The study also found that the effectiveness of various instruments did not necessarily depend on the exchange rate regime or the size of the financial sector.

Tovar *et al.*, (2012) supported this conclusion adding that in countries where the interest rate transmission channel of monetary policy is not functional, raising reserve requirements can have the same effect as that of an increase in interest rate with functional interest rate channel. The study explained that central bank could influence credit conditions and system liquidity through changes in reserve requirements in the midst of different phases of economic cycles. Specifically, during upswing phases of economic cycle, raising reserve requirement prompts banks to increase active interest rates, thereby tightening credit conditions and slowing credit activity as well as limiting excessive leverage from borrowers and vice versa[8].

7 These categories of risks include risks generated by strong credit growth and credit-driven asset price inflation; risks arising from excessive leverage and the consequent de-leveraging; systemic liquidity risks; and risk s related to large and volatile capital flows, including foreign currency lending.

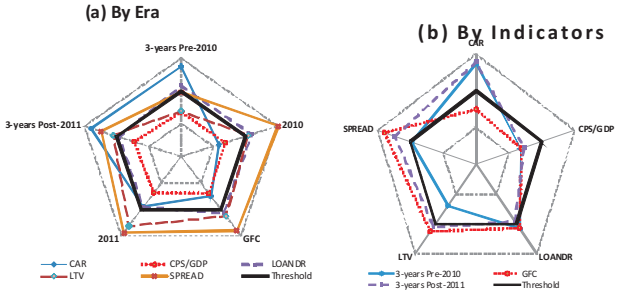
8 In the opposite phase of the cycle, during downturn, lowering reserve requirements makes it possible for the system to supply itself with accumulated liquidity reserves.

Chapter Three

3. Stylised Facts

Nigerian banks were considered fragile and weakly capitalised, prior to 2005. The banking system consolidation, which was completed in 2006, saw the emergence of better capitalised institutions. Consequently, capitalisation of the Nigerian banking industry appeared adequate in the years leading to the global financial crisis. Panels (*a*) and (*b*) of figure 1 jointly present a snapshot of the chronical outcome of prudential assessment of the Nigerian banking industry around the period of the crisis.

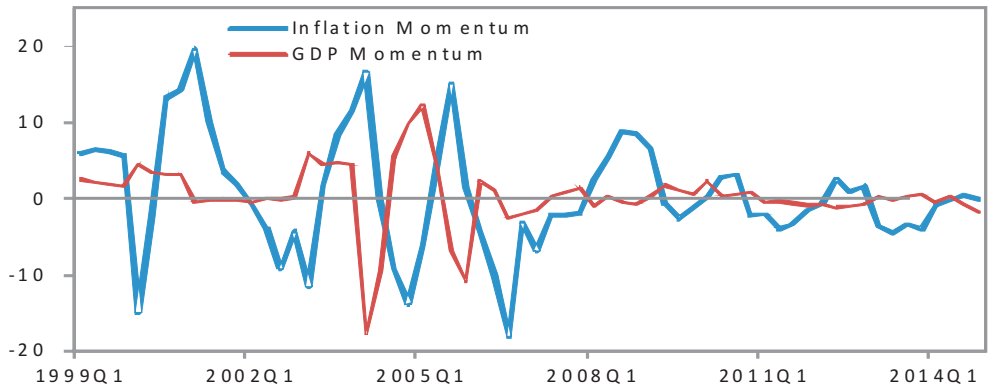
Figure 1: Prudential Assessment circa the Global Financial Crisis



The key indicators considered therein are the capital adequacy ratio, credit-to-GDP ratio, loan to deposit ratio, loan to value, and interest rate spread covering 3-years pre-2010 and 3-years post 2011. In the years before 2010, most indicators reflected benign outcomes. Only loans-to-deposit ratio surpassed its stipulated target while credit-to-GDP ratio fell short of its benchmark. During GFC, including years 2010 and 2011, the ratios had deteriorated as capital adequacy fell below its tolerance limit, credit-GDP ratio remained lower than preferred, while loan-to-deposit ratio, loan-to-value ratio, and interest rate spreads significantly overshot their respective targets. However, following a substantial bailout of the banking system by the Central bank of Nigeria and the creation of the Assets Management Company (AMCON) to assume toxic loans, some recovery was made in the industry post 2011, particularly with respect to capital adequacy ratio and loan-to-deposit ratio. Credit ratio remained critically below target while interest rate spread emerged worrisomely wide.

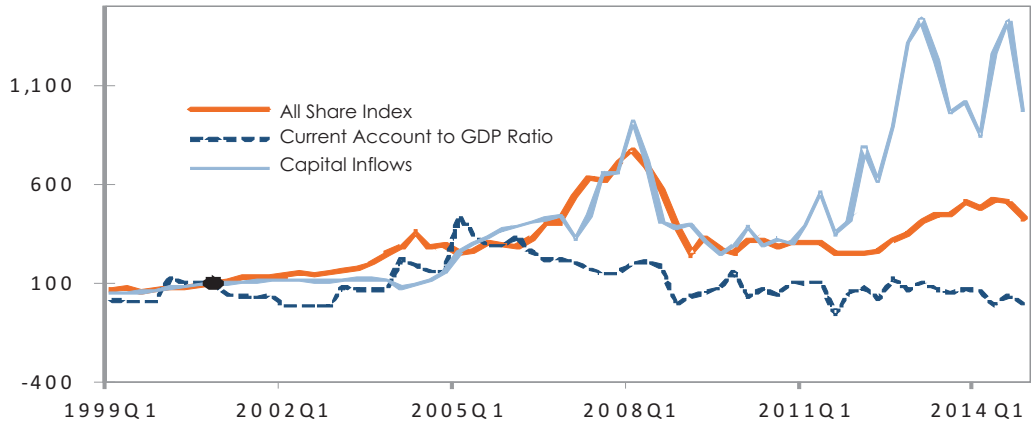
Most analysis of the health of the Nigerian banking system has been conducted without due attention to implications of macroeconomic performance. The banking system does not only support the macroeconomy, it is also highly dependent on the health of the economy. The level of performance or non-performance of credits depends on the vibrancy of the obligor sector. In many respects, banks are quick to channel credit to sector which are deemed to be booming. Hence, good economic outcome and prospects tend to bolster bank lending. The sustainability of such good performance is usually relegated at the point of processing credits and only becomes an issue when bubbles burst. The primary indicators that can be used to gauge macroeconomic risks in this respect are the rate of change of the growth rate of consumer prices (inflation momentum) and rate of change of the growth rate of output (real GDP momentum). A widely oscillating momentum could portend imminent, though undated, crisis. Figure 2 presents the inflation and real GDP momentum for Nigeria before, during and after the GFC. It indicates wide-ranged and increasing momentum ahead of the financial crisis, between 2009 and 2013 with output generally leading prices. Acceleration both in prices and output suggest considerable overheating of the economy leading to possible bubble in the financial sector, ahead of the epicentre of the financial crisis.

Figure 2: The Momentum of Prices and Output (Per cent)



The widely fluctuating momentum noticed in both variables before the crisis started to taper throughout the review period. This reflected the penchant of the banks to awash the intangible sectors with loan facilities, especially in the form of margin lending to aid equity trading in the capital market. The consequence was a more than five-fold rise in equity market capitalisation between 2004 and 2007; thus bourgeoning the bubble and heightening banks' credit risks. The emergent bubble can be easily recognised from the traverses of domestic capital market and indicators of cross border capital flows. Parenthetically, of importance are the all share index in the equity market, the current account to GDP ratio, and capital inflows. To make for clarity and comparability, these indicators, plotted in figure 3, are indexed such that their levels as at 2000:Q4 coincide with 100. This enables us to discern the rate of acceleration of the underlying variables.

Figure 3: Selected Capital Flow Indicators (2000:Q4 =100)



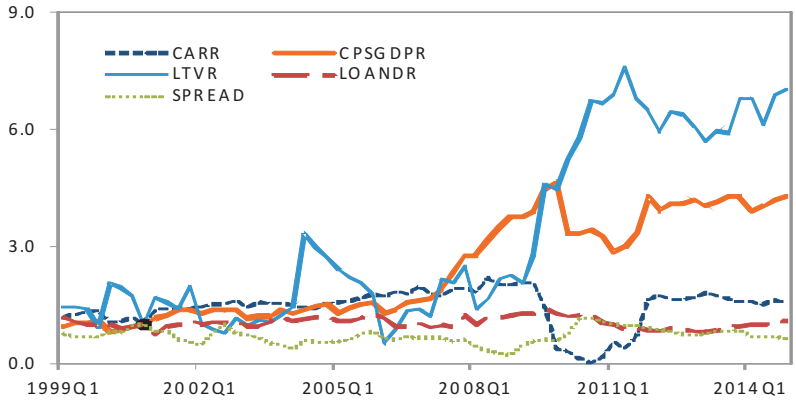
Congruent with the crux of the preceding figure, the plots in figure 3 indicate levitating bubble in the domestic financial sector in the years prior to 2008, when the effect of the global financial crisis touched down in Nigeria. From its level as at end-2000, the all share index increased nearly

six-fold by the end-2007. This was associated with a huge rise in the size of capital inflows, which rose more than seven-fold between 2000 and 2007. Together with the amplified momentum of prices and output, these could have provided early warning signal of an imminent bust in the financial system, as the banks engaged in unsustainably margin lending in the capital market. At the same time, the current account balance as a ratio of GDP maintained a steady but flattened descent, increasing the weight of the financial and capital account, and diminishing the sovereignty of the Nigerian system and escalating its susceptibility to international financial conditions.

The aftermath of this build-up is reflected in trends of some prudential ratios. In figure 4, we present the growth patterns in selected ratios indexed such that they have a common value of 1 at 2000:Q4. The chart indicates that loan-to-value comparatively outstripped other indicators over the entire sample while spread appeared the most modest of the lot. Prior to the GFC, capital adequacy ratio, credit-to-GDP ratio and loan-to-value ratio all ascended consistently from their common level at end-2000. However, while capital adequacy ratio rose slowly, the exposure ratios (loan-to-value and credit-to-GDP) increased more rapidly; suggesting the rising vulnerability of the banking system. From their level as at 2000:Q4 to the twilight of the global financial crisis, credit-to-GDP ratio and the loan-to-value ratio nearly doubled. This was in the build-up to the crisis and the bubble swelled. At the bust of the bubble, the figures deteriorated exponentially with loan-to-value rising nearly eight-fold during the crisis while credit-GDP-ratio more than quadrupled, at its peak, vis-à-vis it level at 2000:Q4. The crisis also brought about a sudden plunge in the capital adequacy ratio, which dropped precariously towards zero at its worst in 2010. This reflected the chronic weakness of the Nigerian banking industry at the time and accelerated the need for a central bank bail-out. Perhaps, because credits and deposits tend to diminish during financial crises,

given the mutually undermined confidence in both banks and banks' customers, loan-to-deposit ratio as well as the spread between the interest rates on credits and the interest rate on deposit remained comparatively muted throughout, even during the global financial crisis.

