The Central Bank Balance Sheet as a Tool for Monetary Policy: Evidence from Nigeria

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Abstract

The study examined the impact of the Central bank of Nigeria's (CBN) balance sheet on the growth of private sector credit, economic growth and price stability during the period 2006-2017. Balance sheet indicators used were total assets of the CBN and proxy for asset distribution. Employing a vector autoregressive (VAR) model, the study found balance sheet policies to be effective in reducing cost of credit, increase in bank lending, economic activities and a decline in inflation. However, the effects favour asset dispersion (credit easing) against growth in assets (quantitative easing), implying that the Bank can, in the short- to medium-term, sustain its intervention programmes on the economy, but that the programmes, are more effective when the CBN acts as a banker's bank.

I.   Introduction

The impact of central bank's interest rate policy on output and inflation is predictable from the traditional interest channel of monetary policy transmission. Traditional monetary policy generally involves measures to signal desired movement in interest rates through the monetary policy rate, while liquidity management operations are designed to help in ensuring that: the rate is effective and the short-term interbank rate tracks the policy rate. The efficacy of such "interest rate policy" is, however, challenged when the economy is found at the liquidity trap region, although not considered by Mishkin (1996) and Krugman (2000) to be true, since central banks can still influence economic activities by sufficiently lowering real rates of interest.

The Global financial crises of 2007/2009 brought forth a chapter in the history of central banking, creating the path for unconventional monetary policy (UMP), to influence otherwise, dysfunctional financial markets. UMP literarily expands the central bank's balance sheet, and/or shifts its asset portfolio holdings to non-

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treasuries that ultimately expose the Bank's balance sheet to different market risks (Caruana, 2012). Although intended initially to repair the monetary policy transmission mechanism by ensuring depth and liquidity in financial markets, and impacting different segments of the yield curve, the focus of the UMP has shifted to achieving inflation targets, and stimulating the real economy(Fawley and Neely, 2013).

The types, details and scale of unconventional monetary policies vary across countries (Javier and Enrique, 2014). However, analysis of their economy-wide effects has concentrated largely on actions of leading central banks, such as the Federal Reserve, Bank of England, European Central Bank and the Bank of Japan (Andrew and Jouchi, 2018). Some have looked at the spill overs on capital flows, asset prices, yields, exchange rates and macroeconomic performance in other countries, including Chen et al., (2012); Tatiana (2013); Carrera et al., (2015); Borrallo et al., (2016), and Fratzscher et al., (2016). Yet, assessment of quantitative effects of non-traditional monetary policy, to the best our knowledge, is the least discussed in Nigeria. This is an essential gap, in the literature, considering efforts of the Central Bank of Nigeria (CBN) at correcting financial market distortions, through non-traditional monetary policy measures, since the 2007. The Bank has intervened in the foreign exchange market and participated in the development of money and capital market institutions. It has created an expanded discount window (EDW) for banks with liquidity challenges after the bank consolidation exercise and injected Tier II capital, amounting to ₦620.0 billion into troubled banks in 2008. The Bank also did the following reduced its monetary policy rate to 6.0 per cent in July 2009, from an all-time high of 20.5 per cent in 2002 to ease liquidity flow into banks and the economy, facilitated the establishment of an Asset Management Corporation of Nigeria (AMCON) in 2010 for the purchase of banks' toxic assets; purchased government securities; and has either directly intervened in real sector production, extended or guaranteed substantial credit to banks for such purpose[1].

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[1]Real sector intervention programs that comprise the ₦200 billion Commercial Agriculture Credit Scheme (CACS); Real Sector Support Facility (RSSF); Small and Medium Enterprises Credit Guarantee Scheme (SMECGS); Small and Medium Enterprises Re-structuring and Refinancing Facility (SMERRF); Agribusiness/ Small and Medium Enterprises Investment Scheme (AGSMEIS); Micro, Small and Medium Enterprises Development Fund (MSMEDF); Nigeria Incentive-based Risk Sharing System for Agricultural Lending (NIRSAL); National Food Security Programme (NFSP); ₦300 billion Power and Airline Intervention Fund (PAIF); Nigeria Electricity Market Stabilisation Fund (NEMSF); Paddy Aggregation Scheme (PAS); Non-oil Export Stimulation Facility (NESF); Anchor Borrowers' Programme (ABP); Accelerated Agricultural Development Scheme (AADS); Textile Sector Intervention Facility (TSIF); Non-oil Export Stimulation Facility; Youth Entrepreneurship Development Programme (YEDP); Presidential Fertiliser Initiative (PFI); Nigerian Bulk Electricity Trading-Payment Assurance Facility (NBET-PAF); National Financial Inclusion Strategy (NFIS); and Export Credit Rediscounting and Refinancing Facility (ECRF).

Altogether, the CBN expanded its balance sheet from ₦4,406.73 billion at end-December 2005 to ₦33,944.9 billion by end-December 2017, a growth of 670.3 per cent in size. Aside the surge, is also a diversified portfolio of assets, from foreign exchange holding between 2005 to 2011 to increased claims on the private sector, as the Bank became aggressive in direct real sector intervention. The demand for foreign reserves and domestic assets by the CBN has significant impact on the economy and could help in measuring the quantitative effects of such 'balance sheet policies' to guide domestic monetary policy. Accordingly, the study primarily focused on such policy targets in Nigeria as credit to the private sector, output and inflation. For that purpose, the policies are classified into quantitative easing (QE), referring to measures which result in the growth in size of the central bank's balance sheet without changing the composition (i.e. portfolio of assets held by the central bank remain unchanged, but the size grows), and credit easing (CE), defined as measures, which cause changes in the composition of balance sheet without an expansion in size. The later expands the portfolio of assets held, including private sector securities that invariably subject the Bank to private sector risks.

The rest of the paper was organised as follows. The structure of a central bank's balance sheet was presented in Section 2, which also contained a description of unconventional monetary policies and their transmission mechanisms. Section 3 reviewed some empirical literature and the Section 4 discussed stylised facts on the balance sheet of the CBN. Section 5 presented the empirical methodology and empirical results. Section 6 concluded the paper.

II.   Literature Review
II.1   Theoretical Framework: The Central Bank's Balance Sheet

For the purpose of analysing quantitative effects of the central banks' balance sheet policies, there is need for clarity about a central bank's balance sheet. Table 1 provides a sketch of the essential assets and liabilities of a typical central bank. The central bank acquires assets from the foreign sector (NFA) and claims on the domestic economy (NDA) and issues such liabilities as reserve money, comprising currency-in-circulation (CIC) and bank reserves that invariably constitute the two main means of payments. Both assets and reserve money are influenced by the central bank, but equilibrium values are largely determined by the demand of counter parties, which arguably makes the balance sheet policies of the central bank partly endogenous.

Table 1: The Central Bank's Balance Sheet

Assets	Liabilities
Net Foreign Assets (NFA)	Currency-in-circulation (CIC)
Net domestic Assets (NDA)	Bank Reserves (BR)
Government securities (CG)	Required Reserves (RR)
Private sector securities (CPS)	Excess reserves (ER)
Claims on banks (CB)	Government Deposits (GD)
Other Items (net)	Private sector Deposits (PSD)
	Capital Account (CA)

NFA is influenced by the trade balance, which fluctuates according to the dynamics of foreign trade, under full capital account mobility, and also domestic monetary policy. Claims on the domestic economy (NDA) comprises net lending to Government (GC), the banks and non-financial private sector (CPS). A change in any of these variables alters central bank's balance sheet: it expands the size in the case of a large purchase of traditional securities (quantitative easing) or change its composition when the Bank acquires non-banks securities (credit easing). It should be expected too that where the central bank finances its purchases with its liabilities, the resultant surge in bank reserves is expected to smoothen operations in the money market, facilitate inter-bank settlements and create a fulcrum for credit expansion, and promote economic growth.