Figure 4: Some Prudential Ratios (2000:Q4 =1)

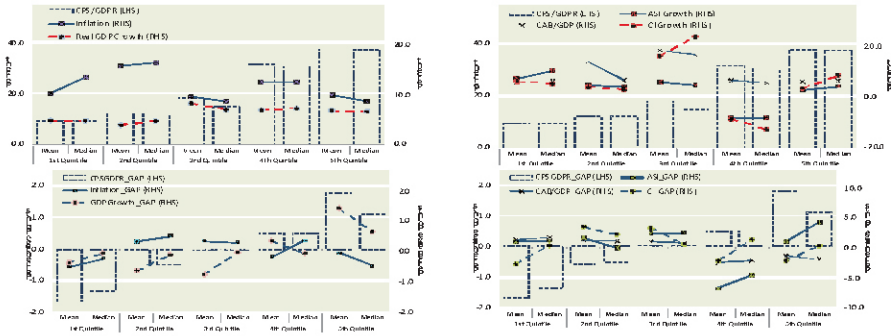


A holistic analysis of the trends in figures 2 to 4 indicates that the momentum of key macroeconomic variables (inflation and GDP) can transmit a build-up of unsustainable financial activities to the markets culminating in a crisis. The charts show that performance of the macro-indicators and prudential ratios flip-flopped and toggled on either sides of the global financial crisis. For instance, while a rapid build-up of macroeconomic heat was noticed prior to the crisis, the indicators of most prudential ratios were relatively subdued. However, during the crisis the baton changed as key prudential ratios increased rapidly whereas the macro-indicators moderated somewhat. The noticeable pattern does not suggest causality of any sort, but the existence of considerable association and correlation. It is indeed possible that the business cycle was decelerated by the financial crisis as the bubble which was supported by excessive macroeconomic expansion busted.

To understand any existing underlying association we conduct a cursory non-linear analysis of the relationship between some macro indicators and some prudential ratios. These are presented in figures 5 and 6 below. Specifically we undertake a quantile analysis of the relationship by disaggregating relevant prudential ratios in quintiles (20 percentiles) and

determining how the means and medians of the respective quintiles relate with the means and medians of corresponding macro indicators. The analysis basically relates credit-to-GDP and loan-to-value (the two dissident exposure) ratios to the macro indicator; both in their levels as well as the deviations from their long-run paths. The quantile association of credit-to-GDP ratio with inflation, GDP growth, all share index, capital flows and current account balance as a ratio of GDP is depicted in figure 5, both in levels and in gaps. The top row shows the relationship in levels while the gap analysis is presented in the bottom row.

Figure 5: Non-linear Association of Private Sector Credit to GDP Ratio with Selected Macroeconomic Indicators in Quintiles



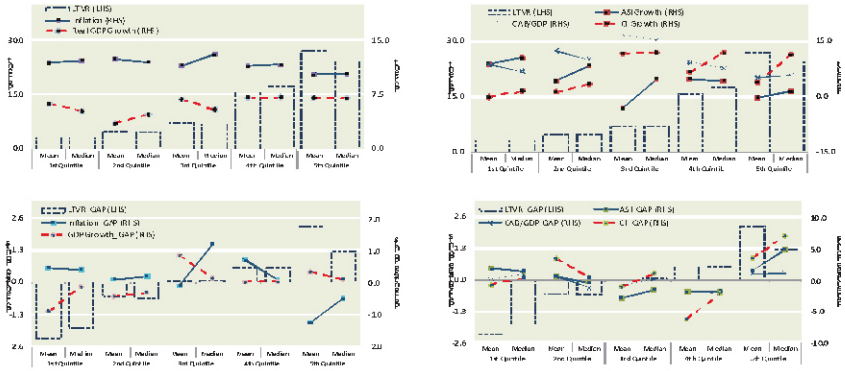
The top panels of figure 5 indicate that average output and inflation relate differently with credit-to-GDP ratio when the ratio is high vis-à-vis when it is low. Rising output growth is seen to be directly associated with high credit-to-GDP ratio. Given that GDP is the denominator of the ratio, this implies that high growth rate of GDP triggers accelerated credit expansion at a rate which outstrips the original growth in credit. This coincides with the bubble building outcome of output momentum suggested earlier in the section.

However, average inflation is seen to be higher when credit-to-GDP ratio is low. The converse outcome may be reflective of the lead role of GDP noticed in figure 1. In the bottom row, the chat shows that faster GDP growth beyond its potential tends to stoke credit creation. Again, this is congruent with the view that output momentum may hold vital information for bubbles in the credit market. For inflation, it is easily observed that the gap between actual credit and its long-run path tends to widen when inflation falls below potential. On the last quadrant of the figure 5, the lower right-hand-side chat, it can be observed that continued increases in the all share price index above its potential reflects almost directly in a widening credit gap. In contrast, positive and widening deviations of current account to GDP ratio from its equilibrium path results in a tapering of credit gaps. It is also noticeable that faster falls of capital flows below its trend is associated with widening gaps of credit from its potential.

Figure 6 also portrays similar outcomes for loan-to-value ratio. The level of loan-to-value does not appear to vary with the averages of inflation rate over the quintiles. Consumer price changes remained relatively unperturbed irrespective of whether loan-to-value ratio was high or low. However, at top percentiles of loan-to-value, average growth rate of GDP was higher than they emerged at bottom percentiles. The mean and median of loan-to-value ratio at the top percentiles are associated with lower outcomes of the averages of all-share index. Capital inflows associate directly with the averages of loan-to-value. The topmost 20 percent of the observations of average loan-to-value relates with higher inflows of capital while average current account balance is maximised at middle levels of loan-to-value. In terms of their deviations from trend, wider positive gaps tend to be associated with higher average growth rates of output. Means and medians of inflation remained largely positive irrespective of whether the average gaps of loan-to-value ratio

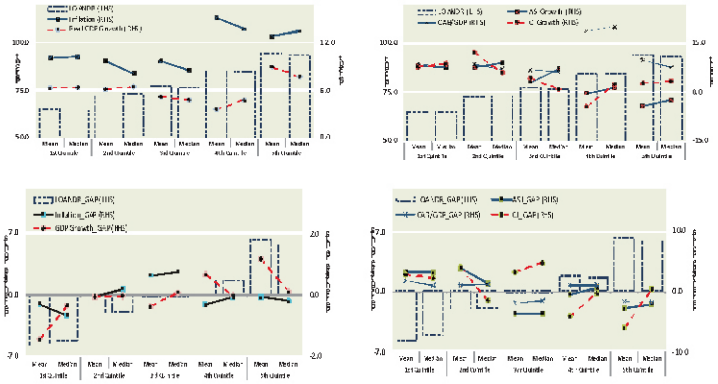
from its trend were wide or narrow. However, at the highest quintile of loan-to-value gap, average inflation was negative while it was positive at the bottom quintiles. The pattern suggested, first, that wider gaps have higher association with inflation gaps and , second, that the association can be deemed inverse.

Figure 6: Non-linear Association of Loan to Value Ratio with Selected Macroeconomic Indicators in Quintiles



All share index outstrips its trend whenever the gap between average loan-to-value ratio and its trends widen. Negative all share index gaps emerged at the middle quintiles, implying that equilibrium all share index is important for ensuring that the averages of loan-to-value ratio do not surpass their potentials. This is somewhat congruent for capital inflows and current account to GDP ratio.

Figure 7: Non-linear Association of Loan to Deposit Ratio with Selected Macroeconomic Indicators in Quintiles



Chapter Four

4. Methodology

4.1 Data and Choice of Variables

The study relied on quarterly data from 1999Q1 to 2014Q4. All gap (actual below potential growth) variables are derived using Hodrick-Prescott filter approach. The variables used in the model include: growth of real gross domestic product, rgrowth), inflation (infr), credit to the private sector to GDP ratio (cpsgdp), interest rate spread (spread), loan-to-value ratio (ltvr), loan-to-deposit ratio (loandr), capital adequacy requirement (carr) and all-share index growth (asigr). The choice of these variables was dependent on theoretically consistency and ex ante intuition of the possible channel path.

In identifying and modelling the transmission channels of macro prudential policy instruments in the Nigerian economy, this study adopts two major approaches. First, a flow chart that was constructed to show the transmission channels and the inter-linkages among the variables. Second, a model that estimates the relationships within and among the variables was developed. Consequently, some important assumptions that macro-prudential policy aims at reducing the risks in the financial sector and the broader economy were made. Again, that the goal of monetary authority is to achieve price and monetary stability which in this regards requires the use of macro-prudential instruments as a complimentary measure to achieving monetary objectives.

4.2 The Model

To remain tractable with our objectives, this paper restricts itself with identifying channels of macro prudential shocks, ascertain the nature of the response of the domestic economy to positive and negative macro prudential shocks as well as the impact (short and long-run) of macro prudential indicators on price stability.

4.2.1 Transmission Mechanism of Macro-prudential Shocks – Analytical Framework

The transmission mechanism was based on the assumption that there are three linkages through which macro-prudential policy instruments impact on monetary policy in Nigeria. These are the credit related instrument, liquidity related and the capital related instrument. Generally, macro prudential policy is designed to mitigate systemic risks and the aforementioned instruments are used to influence economic conditions in the financial sector. Thus, depending on the nature of the perceived systemic risk, central banks evaluate distortions to determine the type of instrument to deploy in managing risks.

In credit related systemic risks, such as insufficient credit in the financial system, macro prudential instruments anchored on ceilings on loan-to-value, caps on the debt-to-income ratio, caps on foreign currency lending and ceilings on credit to GDP can be used to underpin monetary policy. In other words, credit related instruments constrain a build-up of risks in the real estate and financial sector and increase banks resilience to shocks (Grace, Hallissey and Woods, 2015). Thus, banks are leveraged against possible credit crunch and credit cycle which lowers the probability of loan default. The transmission process starts with leveraging on capital (credit to private sector), which reduces the banking system loan gap and the non-performing loan. Declining non-performing loan increases the banking system asset condition that narrows both the price gap and output gap in terms of monetary policy performance. According to Beau, Clerc and Mojon (2012), this transmission channel is likened to the broad credit/balance sheet channel.

On the other hand, the liquidity related instruments of macro prudential policy requires the building of liquid asset buffers so that funding obligations can be met. Some of the measures central banks put in place includes setting limits on net open currency positions/currency mismatch, and limits on maturity mismatch and reserve requirements. The banks raise these instruments to increase liquidity in the system as a safeguard against possible liquidity related risks to avoid contagion in the financial system. The transmission channels of the liquidity instrument are anchored on two major approaches the bank lending and balance sheet channels. For instance, if the Bank raises the reserve requirement to make the banking system less liquid, this reduces the spread of banks' balance sheet and reduce loan gap. This leads to reduced financial intermediation process and more volatility in the financial system. Thus, decrease liquidity conditions reduce the resilience of the bank to banking crisis shocks and worsen macroeconomic conditions. These fundamentals are expected to widen both inflation and output gaps.

In the capital related instruments of macro prudential policy, tools anchored on time-varying capital requirements and restrictions on profit distribution are used to deal with macro prudential shocks. Nevertheless, the two channels follow similar path. For instance, an increase in the leverage ratio increases the banking system resilience to shock and positive bank balance sheets. This improves the financial system intermediation process and favourable growth in the all share index as well as national output.

4.2.2 Model Specification and Estimation Technique

In line with the above analytical framework, this study adopts the structural vector autoregression (SVAR) framework to empirically identify channels of transmission and gauge the impact of macro-prudential policy instrument on financial stability indicators and potential real sector effects.

SVAR uses economic theory to sort out the contemporaneous relationships between the variables (Sims, 1986). Following one of the frameworks adopted by Blanchard and Perotti (2002), the identification procedure is based on a Choleski orthogonalisation, with indicators of macroprudential policy ordered ahead of the risk elements and perhaps inflation and output. It is assumed that instruments of macro-prudential policy are expected to remain unresponsive to risk factors as well as real (demand and supply) factors. The identification procedure therefore follows the assumption that macroprudential policy instruments impacts the risk factors which, in turn, can impact real factors. Thus, we assume that contemporaneous impact of macro-prudential instrument, if any, on real factors will be reflected through the financial stability factors.

To enhance the understanding of evaluating the transmission channels of macro-prudential policy on monetary policy, the estimation of a VAR as proposed by Sims (1980) is paramount. The VAR representation is specified as:

$$Y_t = aY_{t-1} + bX_t + v_t \qquad (1)$$

where Y_t is the vector of endogenous variables, X_t is the vector of exogenous variables and v_t is the residual vector. In addition, ***a*** is a matrix that includes all the coefficients describing the relationships among the endogenous variables, and ***b*** is a matrix that includes all the coefficients describing the relationships among the endogenous and exogenous variables.

Transforming equation (1) to a typical reduced-form VAR as proposed by Sims (1980), in a system of equations can be written in the form:

$$Y_t = A(L)Y_{t-1} + \varepsilon_t \quad (2)$$

Where $\boldsymbol{Y_t}$ is the column vector of observations at time (t) on all variables and is known as the vector of endogenous variables. $\boldsymbol{A(L)}$ is the matrix of coefficients to be estimated and the symbol $\boldsymbol{\varepsilon_t}$ represents the column vector of random disturbances called innovations that may be contemporaneously correlated with each other and assumed to be non-auto correlated over time.

Equation (2) can be expressed further as:

$$Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + A_3 Y_{t-3} + \cdots + A_k Y_{t-p} + \varepsilon_t \quad (3)$$

Typical of a VAR model, each variable is regressed on its own lags and the lags of each of the other variables in the model to tract the interactions and feedback among the variables in the model. The VAR methodology has become a major workhorse for estimating the effects of monetary policy transmission mechanism on output and prices. However, VAR faces the challenge of finding appropriate choleski arrangement of the variables order. In other words, it does not account for theoretical relevance of the economic relationship in terms of character of the economy. Hopefully, the structural VAR aims at addressing such challenges.

4.2.3 A Structural Vector Auto Regression (SVAR) Approach[9]

In estimating the impact of macro prudential policy instrument on monetary policy in Nigeria using SVAR, the structural model of the economy is calibrated as:

$$V_0 y_t = V(L) y_{t-i} + \varepsilon_t \quad (4)$$

Where V_0 is the contemporaneous coefficient matrix; $V(L)$ is a matrix polynomial in the lag operator L, y_t is an n x 1 data vector that includes CARR, SPREAD, LTVR, INFR, RGROWTH for the capital related instrument channel; [LTVR, LOANDR, ASIGR, INFR, RGROWTH], an alternative specification of the capital related channel; [CARR, SPREAD, CPSGDPR, INFR, RGROWTH] for the liquidity related instrument, while [CPSGDPR, LOANDR, ASIGR, INFR, RGROWTH] is for the c redit related instrument channel. Where CARR, SPREAD, LTVR, LOANDR, ASIGR, INFR and RGROWTH are capital adequacy requirement, spread between the prime lending rate and the 3 -month deposit rate, loan -to-value ratio, all -share index growth rate, inflation rate and real GDP growth , respectively, while ε_t is a vector of n x 1 serially uncorrelated structural disturbances and var(ε_t) = Θ, where Θ is a diagonal matrix, so the structural disturbances are assumed to be mutually uncorrelated.

A generic form of specifying the SVAR model in equation (4) is as follow:

$$\begin{pmatrix} V_0 \end{pmatrix}\begin{pmatrix} y_t \end{pmatrix} = \begin{pmatrix} V_{1i} \end{pmatrix}\begin{pmatrix} L y_{t-i} \end{pmatrix} + \begin{pmatrix} \varepsilon_t \end{pmatrix} \quad (5)$$

One of the approaches to recover the parameters in the structural form in equation (5) from the estimated parameters in the reduced form of equation (5) is the use of recursive or Choleski factorization. This assumes Wold-chain ordering in which some variables cannot respond to other variables contemporaneously (An and Sun, 2008; Cheng, 2006). On the other hand,

9 This section benefited immensely from the work of Adebiyi and Abeng (2010) and Adebiyi and Mordi (2010a)

the non-recursive SVAR approach which maintains a contemporaneous feedback mechanism among the variables of interest albeit these two approaches are discussed below. In this consideration, we are dealing with three different instruments, thus, each of the identified instrument would be used to test for the relationships. Consequently, this identification processes would help in placing restrictions on the variables. Again, to determine the threshold of macro prudential policy instruments, sensitivity analysis would be carried out.

4.2.4 The Recursive Structure

Traditionally, VAR proposes an identification restriction based on a recursive structure known as the Choleski decomposition. This structural decomposition separates the residuals into orthogonal (uncorrelated) shocks by restrictions imposed on the basis of an arbitrary ordering of the variables. The decomposition implies that the first variable responds only to its own exogenous shocks, the second variable responds to the first variable and to the second variable's exogenous shocks and so on. The resulting structure is referred to as lower triangular matrix, where all elements above the principal diagonal are zero.

4.2.5 The Non-Recursive Structure

The second identification scheme employed in this study is the non-recursive structure. It is based on economic theory that allows contemporaneous simultaneity among the variables (see Kim and Roubini, 2000). The non-recursive identification used as the baseline identification imposes exclusion on the contemporaneous incidence of the structural shocks based on prior theoretical and empirical information about the structure of the economy. Following Cheng (2006), restrictions are imposed in equation (5) such that, all the zero restrictions follow Blanchard and Qua (1989).

4.2.6 Liquidity Related Instrument Channel

The basic model was modified with a variable that serves as a measure of the interest rate – the inter-bank rate (IBR) and monetary policy rate (MPR).

Comparing the impact of monetary policy shocks in the basic model and the extended model on output and price, would give us an idea of the importance of the channel influencing the latter variables. The modified model is represented below as:

$$X_t = CARR_t, SPREAD_t, CPSGDPR, INFR_t, RGROWTH_t \quad (6)$$

$$\begin{pmatrix} a_{11} & 0 & 0 & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 & 0 \\ a_{31} & a_{32} & a_{33} & 0 & 0 \\ a_{41} & a_{42} & a_{43} & a_{44} & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} \end{pmatrix} \begin{pmatrix} carr \\ spread \\ cpsgdpr \\ infr \\ rgrowth \end{pmatrix} = V(L) \begin{pmatrix} carr \\ spread \\ cpsgdpr \\ infr \\ rgrowth \end{pmatrix} + \begin{pmatrix} \varepsilon_{carr} \\ \varepsilon_{spread} \\ \varepsilon_{cpsgdpr} \\ \varepsilon_{infr} \\ \varepsilon_{carr} \end{pmatrix} \quad (7)$$

where $\varepsilon_{rgrowth}$, ε_{infr}, $\varepsilon_{cpsgdpr}$, ε_{spread} and ε_{carr} are structural disturbances on the respective variables. The first row in equation (7) represents *carr*, which is the exogenous factor of the model. The second row is the *spread* and is allowed to respond to shocks on *carr* alone by assuming nonzero a_{21}. The third row is the *cpsgdpr*, which depends on *carr* and *spread*. The fourth row is the *infr*. Contemporaneously, we allow rgrowth to respond to shocks on *infr*, *cpsgdpr*, *spread* and *carr*.

4.2.7 Credit Related Instrument Channel

For the credit channel, the basic model is augmented with credit to the core private sector and is presented thus:

$$X_t = CPSGDPR_t, LOANDR_t, ASIGR, INFR_t, RGROWTH_t \quad (8)$$

The matrix form of the credit channel is represented as:

$$\begin{pmatrix} a_{11} & 0 & 0 & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 & 0 \\ a_{31} & a_{32} & a_{33} & 0 & 0 \\ a_{41} & a_{42} & a_{43} & a_{44} & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} \end{pmatrix} \begin{pmatrix} cpsgdpr \\ loandr \\ asigr \\ infr \\ rgrowth \end{pmatrix} = V(L) \begin{pmatrix} cpsgdpr \\ loandr \\ asigr \\ infr \\ rgrowth \end{pmatrix} + \begin{pmatrix} \varepsilon_{cpsgdpr} \\ \varepsilon_{loandr} \\ \varepsilon_{asigr} \\ \varepsilon_{infr} \\ \varepsilon_{carr} \end{pmatrix} \quad (9)$$

The credit related instrument channel of transmission attempts to situate monitoring of credit expansion in excess of regulatory threshold. It extends the standard IS-LM construct by including quantum of loans advanced by DMBs

to ascertain DMBs' reactions to changes in policy rate. This is the kernel variable in the credit view.