Traditional interest rate policy of the central bank relies on the market for bank reserves, which the central bank can influence by setting its opportunity cost. The policy rate itself does not impact economic activities directly, but through the long-term rates, to the extent that aggregate demand is interest-sensitive. Under the UMP, however, the central bank can influence market liquidity conditions much more broadly and beyond the reach of bank reserves. Such operations generally result in changes in the central bank balance sheet – in terms of size, composition and risk profile.

II.2   Theoretical Issues
II.2.1   Balance Sheet Policies: Typologies

One of the earliest economists to propose a theoretical model for unconventional monetary policy is Paul Krugman (Krugman, 2000), offering a prescription of how to escape a liquidity trap. He used the Japan's economy as a case study and argued that the only way to overcome a deflation through monetary policy was to substantially increase the money supply to raise inflation expectations, thereby making real interest rates sufficiently negative. Gauti and

Michael (2003) extended Krugman's theory, and argued in favour of managing expectations of private entities, which could be achieved through forward guidance (e.g., a commitment by central bank that future monetary policy will be sufficiently accommodative). Impliedly, increasing the target amount of quantitative easing or diversifying the range of assets to be purchased would bring about strong effects when the efforts are history-dependent and so can mitigate distortions created by the zero-bound level of target policy rate.

The Global financial crisis of 2007/2008, which was the worst since the great depression of the 1930s, expedited action on implementation of UMP, following the inability of global central banks to lower policy target rates to stimulate aggregate demand. The broad objective was to expand economic activities by easing liquidity risk at the target markets, thereby increasing bank loans and raise aggregate demand, as financial asset prices go up.

The variant of UMP adopted by a central bank was functionally-related to the level of financial development, the extent of market distortions and specific objectives. All leading central banks focused centrally on influencing sovereign yields and the term structure, while others concentrated on measures aimed at changing private sector balance sheets. Borio and Disyatat (2010) classifies balance sheet policies into exchange rate policy, quasi-debt management policy, credit policy and bank reserves policy. *Exchange rate policy* involves measures to build foreign reserve or foreign exchange market intervention to affect the exchange rate, its level and/or volatility, at any given level of the policy rate. *Quasi-debt management policy* involves actions to alter composition of claims on the public (government) sector held by the private sector, with a primary intention of influencing the yields. *Credit policy* focuses on operations that target specific segments of the private debt and securities market by changing the central bank's exposure to private sector. In Peersman (2011), credit policies originate from actions that are independent of policy actions (credit multiplier shock), credit supply shocks due to shifts in monetary policy or from innovations to credit supply that are orthogonal to the policy rate. *Bank reserves policy* relates to setting specific target for bank reserves, regardless of how this is counter-balanced on the asset side of balance sheet of the central bank. Bank reserves play a significant role in the transmission of unconventional monetary policy, facilitating inter-bank net settlements, bank lending and economic activities.

Forward guidance is a verbal central bank communication about its future monetary policy stance. It can either be "Delphic" or "Odyssean" (Campbell et al., 2012), meaning that it can either predict the future or attempt to commit to

a given course of future action. The objective is to guide expectations of economic agents in taking long-term business decisions. Also, given the central place of bank credit in the schema, some central banks implement *negative interest rates* to influence bank credit, which literarily involves a charge on deposits by banks at the central bank to discourage excessive demand for it. Angrick and Nemoto (2017) provides an overview of the operational implementation of negative interest rates in Europe and Japan, with emphasis on their transmission mechanism and broader effects on private sector financing condition.

For analytical convenience, these policies are summarised into quantitative easing (QE) and qualitative or credit easing (CE) and extensively discussed in Lenza et al., (2010); Goodfriend, (2009); Bernanke (2009); Roger et al., (2016). Quantitative easing policies tend to expand the balance sheet without necessarily changing the composition, arising, from an increase in traditional assets holdings, such as treasury securities or government bonds. The increase in monetary liabilities, arising from this reflect more on bank reserves since currency demand is largely market-determined and may likely remain unchanged. Qualitative or credit easing, on the other hand, leaves balance sheet size constant, but changes the composition as non-traditional assets are added into the central bank's portfolio, ultimately exposing the balance sheet to more market risks, than usual, as assets are acquired from different segments of the private sector.

II.2.2   The Transmission Mechanism

Different transmission mechanisms of non-traditional monetary policies are proposed in Borio and Disyatat (2010); Lenza et al. (2010); and Joyce et al. (2011). Borio and Disyatat (2010) proposed two channels, namely: signaling channel, referring to the influence on agents' expectations of the future policy rate path; and portfolio rebalancing channel, which shows the change in relative holding of assets with consequences on the term structure. Lloyd (2017) found signaling and portfolio rebalancing channels to be very effective in reducing long-term interest rates in the US.

Lenza et al. (2010) proposes three interest rate channels, namely, liquidity effects channel, which influences short-term inter-bank rate, the spread between the policy rate and short-term inter-bank rate that forms the basis for pricing financial instruments of more relevance for macroeconomic developments and the expectation of future path of monetary policy decisions and its effects on the yield curve.

Joyce et al. (2011) proposed macroeconomic policy news; portfolio balance; and liquidity premia channels of policy transmission. *Macroeconomic/policy news channel* works through reaction of economic agents to any information learned from policy decisions, especially as it relates to inflation expectations or expected future policy rate, as well as the risk around the path of expected future short-term interest rates. The *portfolio rebalancing channel* works through changes in asset prices, income and aggregate demand. Large asset purchase programme or credit easing can reduce bond yields through portfolio rebalancing and stimulates investments in assets further along the risk and maturity curve. One condition for this is the non-substitutability of assets in the market, such that expansionary policies lead economic agents to substitute one asset for the other, raising their prices and reducing the yields, a development which can spill to the foreign exchange and capital markets.

Liquidity premia channel works through the impact of large asset purchase on the long-term interest rates. Long yields can be decomposed into two components: the expected average future short-term rate and the residual, or the "term premium". The expected short rate is a function of expected inflation, expected real activity and some judgement about the preferences of the central bank. The term premium can, in principle, be either positive or negative, and varies over time and across various bond types. Because the central bank is a significant buyer in the market, large asset purchase may improve functionality of the market by reducing illiquidity risk in the market.

The *funding channel or credit channel* targets specific segments of the monetary transmission mechanism that invariably exposes the central bank's balance sheet to different asset classes and risks. It is dominant where emphasis is placed on developing capacity of banks to fund critical economic sectors, as so far demonstrated in Nigeria through different real sector intervention programmes. Figure 1 provides a schema for the various transmission channels of UMP. The ultimate objectives remain attainment of desired levels of macroeconomic variables, such as interest rates, credit to the private sector, exchange rate, economic growth and inflation.