4.2.8 Capital Related Instrument Channel

This channel introduces the importance of leveraging in financial institutions with a view to assessing the value vulnerabilities of the institution. In this case changes in the networth of the financial institutions can warrant adjustments in the capital requirements to restore quality of assets and offer protection to financial system. The extended model is represented by the equation below:

$$X_t = CARR_t, SPREAD_t, LTVR, INFR_t, RGROWTH_t \quad (10)$$

$$\begin{pmatrix} a_{11} & 0 & 0 & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 & 0 \\ a_{31} & a_{32} & a_{33} & 0 & 0 \\ a_{41} & a_{42} & a_{43} & a_{44} & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} \end{pmatrix} \begin{pmatrix} carr \\ spread \\ ltvr \\ inf\, r \\ rgrowth \end{pmatrix} = V(L) \begin{pmatrix} carr \\ spread \\ ltvr \\ inf\, r \\ rgrowth \end{pmatrix} + \begin{pmatrix} \varepsilon_{carr} \\ \varepsilon_{spread} \\ \varepsilon_{ltvr} \\ \varepsilon_{inf\, r} \\ \varepsilon_{carr} \end{pmatrix} \quad (11)$$

Where $\varepsilon_{rgrowth}$, $\varepsilon_{inf\,r}$, $\varepsilon_{cpsgdpr}$, ε_{spread} and ε_{carr} are structural disturbances on the respective variables. The first row in equation (10) represents *carr*, which is the exogenous factor of the model. The second row is the *spread* and is allowed to respond to shocks on *carr* alone by assuming nonzero a_{21}. The third row is the *ltvr*, which depends on *carr* and *spread*. The fourth row is the *infr*. Contemporaneously, we allow rgrowth to respond to shocks on *infr*, *ltvr*, *spread* and *carr*.

Alternatively, adjustments in the loan-to-value ratio can fuel liquidity impact that affects financial institutions loan-deposit portfolio and volatility of the value of the institution on the capital market. These interactions obviously have implications for inflation and output. Consequently, the loan-to-value ratio is exogenised in the model and its structural representation is shown as follows:

$$X_t = LTVR_t, LOANDR_t, ASIGR, INFR_t, RGROWTH_t \quad (12)$$

$$\begin{pmatrix} a_{11} & 0 & 0 & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 & 0 \\ a_{31} & a_{32} & a_{33} & 0 & 0 \\ a_{41} & a_{42} & a_{43} & a_{44} & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} \end{pmatrix} \begin{pmatrix} ltvr \\ loandr \\ asigr \\ \inf r \\ rgrowth \end{pmatrix} = V(L) \begin{pmatrix} ltvr \\ loandr \\ asigr \\ \inf r \\ rgrowth \end{pmatrix} + \begin{pmatrix} \varepsilon_{ltvr} \\ \varepsilon_{sloandr} \\ \varepsilon_{asigr} \\ \varepsilon_{\inf r} \\ \varepsilon_{carr} \end{pmatrix} \quad (13)$$

where ε_{ltvr}, ε_{loandr}, ε_{asigr}, $\varepsilon_{\inf r}$ and $\varepsilon_{rgrowth}$ are structural disturbances on the respective variables. The first row in equation (12) represents *ltvr*, which is the exogenous factor of the model. The second row is the *loandr* and is allowed to respond to shocks on *ltvr* alone by assuming nonzero a_{21}. The third row is the *asigr*, which depends on *ltvr* and *loandr*. The fourth row is the *infr*. Contemporaneously, the rgrowth is allowed to respond to shocks on *infr*, *asigr*, *loandr* and *ltvr*.

Following from the above, the impact and dynamic multipliers can be generated. Since the variables are converted into growth rates the ratio of the impulse response of real output to shock variables can be interpreted as elasticity a. The real output impact multipliers can then be obtained by dividing the elasticity by the coefficients of the structural shocks obtained from the SVAR estimates of the relevant shock variables. Peak or full impact multiplier is obtained based on the maximum accumulated structural impulse response of real output to unanticipated shock in macro-prudential instruments and dividing it by the coefficients of the structural coefficient from the SVAR estimates.

Chapter Five

5. Estimation Procedure/Implementaion

5.1 Diagnostics Test

Given the nature of the data for this study, the stochastic property of the data such as the unit root tests was explored using the Augmented Dickey-Fuller method. The results indicated that all the variables in growth form were stationary at levels except capital adequacy ratio, spread, loan to value ratio and credit to private sector that were stationary after first difference. Thus, transforming these variables aided in keeping them in the same dimension as well as to produce estimates that are meaningful for policy prescriptions.

Table 1: Result of the Unit Root Testsd

Variables	Levels	First Difference	Order of Integration
CARR	0.1166	0.0000	I(1)
Spread	0.1234	0.0000	I(1)
LTVR	0.8508	0.0000	I(1)
INFR	0.0279	0.0000	I(0)
RGROWTH	0.0000	0.0000	I(0)
LOANDR	0.0294	0.0000	I(0)
ASIGR	0.0000	0.0000	I(0)
CPSGDPR	0.8625	0.0000	I(1)

To validate the results of the SVAR, some sensitivity tests were carried out to justify the procedures and the estimates the various instruments used in measuring macroprudential shocks. The result of the lag selection criteria and the stability condition of the VAR estimates are presented in the appendix. The result indicated that lag (2) two was most appropriate for the three related instruments based on the Schwarz information criterion (SIC) and Hannan-Quinn information criterion (HQIC).

The choice of these two criteria was based on their assumptions that they perform better in VAR.

Furthermore, the stability condition also showed that none of the roots lie outside the unit circle in the three instruments used to measure macroprudential shocks on the economy. This indicates that the conditions for using VAR/SVAR for the analysis were met. Intuitively, the linkages and the impact multiplier of shocks can be properly gauged by this technique.

5.1.1 Interpreting the contemporaneous impact coefficients of capital adequacy requirement (CARR)

Table 1 incorporates quarterly data converted into ratios computed on annualized basis, that is, a variable in each quarter calculated with respect to the corresponding quarter of the previous year. The table depicts the impact of different macroeconomic variables and show that generally a one unit innovation in the reserve ratio statistically and significantly affects most of the variables adversely in the contemporaneous period. A unit increase in reserve requirement significantly affect interest rate spread positively by 0.04 units, indicating the impact of contracting monetary policy stance on interest rate spread in the economy, measured by the spread. The negative impact of reserve requirement increase on loan to value ratio and interest rate spread contemporaneously satisfies the theoretical expectations as they simultaneously worsened significantly at one per cent.

Estimation of Contemporaneous CARR Structural Parameters

$$\hat{V_o y_t} = \begin{bmatrix} -0.119* & 0 & 0 & 0 & 0 \\ 0.037* & -0.031* & 0 & 0 & 0 \\ -0.009 & -0.324* & -0.396* & 0 & 0 \\ 0.024 & 0.095* & 0.028* & -0.098* & 0 \\ -0.004 & -0.021* & -0.038* & -0.016* & -0.024* \end{bmatrix} \begin{bmatrix} \varepsilon_{carr} \\ \varepsilon_{spread} \\ \varepsilon_{ltvr} \\ \varepsilon_{inf\,r} \\ \varepsilon_{rgrowth} \end{bmatrix}$$

Note: *, **, and *** denotes significance at 1%, 5% and 10% level, respectively

A positive change in capital adequacy ratio reduces the efficiency ratio at which loans obtained by economic agents are put into use by approximately 0.04 units. In addition, interest rate spread equally exerts a positive effect on loans to value ratio and overall economic growth but a negative effect on inflation. This indicates increased cost of sourcing for operating capital under a tight monetary policy regime. Inflation is observed to negatively decrease by 0.02 units when reserve requirements increases by a unit, though not significantly. However, interest rate spread and loan to value ratio exert significant and negative effect on domestic prices. This finding affirms the traditional economic intuition of inverse correlation between inflation and interest rate.

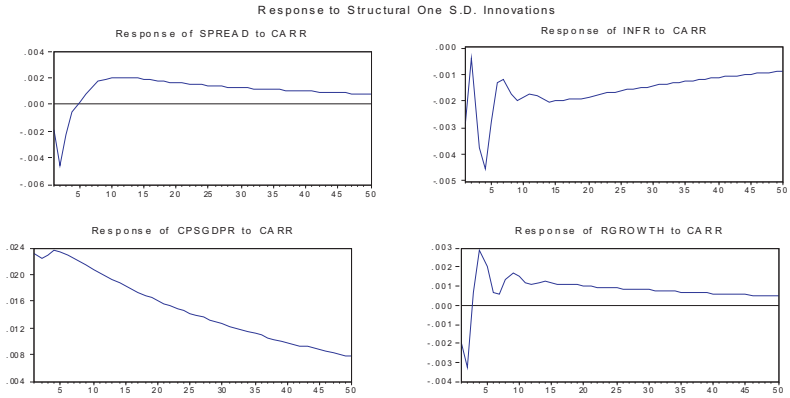
Consequently, while the influence of interest rate spread on inflation was higher as it causes it to change by 0.1 units contemporaneously, a unit change in loan to value ratio induces a negative increase of 0.03 units in inflation rate. Similarly, increases in all the variables in the model, except reserve requirements, exert statistically significant positive effect on real output growth, which is in consonance with economic literature. A unit change in reserve requirement leads to a 0.004 unit decline in real growth while interest rate spread, loan to value ratio and inflation rate cumulatively accelerates output growth by as much as 0.02, 0.04 and 0.02 units, respectively. The high coefficient of the interest rate spread is consequent upon the increasing inflation rate, which culminates in low efficiency in capital resource allocation.

5.2 Impulse Response Analysis

In Figure 8, the response of interest rate spread, inflation rate, credit to private sector growth and real growth rate to a positive one standard deviation innovation in cash reserve requirement are shown. The reaction of spread to a positive innovation in reserve requirement suggests a significant negative impact in the first five quarters in line with

theoretical expectation. It, thereafter, reversed and remained positive for the rest of the forecast horizon. The thin spread position, under an expansionary monetary policy stance, enhanced banks credit to the private sector and sharply decelerated inflationary pressure as growth in money supply is anticipated to be contained.

Figure 8: Response of innovations to a shock on CARR



In the same vein, evidence from innovation in capital adequacy ratio suggests an initial negative trending of the impact on real output growth over a period of two quarters. This decline was, however, short-lived over the preceding quarter; the effect reverted to achieve equilibrium even though it remained above the zero line throughout the forecast horizon.

Real output grew thereafter from quarter three to a crest in the first five quarters in response to policy shock and remained so for the remaining quarters of the forecast. This finding contradicts economic theory suggesting strong influence of the activities of the large informal financial sector that operates outside the purview of the monetary authority. It could also be attributed plausibly to the confidence by the economic agents and the lag associated with output growth which usually takes at least a year to respond since it is dependent on some exogenous factors. This could also be assumed to arise from the minimal engagement of the financial sector in real sector activities growth since the sector is considered the major driver of economic growth in Nigeria.