Figure 1: Transmission Mechanism of the Balance Sheet Approach to Monetary Policy
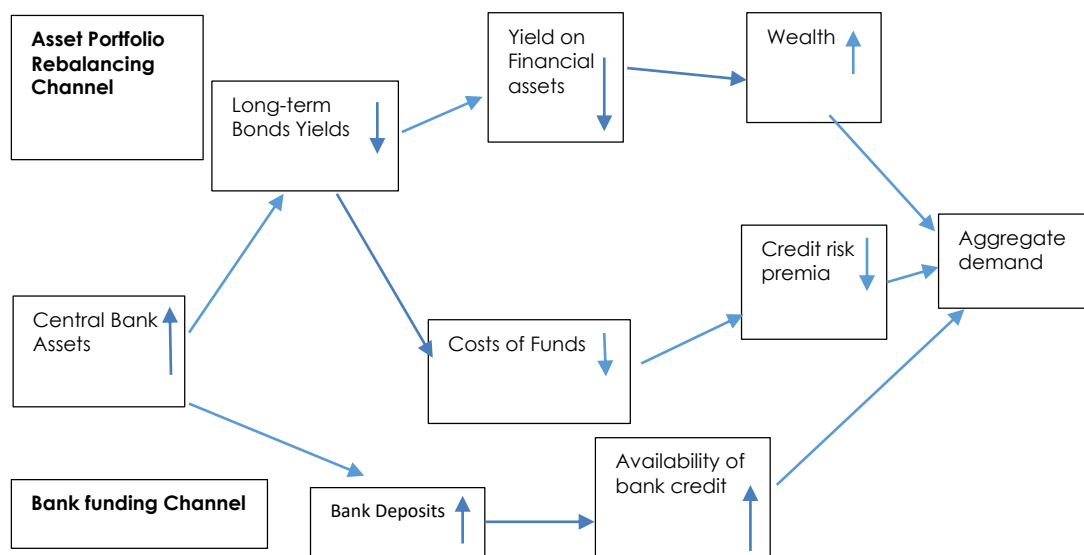
Source: Authors

The upper part of Figure 1 depicts the portfolio-rebalancing channel, and the lower part shows the bank-funding transmission channel. The purchase of bonds by the central bank reduces the supply of those bonds and raises their prices. To the extent that assets are non-substitutable, and more assets are purchased, leading to decline in rates, income rises, and aggregate demand expands. On the liability side, an expansion in banks reserves arising from central purchases of financial assets, increases loanable funds, bank credit and aggregate demand.

III.   Empirical Literature Review

Empirical analysis of balance sheet policies has expanded, but largely concentrated on evaluation of actions taken by leading central banks including: the Federal Reserve, Bank of England, European Central Bank and the Bank of Japan. Pattipeilohy et al. (2013), provides a comprehensive review of research works assessing unconventional monetary policy by the European Central Bank, while some have looked elsewhere (Gagnon et al., 2010, 2011; Joyce, et. al., 2011, 2012; Bhattarai and Neely, 2016). Yet a documentation of spillover effects of these policies on capital flows, asset prices, yields, exchange rates and macroeconomic performance in other countries has also been carried out (Tatiana, 2013; Carrera et al., 2015; Borrallo et al., 2016; Fratzscher et al., 2016).

The initial debate on central bank balance sheet policies has focused on the relevance of portfolio rebalancing effects on term and risk premia. The argument is anchored on imperfections in capital markets, where changing the composition and/or size of the central bank balance sheet implies sufficiently significant changes in the yield structure and macroeconomic performance. Some of the studies, which have toed the above line include Gagnon et al. (2011) and Bauer and Rudebusch (2014) who assessed the impact of large-scale asset purchases by the Fed on yields in the US; Joyce et al (2011) and Joyce and Tong (2012) investigated the impact of the Bank of England's quantitative easing policy on UK asset prices. Applying time series econometrics, Gagnon, et. al., (2010, 2011), found that the large-scale asset purchase by the Fed led to economically-meaningful and long-lasting reductions in longer-term interest rates on a range of securities in the US, including securities that were not included in the purchase programmes. These reductions in interest rates reflect primarily lower risk premiums, including term premia, rather than lower expectations of future short-term interest rates in the US.

Joyce et al. (2011), found that asset purchases, financed by the issuance of central bank reserves in the United Kingdom, depressed medium- to long-term government bond yields by about 100 basis points, with the largest part of the impact coming through a portfolio balance effect. The wider impact on other asset prices was more difficult to disentangle from other influences: the initial impact was muted, but the overall effects were potentially much larger, though subject to considerable uncertainty.

Gambacorta et al. (2012) assessed the macroeconomic effects of unconventional monetary policies in eight advanced economies over a sample spanning the period since the onset of the global financial crisis (2007-2011). A panel VAR was explored. They found that an exogenous increase in central bank balance sheets, at the zero lower bound, led to a temporary rise in economic activity and consumer prices.

Coming from a model-free analysis and dynamic term structure models that decompose declines in yields following Federal Reserve announcements into changes in risk premia and expected short rates, Bauer and Rudebusch (2014) found large scale asset purchases to have important signaling effects on expected future short-term interest rates in the US. Miyagawa and Morita (2013) assessed UMP of the Bank of Japan and confirmed that the monetary policy had contributed to the recovery of the prolonged deflation. The study found a quantitative - easing shock to increase transaction money that raised output and price, which dispelled the anxiety.

Pattipeilohy et al., (2013) reviewed VAR-based studies and those conducted using *events study methodologies and* found evidence of the effectiveness of the European Central Bank (ECB's) unconventional monetary policy measures, i.e. extended liquidity provision (LTRO) and the Securities Market Programme (SMP) on target variables. Their findings suggested that the LTRO interventions in general had a favourable (short-term) effect on government bond yields. They further asserted that changes in the SMP only had a visible downward effect on bond yields in Summer 2011, when the programme was reactivated for Italy and Spain, but the effect dissipated within a few weeks.

Cour-Thimann (2014) adopted the perspective of central bank balance sheets to assess the redistributive effects of monetary policy. The paper used information from the euro area National Central Banks and the US Federal Reserve Banks to analyse the regional and sectoral effects of monetary policy. He found that central bank's balance sheets captured by sustained imbalances in payment flows across the euro area countries that peaked at 10 per cent of GDP in the target balances, and across the US districts that reached 5 per cent of GDP in the equivalent Inter district Settlement Accounts. It further asserted that the imbalances, combined with accommodative central bank liquidity, shifted risks from the private financial sector to the public sector and among taxpayers. Yet, mechanisms were in place to mitigate such risks and the associated redistributive effects. The paper also found that liquidity injection, while directly channeled at the stressed regions or sectors, had indirectly supported the financial sector at large.

Tatiana (2013) examined the impact of unconventional monetary policy measures adopted in developed countries (the US, UK, euro area and Japan) on developing economies (Brazil, China, India and Russia), using a series of event studies. It was found that quantitative easing (QE) by the FED, BoE, ECB and BoJ influenced long-term yields, equity prices, and possibly exchange rates, both in the developed and developing countries.

Miles and Schanz (2014) explored the impact of a central bank changing the size and composition of its balance sheet and found that central bank asset purchases had weak potential to affect households' choices by changing the composition and return on their asset portfolios, and that its size depended on how fiscal policy was conducted. In other words, the portfolio balance sheet of central bank asset purchases is weak in a wide range of environments. Christensen and Krogstrup (2014) found evidence that balance sheet expansion

by the Swiss National Bank, not associated with the purchase of long-term domestic assets, still had a significant impact on domestic sovereign bond yields.

Ferguson et al. (2014) showed that historical expansions and contractions in the balance sheet size correlated highly with public debt level. Though the study found a nexus between central bank balance sheet and inflation rate in most advanced economies, particularly in the 1980s, inflation risk was rather limited in the near term. In addition, it was noted that huge purchase of government bonds also impacted on public finance, as depressed bond yields tended to reduce government debt service costs. The authors further observed threats to long-run price stability from historical evidence, especially when there was persistence in fiscal deficit and the independence of central bank was largely compromised.

Rule (2015) examined the role the liability side of a balance sheet played in understanding credit and monetary developments in the economy. It noted the absence of an agreed standard or frequency in the presentation and publication of balance sheets, attributing this to inconsistent definitions and existence of various central bank operational frameworks, across regions and continents. It further highlighted how the structure of the balance sheet affected central banks' income flow in addition to how a positive capital level was important for a central bank to achieve its goals.

Del Negro and Sims (2014) employed a simple general equilibrium model and opined that it would be apt for a central bank, with a large balance sheet composed of long-duration nominal assets, to have access to, and be willing to ask for support for its balance sheet by the fiscal authority. Else, its ability to control inflation may be at risk. The study further asserted that the type of balance sheet support within government transaction was different from the need for fiscal backing of inflation policy that arose where the central bank's balance sheet was merged with that of the rest of the government.