5.3 Loan to value ratio (LTVR)-Balance Sheet Approach

The matrix below presents an overview of the impacts of different macro - factors on macro prudential variables indicators and other macro variables. It can be gleaned from the result that a one - unit change in loan to value ratio (LTVR) affects itself adversely by 0.53 units. A higher LTVR depicts how riskier the loan is for a lender. Hence, the LTVR hasan inverse relationship on its own effect. A high LTVR also directly affects the flow of credit; nonetheless it results in greater financial resilience of the financial system and would require sound risk management policy from the monetary authority. The re is a positive relationship between LTVR and loan to deposit ratio (LTDR).

Estimation of Contemporaneous LTVR Structural Parameters

$$\begin{bmatrix} 0.529^{*} & & & & \\ -0.223^{*} & 0.245^{*} & & & \\ -0.135^{*} & 0.164^{*} & 0.144^{*} & & \\ -0.064^{*} & 0.053^{*} & 0.017 & 0.096^{*} & \\ 0.029^{*} & 0.016^{*} & 0.005^{*} & 0.009^{*} & 0.021 \end{bmatrix} \begin{bmatrix} \varepsilon_{ltvr} \\ \varepsilon_{loandr} \\ \varepsilon_{asigr} \\ \varepsilon_{\inf r} \\ \varepsilon_{rgrowth} \end{bmatrix}$$

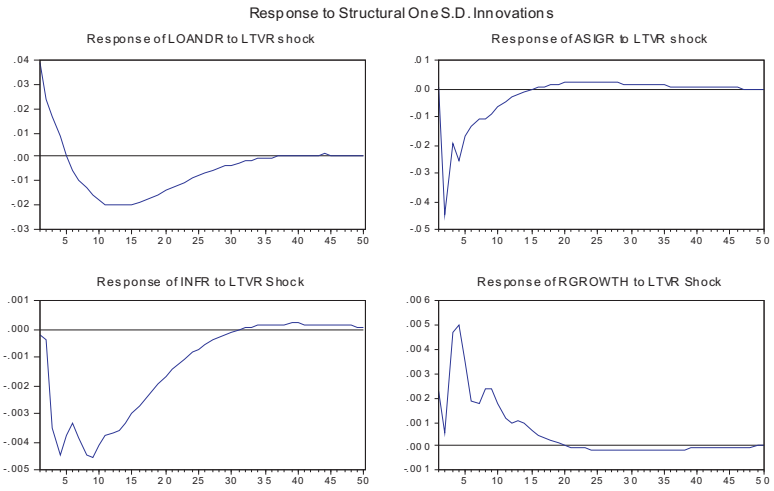
A one-unit increase in the LTVR causes a rise of 0.22 units in LTDR. If the ratio is too high, it means that banks might not have enough liquidity to cover any unforeseen fund requirements, and in fact meeting its obligations could become a herculean task. On the other hand, if the ratio is low, banks have greater leverage to lend to its customers and this may impact negatively on their earnings. Also, a unit increase in LTDR had a declining impact on itself. The result further reveals positive relationships between LTVR and ASIGR as well as between LTDR and ASIGR. However, all-share index growth had a negative impact on itself. A positive relationship was witnessed between LTVR and INFR, while LTDR, ASIGR and INFR are inversely related with 0.05, 0.02 and 0.10 units increases respectively.

The growth equation indicated negative relationships between itself and all other macrovariables with declines of 0.03, 0.02, 0.01, 0.01 and 0.02 units, respectively. This finding showed that a unit increase in real growth would have marginal impacts on LTVR (0.03), LTDR (0.02), ASIGR (0.01), INFR (0.01) and RGROWTH (0.02) itself.

5.3.1 Impulse Response Analysis of Shocks to LTVR

Figure 9 shows the responses of loan to deposit ratio and other selected macroeconomic variables to a positive one-standard error-shock of loan to value ratio. The results are the impulse responses derived from the model. It is evident that in response to a positive innovation in loan to value ratio, loan to deposit ratio falls for the first thirteen quarters and then starts improving. This evidence, in turn adversely affects the flow of credit for investment which could ultimately dampen its impact on real output growth. For the all-share index growth rate, it is observed to instantaneously decline to about two quarters in response to an increase in one standard deviation shock to the loan to value ratio. It then increased for three quarters and registered a marginal fall in the sixth quarter. This indicates that a shock to the loan to value ratio affects the stock market indicator adversely. Therefore, by extension, the corporate earnings of banks and firms would be negatively affected and with their stock returns nose-diving on the exchange.

Figure 9: Response of innovations to a shock on LTVR



With regards to the response of inflation to loan to value ratio, inflation is observed to decline for the first five quarters before rising for a short period for about three quarters. It, thereafter decline up to the tenth quarter and later increased throughout the horizon. This finding follows conventional economic logic since a positive shock to LTVR pushes more funds to the banks/firms, it is expected that inflation may react inversely to this increase in liquidity in the system but over time when it is fully absorbed, it then return to its upward movement and during the time-horizon. Real output growth responded negatively to a shock from LTVR, thereafter rose for about three quarters before declining continuously throughout the sample period.

Estimation of Contemporaneous CARR Structural Parameters (Liquidity Related)

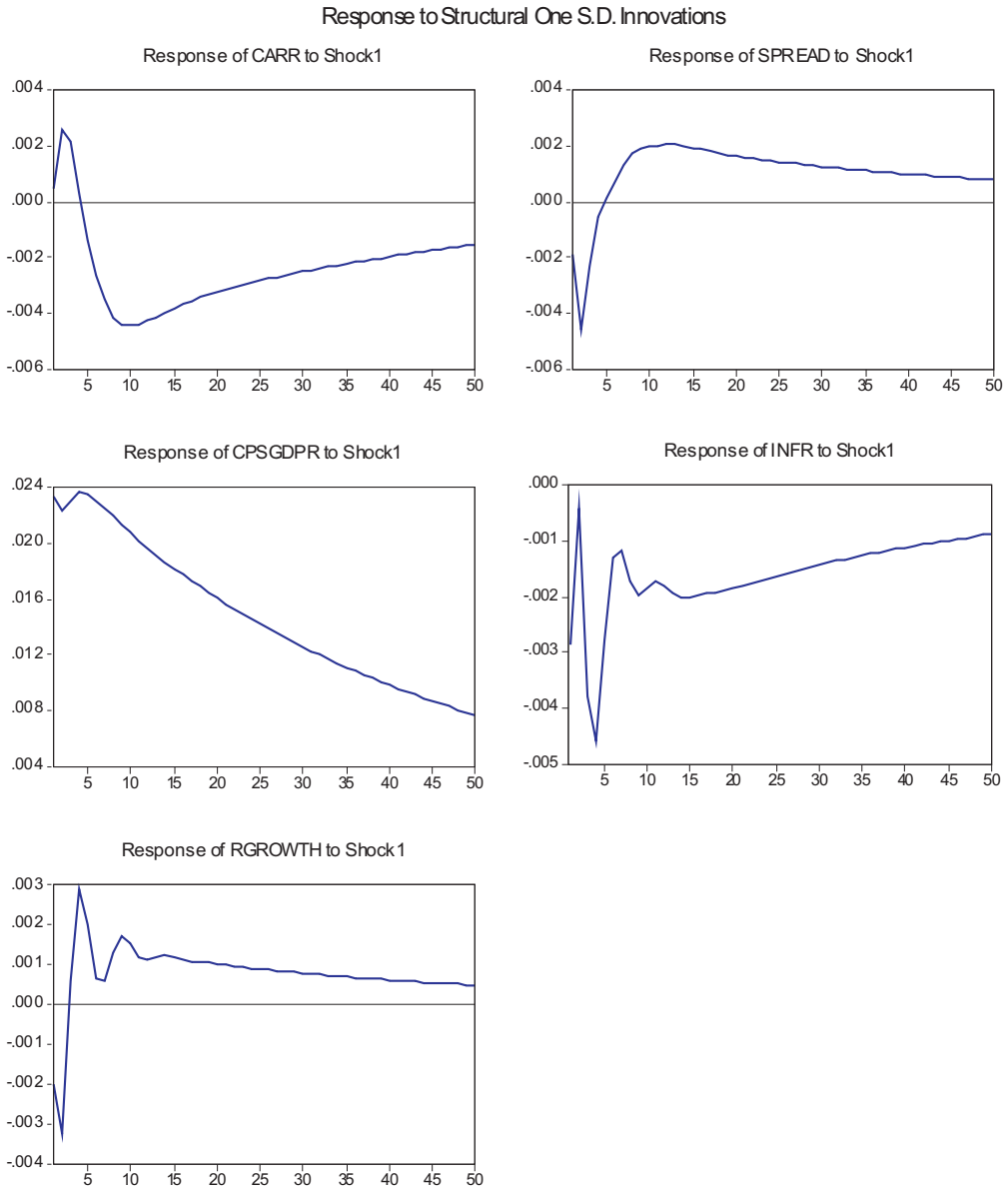
$$\begin{bmatrix} 0.182* & & & & \\ -0.083* & -0.039* & & & \\ -1.055* & -0.655* & 0.528* & & \\ 0.115* & 0.114* & -0.013 & 0.097* & \\ -0.058* & -0.033* & 0.036* & 0.015* & 0.024* \end{bmatrix} \begin{bmatrix} \varepsilon_{carr} \\ \varepsilon_{spread} \\ \varepsilon_{cpsgdpr} \\ \varepsilon_{infr} \\ \varepsilon_{rgrowth} \end{bmatrix}$$

This result represents the liquidity related channel of the transmission of macro-prudential policy instrument in the Nigerian Economy through the capital adequacy requirement ratio channel. It can be gleaned from the result that a unit increase in capital adequacy requirement ratio which implies increased liquidity in the system positively affects interest rate spread by 0.08 units. A unit increase in capital adequacy requirement ratio also positively influenced credit to private sector and growth by 1.055 and 0.058 units while its impact on inflation was negative. This implies that increase in capital adequacy ratio could help to increase liquidity in the banking system making credit to the private sector more available with multiplier effects on output and productivity of the firms, and the economy at large, while impacting negatively on inflation.

The result of the impulse response function also supports the results of the structural parameters as it shows a positive relationship between capital adequacy requirement ratio and interest rate spread, credit to private sector and output. It also corroborated the inverse relationship between the policy variable and inflation in Nigeria. In other words, the result suggests that increasing the prudential instrument dampens inflation.