Fratzscher, et. al., (2016) analysis on the global spillovers of the Federal Reserve's unconventional monetary policy measures revealed that the measures in the early phase of the crisis (QE1) were highly effective in lowering sovereign yields and raising equity markets, especially in the US, relative to other countries. Fed measures since 2010 (QE2) boosted equities worldwide, while they had muted impact on yields across countries. Yet Fed policies functioned in a procyclical manner for capital flows to emerging markets (EMEs) and a counter-cyclical way for the US, triggering a portfolio rebalancing across countries out of EMEs into US equity and bond funds under QE1, and in the opposite direction under

QE2. Second, the impact of Fed operations, such as Treasury and Mortgage Backed Securities(MBS) purchases, on portfolio allocations and asset prices, dwarfed those of Fed announcements, underlining the importance of the market repair and liquidity functions of Fed policies. Third, they found no evidence that foreign exchange or capital account policies helped countries shield themselves from these US policy spillovers, but rather that responses to Fed policies were related to country risk. The results, thus, illustrated how US unconventional measures had contributed to portfolio reallocation, as well as, a re-pricing of risk in global financial markets.

Pattipeilohy (2016) examined developments in the composition of central bank balance sheet for a large set of central banks within a unified framework. The study found significant composition changes in the balance sheets of advanced economies, owing to unconventional monetary policy measures, and that the balance sheet of central banks in emerging economies remained unchanged over the review period.

Chen et al., (2016) estimated a global vector error-correction model (GVECM to trace the spillover effects of the US quantitative easing (QE) on both emerging and advanced economies. They focused on the effects of reductions in the US term and corporate spreads and found effects of QE to be sizeable and vary across economies; estimated effects on the emerging economies were diverse, but generally larger than those found for the United States and other advanced economies. These heterogeneous effects pointed to unevenly distributed benefits and costs of cross-border monetary policy spillovers.

These empirical findings suggest the strong influence of central bank's balance sheet policies on domestic macroeconomic outcomes and their spill overs. Assessment of effects of non-traditional monetary policy measures in Nigeria has remained scanty, despite sustained liquidity support for banks, direct real sector interventions and credit guarantees by the CBN, which have expanded its Bank's balance sheet and asset composition, over time. Doguwa and Essien (2013) found that the analytical balance sheet of the central bank and monetary survey were useful tools in the analysis of monetary and credit developments in the economy. The authors neither showed how balance sheet policies grew the balance sheet size, its composition or their macroeconomic outcomes. The attempt in Kure et al., (2016), to show substantial liquidity injection via non-traditional monetary measures over time, however, did not provide any quantitative assessment of these measures on target monetary policy variables. Thus, while this study potentially fills a sizeable gap on the dynamic effects of balance sheet size and composition, it equally creates a climate for a broader

discourse on the effectiveness of such non-traditional monetary policy measures in Nigeria.

IV. The Central Bank of Nigeria's Balance Sheet: Some Stylised Facts
IV.1 Policy Evolution and Central Bank Balance Sheet (2006-2017)

At the end of the bank consolidation exercise in 2005, twenty-five banks emerged from 89 at end-2004. The relatively stronger banks made possible, a new monetary policy implementation framework in December 2006 that comprised a monetary policy rate and a standing facilities window to guide movement in interbank short rates. During this period, monetary policy relied basically on the policy rate, open market operations and complementary discount window operations to achieve targets.

While all the new banks met the minimum capital requirements of ₦25 billion that could enable them finance big tickets transactions, post-consolidation challenges[2] that required some stabilisation measures in the banking system persisted and fueled by the global financial and economic crises of 2007/2009. Indeed, the GFC distorted domestic financial markets equilibrium and expedited actions on non-traditional intervention measures by the CBN in its bid to repair the monetary policy transmission mechanism.

Initial measures took the form of liquidity support to banks through the expanded discount window (EDW) operations in October 2008, where money market instruments such as Bankers' Acceptances and Commercial Paper were discounted at the CBN. In addition, the policy rate was reduced to 6.0 per cent in July 2009, followed by direct injection of liquidity into banks in the form of Tier II capital in 2009 and the establishment of the Assets Management Corporation of Nigeria (AMCON) for the purchase of bad assets from banks. Substantial liquidity was injected into the economy through different real sector intervention programmes[3]. Collectively, the size of the Bank's balance sheet, which reflecting these developments, experienced several jumps as revealed in Figure 2. It grew, year-on-year, by 127.7 per cent at end-December 2006, 91.1 per cent at end-December 2011 and 50.0 per cent at end-December 2016. However, there was a disproportionate change in the components, with Figure 3a revealing a preference for accumulation of foreign assets between 2006 and 2011, followed by claims on financial institutions, particularly banks (CB), and lending to Federal Government, respectively.

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[2] Related largely to poor corporate governance
[3] ibid

Thus, beside the increase in the size of traditional securities, notably government securities, there was a change in assets composition, as well, such as increased claims on banks, non-bank financial institutions and non-bank public institutions. Apparently, the CBN engaged in both quantitative easing (QE), with increased holding of traditional securities and credit easing (CE), with the diversification of its portfolio to private securities. As it is customary, changes in the asset side of the Bank's balance sheet should have a corresponding change in liabilities. Figure 3b showed massive reserve accumulation by banks from 2011, as currency-in-circulation generally moderated, reflecting the cash-less policy of the CBN. Growth in reserves is expected to reduce short-term rates, and by extension, the term structure and increase banks credit to the private sector, along with some pressure on the foreign exchange market.

Figure 2: The Central Bank's Balance Sheet and Intervention Programmes (2006-2017)
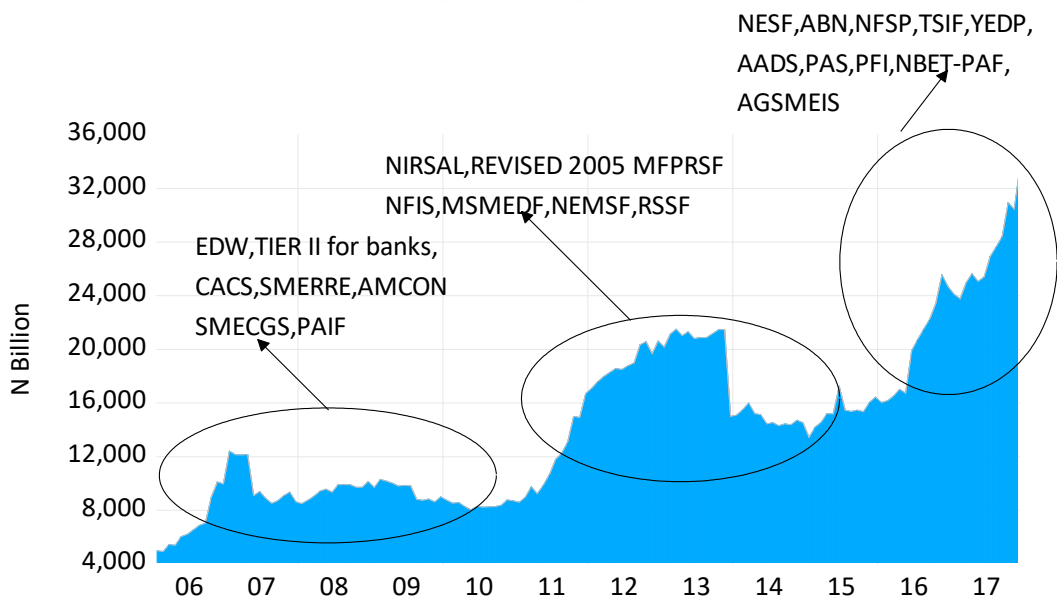
Source: Compiled by authors from Central Bank of Nigeria

Figure 3a: Percentage Share of CBN Assets (2006-2017)

Foreign Assets

Claims on Government

Claims on Private Sector

Claims on Banks

Source: Compiled by authors from Central Bank of Nigeria
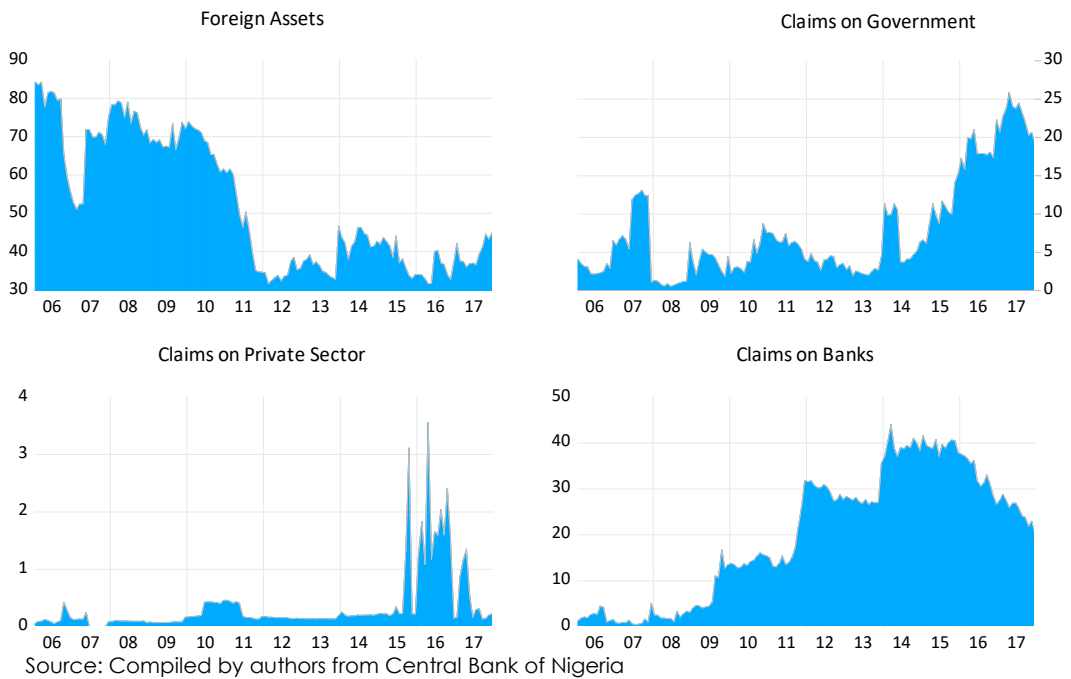
Figure 3b: Composition of Reserve Money of the Central Bank of Nigeria (2006M1-2017M12) (per cent)

Bank Reserves

Currency in Circulation

Source: Compiled by authors from Central Bank of Nigeria
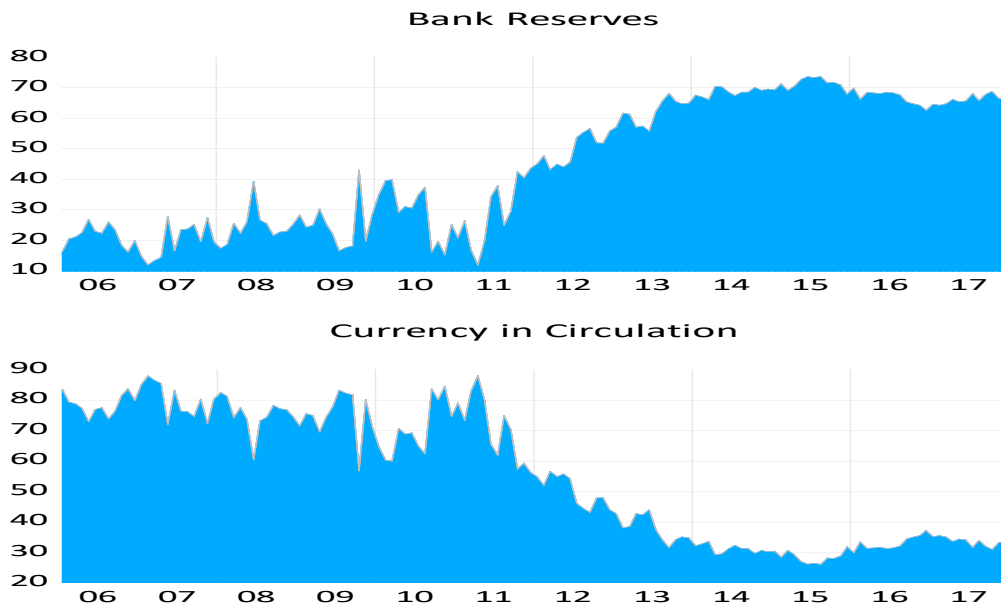
IV.2   Aggressiveness of Balance Sheet Policies

The relative changes in components of assets and liabilities indicate aggressiveness of balance sheet policies of the central bank (Pattipeilohy, *et al.*, 2013, 2016). For instance, in Table 2, the ratio (CG+CPS)/FA showed the distribution of the Bank's assets between the domestic economy and foreign sector. This ratio was expected to rise where the central bank kept more domestic resources on its balance sheet, either through increased holding of government securities or private sector claims. Otherwise, the central bank was classified as a foreign exchange hoarder. Similarly, a decline in CPS/CG ratio suggested possible crowding out of private sector credit from increased government financing by the CBN. Otherwise, the Bank is a bankers' bank. Similarly, a rise in BR/C ratio suggests massive accumulation of reserves by banks, relative to currency. A rise in (CG+CPS)/FA and BR/CIC ratio showed substantial liquidity into the banking system that was expected to influence macroeconomic indicators.

The ratios in Table 2 and the graphs in Figure 4 revealed the aggressiveness of the CBN's non-traditional monetary policy. It was observed that growth in assets was persistent over time, but it was also evident that prior to 2011, the CBN was a foreign exchange hoarder, largely to protect the foreign exchange value of the domestic currency. It, however, accumulated more domestic assets afterwards as it became more aggressive with the intervention programmes.

Table 2: Stylised Analytical Balance Sheet of the Central Bank

| Assets		Liabilities	
Foreign Assets	FA	Currency in Circulation	CIC
Government Securities	CG[4]	Bank Reserves	BR
Private Securities	CPS[5]		

Source: Calculation is based on Pattipeilohy, *et al.,* 2013

This evidence was reinforced by the rising CPS/CG ratio, especially from 2008, when the CBN became more of a banker's bank. Accordingly, banks accumulated reserves between 2001 and 2015, as revealed by the rise in BR/CIC ratio. It is expected, that with increased reserves, banks would be well positioned to influence economic activities through loans.