From macro prudential perspective, assuming the economy shows signs of vulnerabilities of prudential shocks, raising the capital adequacy requirement ratio through the stakeholder's effort helps to increase liquidity conditions of banks, thereby making credit to the private sector available to stimulate the economy and its resilience to financial shocks and exposures, which helps to enhance the efficiency of the financial system. On the other hand, the process and magnitude of liquidity could have some inflationary tendencies. This impact on inflation, nonetheless, was counter-intuitive suggesting that the inflationary tendencies may be weakened in the process of transmitting the impulses. This implies that the threshold for appropriate capital adequacy requirement ratio must be critically determined based on the financial condition of the economy to ensure that non-inflationary output growth can be achieved.

Figure 10: Response of innovations to a shock on CARR



Estimation of Contemporaneous CPSGDPR Structural Parameters (Credit Related Channel)

$$\begin{bmatrix} 1.860* & & & & \\ -0.243* & 0.326* & & & \\ -0.478* & -0.156* & -0.138* & & \\ -0.262* & 0.034* & 0.017 & -0.097* & \\ 0.083* & 0.009* & 0.001 & -0.013* & 0.022* \end{bmatrix} \begin{bmatrix} \varepsilon_{cpsgdpr} \\ \varepsilon_{loandr} \\ \varepsilon_{asigr} \\ \varepsilon_{\inf r} \\ \varepsilon_{rgrowth} \end{bmatrix}$$

The result of the credit related instrument of macro-prudential policy in Table 5.4 shows the impact of credit to private sector on the other variables. As indicated in the preceding section, credit related instrument helps in building resilience to shocks in the banking system. It revealed that a one-unit change in credit to private sector causes loan to deposit ratio to increase by a 0.243 units. In other words, improved credit conditions in the economy reduce non-performing loans that constitute prudential risks to the economy.

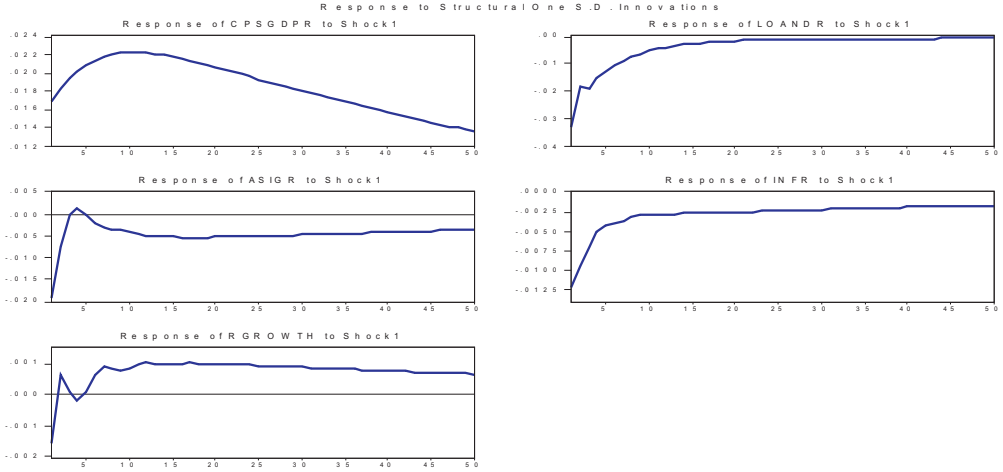
Furthermore, it can be deduced that a one-unit change in credit to private sector leads to 0.478 units increase in all share index. This result is not unexpected in Nigeria as most investors often prefer to invest in portfolio-related investment which is prone to reversal. When there is increased credit in the economy, activities in the stock exchange often pick up which requires tight prudential guidelines to manage. Thus, the intuition is that where hot money begins to maintain a steady flow in the economy, it may portend some prudential risks as it negates full financial intermediation principles. Similarly, a unit increase in credit to private sector results in 0.262 units increase in inflation, indicating that such phenomenon may be inflationary. However, the change in credit to private sector depresses output in Nigeria. This may be due to structural

challenges in the economy that underpins efficient and effective transmission of monetary policy impulses to the real sector of the economy.

Similarly, the result of the impulse response showed that a positive one standard deviation shock to credit to private sector has detrimental impact on loan to deposit ratio, all share index and inflation while output growth responded positively. This result supports the weak transmission mechanism process of the instrument indicating that if credit is not properly applied, it could constitute prudential risks to the economy.

From monetary policy and macro prudential perspectives, these results are intuitive given that available credits are often channeled to the portfolio investment window which does not to a large extent promote output performance. On one hand, such credits extended to the private sector are inflationary if not supported by appropriate policy stance. Consequently, it is necessary to determine when credit availability may constitute prudential risks. On the other hand, inadequate credit availability even engenders more pronounced prudential risks to the economy. The determination of the threshold of sufficient credit in the banking system, therefore, is more critical to ensure that the economy's resilience to vulnerable financial conditions are avoided and mitigated.

Figure 11: Response of innovations to a shock on CPSGDPR



5.4 Capital Related Instrument: Dynamic Impact

Table 2 : Dynamic effect 1

Quarter	infr to carr shock (a)	estimates of carr shock (b)	Dynamic Impact (c)=(a)/(b)	infr to spread shock (d)	estimates of spread shock (e)	Dynamic Impact (f)=(d)/(e)	infr to ltvr shock (g)	estimates of ltvr shock (h)	Dynamic Impact (i)=(g)/(h)
1	0.00120	-0.02400	-0.04979	-0.01499	-0.09500	0.15778	0.00294	-0.02800	-0.10511
2	-0.00517	-0.02400	0.21546	-0.01295	-0.09500	0.13626	0.00452	-0.02800	-0.16150
3	-0.00679	-0.02400	0.28308	-0.00831	-0.09500	0.08749	0.00632	-0.02800	-0.22557
4	-0.00601	-0.02400	0.25038	-0.00459	-0.09500	0.04832	0.00480	-0.02800	-0.17150
5	-0.00402	-0.02400	0.16767	-0.00284	-0.09500	0.02987	0.00203	-0.02800	-0.07232
6	-0.00249	-0.02400	0.10383	-0.00303	-0.09500	0.03188	-0.00009	-0.02800	0.00328
7	-0.00193	-0.02400	0.08046	-0.00373	-0.09500	0.03928	-0.00123	-0.02800	0.04389
8	-0.00172	-0.02400	0.07158	-0.00386	-0.09500	0.04067	-0.00203	-0.02800	0.07264
9	-0.00131	-0.02400	0.05454	-0.00355	-0.09500	0.03735	-0.00288	-0.02800	0.10293
10	-0.00077	-0.02400	0.03225	-0.00333	-0.09500	0.03506	-0.00357	-0.02800	0.12757
11	-0.00040	-0.02400	0.01663	-0.00335	-0.09500	0.03529	-0.00385	-0.02800	0.13736
12	-0.00024	-0.02400	0.00996	-0.00337	-0.09500	0.03545	-0.00376	-0.02800	0.13439

In table 2, it can be noticed that the response of inflation (0.0012) to a one standard deviation shock to CARR (-0.024) showed a dynamic impact multiplier of negative 5.0 per cent in quarter 1, realizing its full impact in quarter 12 with a dynamic multiplier of 1.0 per cent. Its maximum impact (-0.0068) which occurred in quarter 3 recorded a dynamic impact elasticity of 28.3 per cent.

In terms of the spread, it tend to produce 15.8 per cent dynamic impact multiplier in quarter 1 which shows that the maximum or peak effect happened in the first quarter arising from a one standard deviation innovation of -0.09. The intuition of this result is that a shock to spread would result to an increase on the average in inflation by 8.7 per cent after the second quarter. Thereafter, the dynamic impact decelerates over the next eleven quarters. This is typical of a humped shaped inflation path that responds to a short-term adjustment in the short-term interest rates.

When the loan-to-value ratio is considered, it can be discernible that when financial institutions are highly leveraged, it tends to increase their risks and their ability to undertake intermediation. Thus, in quarter one the impact on inflation (0.00294) of a one standard deviation structural innovation (-0.028) results in a dynamic multiplier of -0.10511 (negative 10.5%). On a margin, inflation will fall by 10.5 per cent after the first quarter with a full impact (-0.00376) occurring at quarter 12 with due to a -0.028 structural innovation in the loan-to-value ratio. The maximum impact (0.00632) occurs at quarter 3, leading to a dynamic multiplier of -0.2256 (negative 22.6%) implying that the dampening effect of a highly leverage financial system lingers on up to the third quarter before reversing its path.

Table 3: Dynamic effect 2

Quarter	rgrowth to carr shock	estimates of carr shock	Dynamic impact	rgrowth to spread shock	estimates of spread shock	Dynamic Impact	rgrowth to lvr shock	estimates of lvr shock	Dynamic Impact
	(c)	(b)	(c)=(a)/(b)	(d)	(e)	(f)=(d)/(e)	(g)	(h)	(i)=(c)/(h)
1	-0.00047	0.00400	-0.11850	-0.00295	0.02100	-0.14038	0.00560	0.03800	0.14734
2	-0.00092	0.00400	-0.23025	0.00087	0.02100	0.03862	0.00423	0.03800	0.11132
3	0.00167	0.00400	0.41800	0.00313	0.02100	0.14914	0.00175	0.03800	0.04613
4	0.00258	0.00400	0.64375	0.00169	0.02100	0.08067	0.00098	0.03800	0.02587
5	0.00139	0.00400	0.34750	0.00013	0.02100	0.00595	0.00187	0.03800	0.04911
6	0.00024	0.00400	0.06100	0.00044	0.02100	0.02090	0.00244	0.03800	0.06418
7	0.00019	0.00400	0.04700	0.00151	0.02100	0.07181	0.00202	0.03800	0.05305
8	0.00058	0.00400	0.14400	0.00185	0.02100	0.08786	0.00142	0.03800	0.03729
9	0.00060	0.00400	0.15075	0.00144	0.02100	0.06862	0.00134	0.03800	0.03524
10	0.00027	0.00400	0.06800	0.00108	0.02100	0.05162	0.00159	0.03800	0.04195
11	0.00000	0.00400	0.00123	0.00112	0.02100	0.05319	0.00170	0.03800	0.04482
12	-0.00002	0.00400	-0.00570	0.00127	0.02100	0.06052	0.00155	0.03800	0.04076

In terms of identifying the dynamic multipliers of macro-prudential instruments on output shows that CARR adjustment had the greatest impact on output. It showed an inertia in the first quarter with an impact of -0.00047 given a one standard deviation innovation of 0.004 showing a dynamic multiplier of -0.1185 (negative 11.9%). The maximum impact occurred in the 4th quarter with a dynamic impact elasticity of 0.64375 (64.4%) but falls thereafter.

It means that a 0.004 innovation in CARR can increase output eventually after the 4th quarter. This is quite intuitive as it reflects the lagged delay of investment. It can also be observed that in the first quarter there is a compensating effect between the spread and the loan-to-value ratio with approximately a dynamic multiplier of 14.0 per cent.

5.5 Capital Related – Alternative model

Table 4: Dynamic effect 3

Quater	infr to ltvr shock (a)	estimates of ltvr shock (b)	Dynamic Impact (c)=(a)/(b)	infr to loandr shock (d)	estimates of loandr shock (e)	Dynamic Impact (f)=(d)/(e)	infr to asigr shock (g)	estimates of asigr shock (h)	Dynamic Impact (i)=(g)/(h)
1	-0.00016	0.06400	-0.00247	0.01662	0.05300	0.31355	0.00277	-0.01700	-0.16271
2	-0.00038	0.06400	-0.00597	0.01383	0.05300	0.26096	0.00435	-0.01700	-0.25594
3	-0.00349	0.06400	-0.05455	0.01129	0.05300	0.21292	0.00415	-0.01700	-0.24406
4	-0.00444	0.06400	-0.06931	0.00749	0.05300	0.14123	0.00205	-0.01700	-0.12071
5	-0.00374	0.06400	-0.05836	0.00379	0.05300	0.07155	0.00072	-0.01700	-0.04253
6	-0.00336	0.06400	-0.05247	0.00229	0.05300	0.04326	0.00059	-0.01700	-0.03482
7	-0.00384	0.06400	-0.06003	0.00235	0.05300	0.04428	0.00086	-0.01700	-0.05082
8	-0.00447	0.06400	-0.06978	0.00225	0.05300	0.04245	0.00073	-0.01700	-0.04300
9	-0.00453	0.06400	-0.07072	0.00142	0.05300	0.02674	0.00028	-0.01700	-0.01659
10	-0.00414	0.06400	-0.06461	0.00048	0.05300	0.00909	-0.00001	-0.01700	0.00068
11	-0.00378	0.06400	-0.05902	0.00006	0.05300	0.00117	0.00001	-0.01700	-0.00081
12	-0.00365	0.06400	-0.05700	0.00006	0.05300	0.00115	0.00014	-0.01700	-0.00835

In the alternative model, in the inflation case, the loan-to-value instrument produces very weak impact on a margin, although both the loan-to-deposit ratio and all-share index growth showed significant dynamic elasticities in the first three quarters, they are generally self-offsetting. This shows the weakness of this channel of macro-prudential instrument.

Table 5: Dynamic effect 4

Quarter	rgrowth to ltvr shock	estimates of ltvr shock	Dynamic Impact	rgrowth to loandr shock	estimates of loandr shock	Dynamic Impact	rgrowth to asigr shock	estimates of asigr shock	Dynamic Impact
	(a)	(b)	(c)=(a)/(b)	(d)	(e)	(f)=(d)/(e)	(g)	(h)	(i)=(g)/(h)
1	0.00229	-0.02900	-0.07900	0.00708	-0.01600	-0.44275	0.00659	-0.00500	-1.31720
2	0.00057	-0.02900	-0.01948	0.00166	-0.01600	-0.10350	0.00120	-0.00500	0.24020
3	0.00470	-0.02900	-0.16207	-0.00227	-0.01600	0.14200	-0.00135	-0.00500	0.27080
4	0.00505	-0.02900	-0.17421	-0.00159	-0.01600	0.09963	-0.00031	-0.00500	0.06220
5	0.00350	-0.02900	-0.12052	0.00137	-0.01600	-0.08556	0.00105	-0.00500	-0.20960
6	0.00188	-0.02900	-0.06469	0.00229	-0.01600	-0.14331	0.00076	-0.00500	-0.15220
7	0.00177	-0.02900	-0.06103	0.00108	-0.01600	-0.06719	-0.00017	-0.00500	0.03380
8	0.00234	-0.02900	-0.08083	-0.00010	-0.01600	0.00618	-0.00051	-0.00500	0.10280
9	0.00240	-0.02900	-0.08290	0.00004	-0.01600	-0.00248	-0.00015	-0.00500	0.03020
10	0.00181	-0.02900	-0.06231	0.00080	-0.01600	-0.04981	0.00022	-0.00500	-0.04480
11	0.00120	-0.02900	-0.04141	0.00108	-0.01600	-0.06756	0.00019	-0.00500	-0.03820
12	0.00100	-0.02900	-0.03438	0.00075	-0.01600	-0.04706	-0.00005	-0.00500	0.01014

In the output case, the estimation outcome is apparently similar to the

Table 6: Dynamic Effect 5 (Liquidity Related instrument)

Quarter	infr to corrshock	estimates of corrshock	Dynamic Impact	infr to spreadshock	estimates of spreadshock	Dynamic Impact	infr to cpsgdprshock	estimates of cpsgdprshock	Dynamic Impact
	(a)	(b)	(c)=(a)/(b)	(d)	(e)	(f)=(d)/(e)	(g)	(h)	(i)=(g)/(h)
1	-0.00286	-0.11500	0.02488	-0.00751	-0.11400	0.06583	0.01128	0.01300	0.86777
2	-0.00042	-0.11500	0.00362	-0.01254	-0.11400	0.11003	0.00671	0.01300	0.51638
3	-0.00377	-0.11500	0.03282	-0.01164	-0.11400	0.10207	0.00552	0.01300	0.42485
4	-0.00457	-0.11500	0.03971	-0.00960	-0.11400	0.08423	0.00319	0.01300	0.24538
5	-0.00279	-0.11500	0.02426	-0.00674	-0.11400	0.05908	0.00046	0.01300	0.03523
6	-0.00130	-0.11500	0.01127	-0.00405	-0.11400	0.03550	-0.00032	0.01300	-0.02438
7	-0.00119	-0.11500	0.01035	-0.00246	-0.11400	0.02161	0.00054	0.01300	0.04177
8	-0.00173	-0.11500	0.01500	-0.00174	-0.11400	0.01525	0.00126	0.01300	0.09723
9	-0.00199	-0.11500	0.01729	-0.00121	-0.11400	0.01065	0.00105	0.01300	0.08062
10	-0.00187	-0.11500	0.01622	-0.00069	-0.11400	0.00606	0.00040	0.01300	0.03108
11	-0.00173	-0.11500	0.01501	-0.00036	-0.11400	0.00316	0.00000	0.01300	-0.00005
12	-0.00179	-0.11500	0.01555	-0.00034	-0.11400	0.00296	-0.00009	0.01300	-0.00686

In the above liquidity related instrument, adjustment in the CARR is more likely to operate through the CPSGDPR through the liquidity effects it generates and producing an elevation of prices by creating a liquidity surfeit in the first 4 quarters. This however, dies off with the full impact in the 12th quarter dampening inflation. This appears to be too long a period for inflation, but importantly, there is a path to a deceleration process.

Table 7: Dynamic Effect 6

Quarter	rgrowth to car shock (a)	estimates of car shock (b)	Dynamic Impact (c)=(a)/(b)	rgrowth to spread shock (d)	estimates of spread shock (e)	Dynamic Impact (f)=(d)/(e)	rgrowth to cpsgdpr shock (g)	estimates of cpsgdpr shock (h)	Dynamic Impact (i)=(g)/(h)
1	-0.0020	0.0580	-0.0342	-0.0034	0.0330	-0.1024	0.0073	-0.0360	-0.2019
2	-0.0033	0.0580	-0.0562	-0.0014	0.0330	-0.0439	0.0024	-0.0360	-0.0678
3	0.0006	0.0580	0.0108	0.0005	0.0330	0.0162	-0.0026	-0.0360	0.0711
4	0.0029	0.0580	0.0498	0.0013	0.0330	0.0386	-0.0024	-0.0360	0.0668
5	0.0020	0.0580	0.0350	0.0005	0.0330	0.0152	0.0004	-0.0360	-0.0119
6	0.0007	0.0580	0.0119	-0.0004	0.0330	-0.0126	0.0018	-0.0360	-0.0490
7	0.0006	0.0580	0.0108	-0.0004	0.0330	-0.0109	0.0010	-0.0360	-0.0274
8	0.0013	0.0580	0.0231	0.0003	0.0330	0.0104	0.0000	-0.0360	-0.0001
9	0.0017	0.0580	0.0297	0.0008	0.0330	0.0253	0.0000	-0.0360	-0.0009
10	0.0015	0.0580	0.0263	0.0008	0.0330	0.0255	0.0006	-0.0360	-0.0177
11	0.0012	0.0580	0.0208	0.0007	0.0330	0.0206	0.0010	-0.0360	-0.0268
12	0.0011	0.0580	0.0194	0.0007	0.0330	0.0201	0.0008	-0.0360	-0.0230

On output, the impact appears to be insignificant and reduces the strength of this channel of macro-prudential instrument.

Table 8: Dynamic Effect 7 (Credit Related Instrument)

Quarter	infr to cpsgdpr shock (a)	estimates of cpsgdpr shock (b)	Dynamic Impact (c)=(a)/(b)	infr to loandr shock (d)	estimates of loandr shock (e)	Dynamic Impact (f)=(d)/(e)	infr to asigr shock (g)	estimates of asigr shock (h)	Dynamic Impact (i)=(g)/(h)
1	0.01223	0.26200	0.04669	0.00940	-0.03400	-0.27656	-0.00573	-0.01700	0.33694
2	0.00957	0.26200	0.03651	0.00887	-0.03400	-0.26100	-0.00265	-0.01700	0.15588
3	0.00689	0.26200	0.02629	0.00393	-0.03400	-0.11562	-0.00303	-0.01700	0.17829
4	0.00513	0.26200	0.01959	-0.00006	-0.03400	0.00184	-0.00247	-0.01700	0.14512
5	0.00435	0.26200	0.01658	-0.00074	-0.03400	0.02162	-0.00127	-0.01700	0.07471
6	0.00400	0.26200	0.01527	0.00043	-0.03400	-0.01259	-0.00025	-0.01700	0.01482
7	0.00365	0.26200	0.01393	0.00094	-0.03400	-0.02759	-0.00010	-0.01700	0.00576
8	0.00326	0.26200	0.01244	0.00028	-0.03400	-0.00818	-0.00036	-0.01700	0.02100
9	0.00300	0.26200	0.01144	-0.00048	-0.03400	0.01421	-0.00043	-0.01700	0.02535
10	0.00292	0.26200	0.01113	-0.00054	-0.03400	0.01579	-0.00021	-0.01700	0.01259
11	0.00291	0.26200	0.01111	-0.00013	-0.03400	0.00368	0.00001	-0.01700	-0.00041
12	0.00287	0.26200	0.01097	0.00014	-0.03400	-0.00409	0.00004	-0.01700	-0.00233