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[4] Comprises claims on Federal, States and Local governments and non-financial public enterprises
[5] Comprises claims on banks, non-financial private sector and other financial institutions

Figure 4: Indicators of the CBN Bank Balance Sheet (2006-2017) (Ratios)
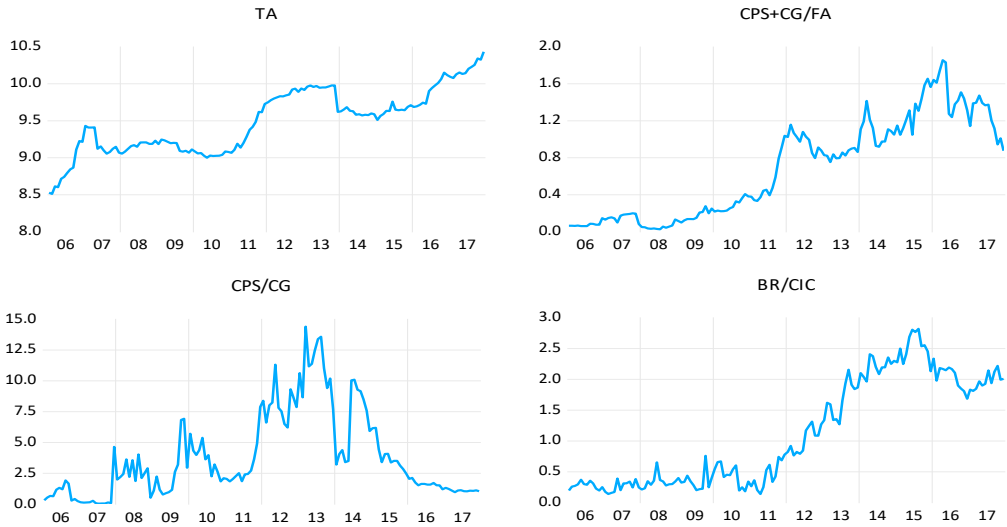
Source: Authors' calculations from the CBN analytical balance sheet

## IV.3   Measurement of Asset Concentration: The Herfindahl Index

We have indicated that balance sheet policies can either swell the balance sheet or cause its dispersions. The indicator for size is simply the stock of central bank assets, but the measure of asset dispersion or credit easing can be indicated by a size- neutral metric, as shown in End and Pattipeilohi (2015). It is a form of Herfindahl Index, HI, which is defined as the sum of squared share in total assets:

$$\text{Hi}^i_j = \sum \left(\frac{\text{x}_j}{\sum \text{x}_j} \right)^2 \tag{1}$$

Equation 1 assumes a central bank i with assets $x_j; j = 1, 2, ..., n$, which may be evenly distributed or concentrated. HI ranges between 0 and 1, with a value close to one, signifying asset concentration or low asset dispersion. Apparently, the size of the metric depends on the classes of assets considered in the calculation, with more assets classes, yielding a lower value and vice versa. Thus, we expect HI to be closed to zero with a more diversified portfolio that conduce more liquidity for the private sector, which nonetheless, exposes the central bank to private sector risks. Figure 5 presents graphs for the Herfindahl Index and proxy for the balance sheet size of the CBN. HI is calculated for each month with four classes of the Bank's assets, namely; net foreign assets, credit to

the government, credit to domestic banks[6] and claims on the private sector[7]. The information reveals a greater concentration of assets in 2006 but a progressive dispersed posture afterwards. A greater dispersion in assets is observed between 2011 and 2017, arising from the greater need for real sector support by the CBN. Empirically, the study reckoned that both asset measures have specific implications on macroeconomic target variables.

Figure 5: Relationship between growth in CBN Assets (TA) (QE) and credit easing HI (CE)
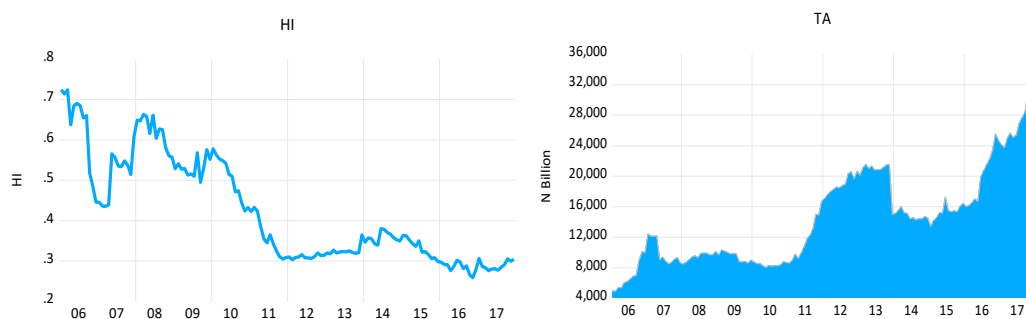
Source: Authors' calculations from the CBN analytical balance sheet

V.   Methodology
V.1   The Model

The need to capture real-time effects of policy actions makes it imperative to avoid over-simplifications, especially as it affects the interaction among macroeconomic variables. Vector autoregressive (VAR) models (Sims 1980) obviate theoretic assumptions in monetary policy analysis, distinguishing exogeneous from endogenous variables and holds variables in the model to be endogenous. We apply an unrestricted VAR version in this analysis because we do not want to impose any ex-ante restrictions on the assumed effects of central bank balance sheet policies on our objective variables, but to allow the data speak. The basic model structure, an order p vector auto aggressive VAR(p) assumes a K-dimensional set of variables, each depending on its history (lags) and the lags of other variables.

$$Y_t = A_0 + B(L)Y_t + ... + B(L^p)Y_t + \varepsilon_t \tag{2}$$

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[6] Comprises banks and non-banking financial institutions
[7] Comprises non-financial private sector and non-financial public enterprises.

Where Y_t is a vector of K endogenous variables, A_o a vector of constants, $B(L)$ is matrix polynomial in the lag operator and ε_t, the contemporaneous matrix of the mutually uncorrelated disturbances.

Endogenous variables comprises: the proxy for balance sheet size, measured by total assets of the central bank (TA); a measure of asset dispersion, represented by the Herfindahl Index (HI); and the inter-bank rate (IBCR)[8], measuring conventional monetary policy. Other variables were banks' credit to the private sector (CPS), which was total commercial banks credit to the economy; the All Share Index (ASI), as the proxy for real GDP growth in the model[9]; the prime lending rate of banks (PLR), capturing cost of bank credit and inflation (INF), the year-on-year change in the consumer price index.

V.2   Data

The data for the study was collected from the statistical database of the Central Bank of Nigeria and covered the period 2006M1 to 2017M12. The period was chosen because it cuts across important phases of the nation's financial history which included: post-bank consolidation period; the global financial and economic crises of 2007-2009, that necessitated massive liquidity injection into banks; and the massive real sector intervention programmes of the CBN. It is important to stress that most real sector intervention programmes were channelled through the banks. Thus, a strong connection is expected between changes in central bank's balance sheet and growth in bank reserves and credit growth.

Table 3: Summary Statistics

	TA	IBCR	PLR	CPS	ASI	INF	HI
Mean	16.40	11.79	16.91	16.17	10.34	11.04	0.42
Median	16.48	10.50	16.82	16.46	10.27	10.94	0.36
Maximum	17.30	64.58	19.66	16.96	11.09	18.72	0.72
Minimum	15.42	0.77	14.58	13.92	9.90	3.00	0.26
S.D.	0.43	8.23	1.02	0.70	0.29	3.59	0.13
Skewness	0.00	2.58	0.59	-1.08	0.63	0.13	0.67
Kurtosis	2.15	14.63	3.64	3.32	2.56	2.42	2.11
Prob.	0.12	0.00	0.00	0.00	0.01	0.30	0.00
Obs.	144	144	144	144	144	144	144

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[8] Is the average of the call and open buy-back (OBB) rate
[9] ASI is used because real GDP growth was not available on monthly basis.

Tables 3 and 4 contained the summary statistics and the cross correlations among variables in the model, respectively. From Table 3, the log of assets averaged 16.4 per cent and the measure of asset dispersion averaged 0.4. This suggested growth and dispersion of assets during the period of study. Although variables exhibited some variability, there were no outliers. Also, most variables had their kurtosis lower than 3, while three variables were found to be leptokurtic. Beside two variables, the low probability values of the JB statistics suggests that the null of normality is rejected for all other variables in the model.

Table 4: Correlations Matrix

	TA	IBCR	PLR	CPS	ASI	INF	HI
TA	1.00						
IBCR	0.45	1.00					
PLR	0.04	0.01	1.00				
CPS	0.80	0.34	0.06	1.00			
ASI	0.00	-0.02	-0.38	-0.18	1.00		
INF	0.33	0.34	0.21	0.46	-0.48	1.00	
HI	-0.89	-0.32	-0.01	-0.82	0.22	-0.26	1.00

The cross-correlations matrix suggested some positive association of the balance sheet size and variables in the model. Interestingly, the balance sheet size was negatively correlated with the measure of assets dispersion, confirming that as the size expanded, so was also the dispersion of central bank's assets during the review period. Results also suggested that multi-collinearity appeared not to be a problem in the model.