Table 9: Dynamic Effect 8 (Credit Related Instrument)

Quarter	rgrowth to cpsgdpr shock (a)	estimates of cpsgdpr shock (b)	Dynamic Impact (c)=(a)/(b)	rgrowth to loandr shock (d)	estimates of loandr shock (e)	Dynamic Impact (f)=(d)/(e)	rgrowth to asigr shock (g)	estimates of asigr shock (h)	Dynamic Impact (i)=(g)/(h)
1	0.00159	-0.08300	-0.01912	0.00373	-0.00900	-0.41467	0.00180	-0.00100	-1.80300
2	0.00064	-0.08300	-0.00767	-0.00234	-0.00900	0.26000	-0.00383	-0.00100	3.82500
3	0.00007	-0.08300	-0.00089	0.00020	-0.00900	-0.02244	0.00035	-0.00100	-0.35100
4	-0.00016	-0.08300	0.00195	0.00364	-0.00900	-0.40444	0.00109	-0.00100	-1.09100
5	0.00007	-0.08300	-0.00090	0.00408	-0.00900	-0.45356	0.00065	-0.00100	-0.64700
6	0.00065	-0.08300	-0.00783	0.00164	-0.00900	-0.18211	-0.00047	-0.00100	0.46700
7	0.00092	-0.08300	-0.01106	-0.00016	-0.00900	0.01778	-0.00059	-0.00100	0.59000
8	0.00086	-0.08300	-0.01034	0.00002	-0.00900	-0.00219	-0.00005	-0.00100	0.05110
9	0.00076	-0.08300	-0.00910	0.00095	-0.00900	-0.10522	0.00032	-0.00100	-0.32200
10	0.00081	-0.08300	-0.00972	0.00114	-0.00900	-0.12656	0.00020	-0.00100	-0.19800
11	0.00094	-0.08300	-0.01137	0.00056	-0.00900	-0.06189	-0.00008	-0.00100	0.08100
12	0.00102	-0.08300	-0.01230	0.00003	-0.00900	-0.00323	-0.00015	-0.00100	0.15300

In the credit related instrument of macro-prudential policy, the dynamic multipliers are also insignificant, especially if CPSGDPR should be used as a macro-prudential instrument. Little impact is observed for both inflation and GDP growth.

From the above, it can be inferred that the capital related model of macro-prudential policy fits the data better and is more tractable than the other channels estimated.

Chapter Six

6. Policy Implications and Recommendations

One of the key policy objectives of the Central Bank of Nigeria is to promote and maintain a safe and sound financial system that can enhance overall macroeconomic development. Against the implications of the findings on the impacts of macro-prudential policy shocks on the economy, there are some important intuitions that can be gleaned with potential attributes that can inform management decisions on policies aimed at guaranteeing a safe and sound financial system. First, it highlights the importance of macro-prudential measures in ensuring the soundness of the entire financial system. Second, the paper identified the key channels and measures their potential impacts on the economy-wide range. Third, the papers succinctly relate the impact of shocks to these macro-prudential instruments on the stability of the entire financial system. Above all, adverse shocks to these variables can be very costly if substantial prov

Consequently, the three key channels: capital, credit and liquidity provide eclectic mechanisms for tracking the dynamics of capital adequacy ratio, loan to value and liquidity in the banking system, respectively on the health of the economy. Therefore, this paper suggests among other things that;

i) From time to time, macro-prudential analysis should be carried out to keep an eye to the behaviour of these important variables and other variables that affect the prudential variables and guidelines.
ii) There is the need to link these prudential variables to on-site and off-site supervision by the bank examiners.

iii) A Macro-prudential Unit or Office or desk should be set up to systematically monitor these critical variables; and

iv) There is the need to strengthen both micro and macro-prudential based supervision to forestall systemic risks that can spillover the economy and mitigate such risks with appropriate prudential guidelines.

6. 1 Conclusion

This paper has examined the transmission channel of macro-prudential policy instrument on the Nigerian economy. It attempted to identify the links and how the shocks (impulses) from these prudential instruments are transmitted to the economy. Following a critical search of the literature on the subject, three key channels have been identified: the capital, credit and liquidity channels. Using a structural VAR (SVAR) framework to examine the impact of macro-prudential shocks based on the identified channels, the result depicts the impact of different macroeconomic variables and show that generally a one unit innovation in the reserve ratio statistically and significantly affects most of the variables adversely in the contemporaneous period.

Specifically, it is found that the loan to value which is the credit channel is the main link in which prudential weakness can trigger systemic crisis in Nigeria. for instance, a unit increase in reserve requirement significantly affect interest rate spread positively by 0.04 units, indicating the impact of contracting monetary policy stance on interest rate spread in the economy, measured by the spread. The negative impact of reserve requirement increase on loan to value ratio and interest rate spread contemporaneously satisfies the theoretical expectations as they simultaneously worsened significantly at one per cent. This indicates that a shock to the loan to value ratio affects the stock market indicator adversely and by extension, the corporate earnings of banks and firms would be negatively affected.

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Appendices

Appendix 1: Model 1

Roots of Characteristic Polynomial

Endogenous variables: CARR SPREAD LTVR INFR RGROWTH

Root	Modulus
0.881172 - 0.078453i	0.884657
0.881172 + 0.078453i	0.884657
0.214688 - 0.693991i	0.726440
0.214688 + 0.693991i	0.726440
0.621042	0.621042
0.412937 - 0.325191i	0.525611
0.412937 + 0.325191i	0.525611
0.214353 - 0.162028i	0.268702
0.214353 + 0.162028i	0.268702
0.068167	0.068167

No root lies outside the unit circle.

VAR satisfies the stability condition.

Appendix 2:

Endogenous variables: CARR SPREAD LTVR INFR RGROWTH

Lag	LogL	LR	FPE	AIC	SC	HQ
0	537.3806	NA	1.00e-14	-18.04680	-17.87074	-17.97807
1	686.8893	268.6088	1.47e-16	-22.26743	-21.21106*	-21.85507*
2	716.8501	48.74980*	1.27e-16*	-22.43560	-20.49891	-21.67959
3	739.0415	32.34683	1.46e-16	-22.34039	-19.52339	-21.24075
4	768.1515	37.49758	1.40e-16	-22.47971	-18.78240	-21.03643
5	795.3262	30.39880	1.53e-16	-22.55343*	-17.97581	-20.76651

Appendix 3: Model 2:

VAR Lag Order Selection
Criteria
Endogenous variables: CARR SPREAD LTVR INFR
RGROWTH

Lag	LogL	LR	FPE	AIC	SC	HQ
0	357.7530	NA	3.59e-12	-12.16390	-11.98627	-12.09471
1	471.0802	203.2075*	1.71e-13*	-15.20966*	-14.14392*	-14.79453*
2	494.2595	37.56649	1.86e-13	-15.14688	-13.19301	-14.38581
3	510.7465	23.87772	2.62e-13	-14.85333	-12.01134	-13.74632
4	534.7452	30.61898	3.00e-13	-14.81880	-11.08869	-13.36585
5	561.2577	29.25512	3.37e-13	-14.87095	-10.25272	-13.07206

* indicates lag order selected by the
criterion

Appendix 4

Roots of Characteristic Polynomial

Endogenous variables: LTVR LOANDR ASIGR INFR RGROWTH

Root	Modulus
0.902025 - 0.091218i	0.906625
0.902025 + 0.091218i	0.906625
0.251597 - 0.727538i	0.769813
0.251597 + 0.727538i	0.769813
0.643668	0.643668
0.343465	0.343465
-0.272228 - 0.075757i	0.282573
-0.272228 + 0.075757i	0.282573
0.015011 - 0.084040i	0.085370
0.015011 + 0.084040i	0.085370

No root lies outside the unit circle.

VAR satisfies the stability condition.

Appendix 5 Model 3

VAR Lag Order Selection

Criteria

Endogenous variables: CARR

SPREAD CPSGDPR INFR

RGROWTH

Lag	LogL	LR	FPE	AIC	SC	HQ
0	520.0367	NA	1.80e-14	-17.45887	-17.28281	-17.39014
1	705.9361	333.9888	7.73e-17	-22.91309	-21.85671*	-22.50072*
2	734.1881	45.96933	7.05e-17*	-23.02333	-21.08664	-22.26732
3	754.3217	29.34722	8.72e-17	-22.85836	-20.04136	-21.75872
4	787.0844	42.20285*	7.36e-17	-23.12151	-19.42419	-21.67822
5	817.9903	34.57273	7.08e-17	-23.32171*	-18.74408	-21.53479

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

Appendix 6

Roots of Characteristic Polynomial

Endogenous variables: CARR SPREAD CPSGDPR INFR RGROWTH

Root	Modulus
0.975793	0.975793
0.718371 - 0.176179i	0.739660
0.718371 + 0.176179i	0.739660
0.244625 - 0.684501i	0.726899
0.244625 + 0.684501i	0.726899
0.619342	0.619342
0.105153 - 0.317136i	0.334114
0.105153 + 0.317136i	0.334114
0.165503 - 0.038107i	0.169833
0.165503 + 0.038107i	0.169833

No root lies outside the unit circle.

VAR satisfies the stability condition.

Appendix 7: Model 4

Endogenous variables:

CPSGDPR LOANDR ASIGR

INFR RGROWTH

Lag	LogL	LR	FPE	AIC	SC	HQ
0	351.9223	NA	4.39e-12	-11.96284	-11.78522	-11.89365
1	490.4927	248.4709	8.77e-14	-15.87906	-14.81331*	-15.46393*
2	514.8041	39.40125	9.16e-14	-15.85531	-13.90144	-15.09424
3	536.7454	31.77710	1.07e-13	-15.74984	-12.90785	-14.64283
4	564.6341	35.58218	1.07e-13	-15.84945	-12.11934	-14.39650
5	600.7274	39.82706*	8.65e-14*	-16.23198*	-11.61374	-14.43308

Appendix 8

Roots of Characteristic Polynomial
Endogenous variables: CPSGDPR LOANDR ASIGR INFR RGROWTH
Exogenous variables: C
Lag specification: 1 2
Date: 06/04/15 Time: 12:03

Root	Modulus
0.985770	0.985770
0.811987	0.811987
0.258425 - 0.717921i	0.763016
0.258425 + 0.717921i	0.763016
0.652653	0.652653
-0.355298 - 0.037949i	0.357319
-0.355298 + 0.037949i	0.357319
0.195434 - 0.127909i	0.233571
0.195434 + 0.127909i	0.233571
0.044250	0.044250

No root lies outside the unit circle.
VAR satisfies the stability condition.