V.3   Unit Root Test

 The graphical view of the variables in Figure 6 suggested that besides the constants, most variables in the model exhibited trends as well, which was reflected, accordingly, in the test for unit root. Augmented Dickey Fuller (ADF) and Philip Peron (PP) tests were used for the unit root tests and the results revealed that, other than inter-bank call and the prime lending rate, which were stationary at level, all other variables, as shown in Table 5, appeared to be stationary at first difference. A Johansen test for long-run co-integration confirmed two co-integration equations by the Trace test and one co-integrating equation by Max- Eigen value test. Thus, to eliminate the risk of spurious results, the VARs were estimated with one lag, supported by four lag selection criteria (FPE, AIC, SC & HQ), which implicitly allowed for co-integration among the variables in the model.

Table 5: Unit Root test

	ADF					PP				
	Level		1st diff		Decision	level		First Dif.		Decision
	ADF	Prob	ADF	Prob		ADF	Prob	ADF	Prob	
TA	-1.88	0.66	-11.56	0.00	I(1)	-2.34	0.41	-11.87	0.00	I(1)
CPS	-2.28	0.14	-9.45	0.00	I(1)	-1.87	0.66	-20.51	0.00	I(1)
IBCR	-4.95	0.00	-	-	I(0)	-8.78	0.00	-	-	I(0)
INF	-1.97	0.61	-10.36	0.00	I(1)	-2.1	0.54	-10.33	0.00	I(1)
HI	-2.63	0.26	-13.3	0.00	I(1)	-2.74	0.22	-13.23	0.00	I(1)
EXR	-1.61	0.78	-8.07	0.00	I(1)	-1.64	0.77	-6.38	0.00	I(1)
PLR	-2.73	0.07	-	-	I(0)	-2.74	0.07	-	-	I(0)
OP	-2.42	0.37	-8.00	0.00	I(1)	-2.19	0.49	-8.03	0.00	I(1)
ASI	-1.65	0.45	-10.84	0.00	I(1)	-2.17	0.50	-11.49	0.00	I(1)

Figure 6: Graphical View of Variables in the Model (Per Cent)
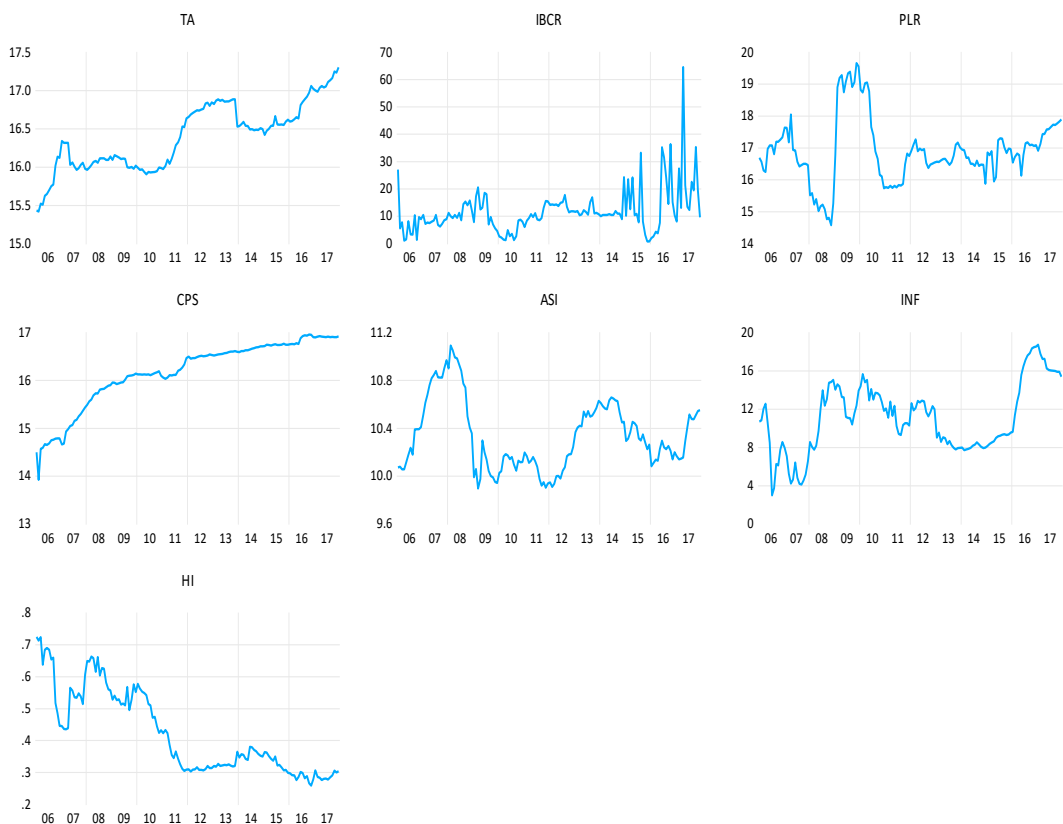
V.4   Empirical Estimates

The baseline model reported the responses of target variables to innovations in the balance sheet equations. We first examined the response of target variables to the size equation and then the composition equation. In all the models, Cholesky decomposition for shocks identification, as opposed to a more structural approach, was used. Specifically, the paper accorded exogeneity to policy variables in the model, which were the CBN total assets and the proxy for asset dispersion. The all share index was the proxy for real sector activities, in place of real GDP growth, which was not available monthly. The hypothesis tested was that shocks to CBN assets and its dispersion influenced positively bank reserves and banks' credit to the economy, capital market activities and reduced inflation. The inter-bank call rate was the proxy for conventional monetary policy in the model and is expected to be sensitive to changes in Bank's assets, influences bank reserves upon which bank credit was assumed to depend. Impulse responses were observed for a twenty-four months period because monetary policy impact is largely short- to medium-term. Table 6 confirmed that the model satisfied stability condition. Also, residual test for serial correlation and heteroscedasticity rejected the nulls of both tests.

Table 6: VAR Stability Condition

Variables: TA IBCR PLR CPS ASI INF	
Root	Modulus
0.971095	0.971095
0.933386 - 0.101167i	0.938853
0.933386 + 0.101167i	0.938853
0.928746 - 0.007515i	0.928776
0.928746 + 0.007515i	0.928776
0.434959	0.434959
-0.386114	0.386114
0.276112	0.276112
-0.263547	0.263547
-0.122655 - 0.106530i	0.162459
-0.122655 + 0.106530i	0.162459
0.130242	0.130242
No root lies outside the unit circle.	
VAR satisfies the stability condition.	

V.4.1   Impact of a Size Shock

Evidence from Figure 7a suggested that a one standard deviation shock to the CBN balance sheet size generated an initial increase in the inter-bank rate in the

first month, but a progressive decline from the second month. This was partly a response of massive reserve accumulation by banks from increased bank deposits or a reflection of the liquidity support from the CBN for real sector production. The decline in the call rate and growth in reserves should pull other money market rates along as revealed by the decline in the average lending rate. Consequently, credit to the private sector grew, possibly from the stand point of increased reserves, and the increased government's emphasis on real sector intervention, through the banking system. Given these developments, domestic production of goods and services rose as shown by the all share index, the proxy for output. However, the response was hump-shaped, consistent with some empirical studies on unconventional monetary policy (Peersman, 2011). The rate of inflation declined progressively, which could be ascribed to different transmission channels: initial increase in inflation may not be unexpected, given the volume of bank credit from a given increase in reserves.

However, the decline in inflation might be a reflection of the signals received in the market of a possible economic down-turn by economic agents and the consequent re-pricing of their goods and services. Also, increased private sector credit might be as a result of expanded local production of basic agricultural commodities, which constituted a significant component of the consumer price index. Cumulatively, the impact of a size shock in two years (Figure 7b) was consistent with *apriori* expectations, but largely modest: the inter-bank call rates decline from 0.5 per cent in the first year to 0.25 per cent in the second year. Growth in credit to the private sector was 0.02 per cent in the second year and 0.01 per cent, cumulatively. A modest improvement in economic activities was also observed with a size shock and the decline in inflation was also modest at 0.05 per cent, cumulatively.

Figure 7a: Impulse Responses of Economic Variables to a One Standard Deviation Shock to CBN Assets
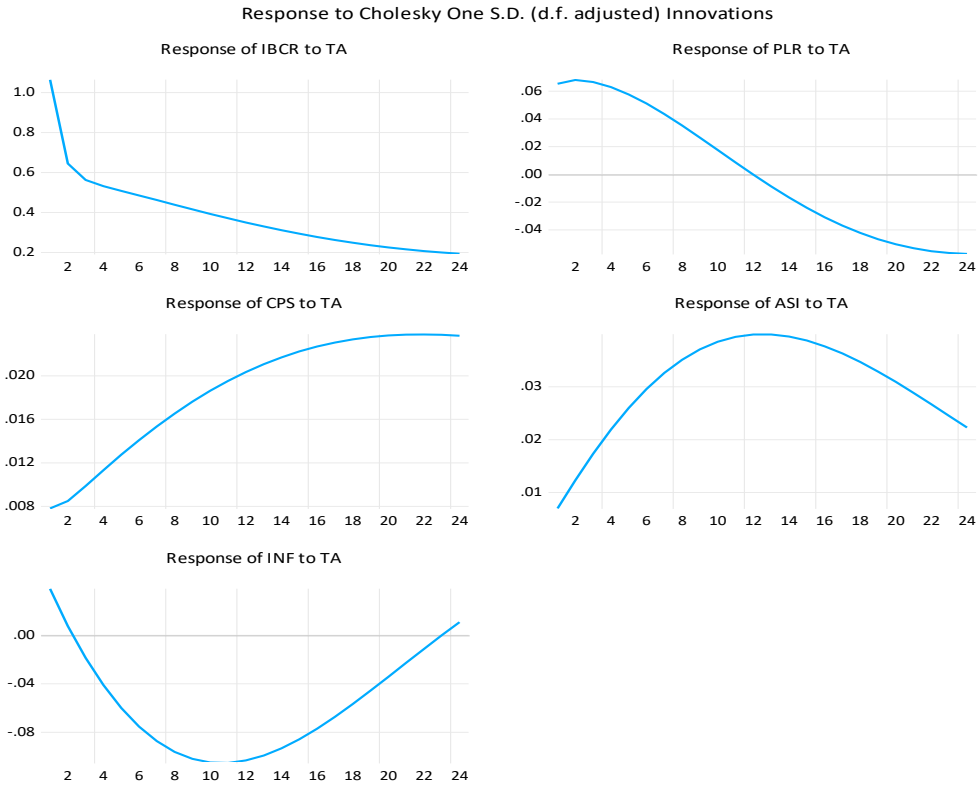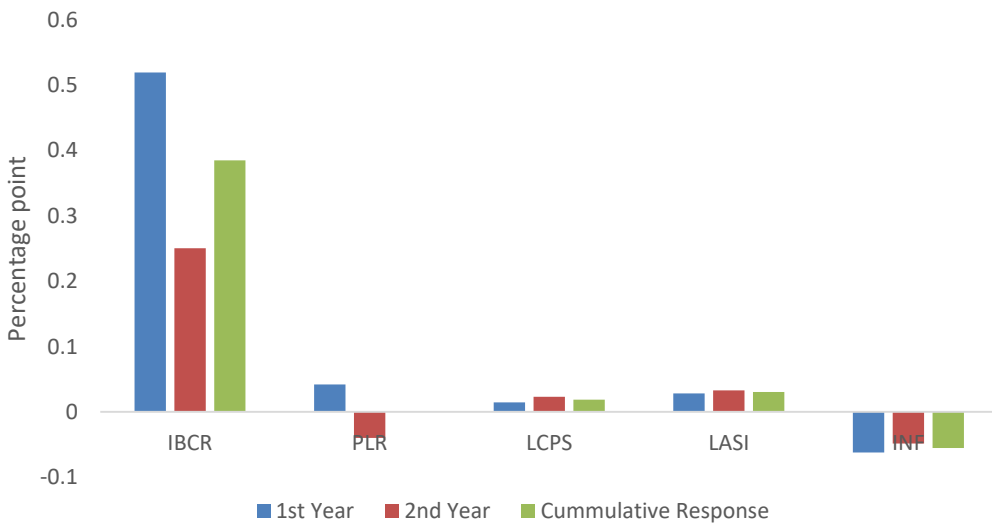
Response to Cholesky One S.D. (d.f. adjusted) Innovations

Figure 7b: Twelve Months Cumulative Responses of Target Variables to a Standard Deviation Shock to CBN Assets

V.4.2   Variance Decomposition

Variance decomposition which was based on Cholesky's ordering and reported for six months was presented in Table 8. The Table revealed the relative contributions of credit to the private sector, all share index and inflation to the size shock. Consistent with the impulse responses, the assets shock to private sector credit grew from 0.9 per cent to 2.2 per cent, higher than the contribution of the inter-bank rate at 0.5 per cent to 1.3 per cent in the review period. However, credit to the private sector showed great persistence, as between 95.9 to 98.5 per cent was explained by its own shock. For the real economic activities, the contribution of asset shock ranged between 0.9 to 9.3 per cent, while over 90 per cent was due to own shock and an average of 0.1 per cent was attributed to inflation. Similarly, inflation was explained largely by its own shock, as the size variable explained only between 0.1 and 0.2 per cent.

Table 8: Error Variance Decomposition

Table 8a: Variance Decomposition of CPS:

Period	S.E.	TA	IBCR	PLR	CPS	ASI	INF
1	0.08	0.94	0.45	0.09	98.51	0.00	0.00
2	0.11	1.07	0.68	0.16	98.07	0.01	0.01
3	0.13	1.27	0.94	0.24	97.50	0.03	0.02
4	0.15	1.54	1.10	0.33	96.97	0.04	0.02
5	0.17	1.85	1.20	0.43	96.44	0.06	0.03
6	0.18	2.20	1.28	0.54	95.88	0.07	0.03

Table 8b: Variance Decomposition of ASI:

Period	S.E.	TA	IBCR	PLR	CPS	ASI	INF
1	0.07	0.90	0.00	3.32	1.05	94.73	0.00
2	0.10	1.92	0.00	2.18	1.76	94.02	0.12
3	0.12	3.34	0.00	1.53	2.65	92.12	0.35
4	0.14	5.08	0.01	1.23	3.74	89.28	0.67
5	0.15	7.08	0.03	1.15	4.98	85.75	1.01
6	0.17	9.26	0.05	1.21	6.35	81.79	1.35

Table 8c: Variance Decomposition of INF:

| Period	S.E.	TA	IBCR	PLR	CPS	ASI	INF
1	1.0	0.1	0.2	0.4	0.4	0.1	98.9
2	1.4	0.1	0.1	0.5	0.6	0.1	98.6
3	1.7	0.1	0.1	0.7	0.9	0.1	98.2
4	2.0	0.1	0.1	0.9	1.3	0.0	97.6
5	2.1	0.2	0.0	1.1	1.7	0.0	96.9
6	2.3	0.2	0.0	1.2	2.2	0.1	96.2

Cholesky Ordering: TA IBCR PLR CPS ASI INF

V.4.3   Impact of a Composition Shock

The responses of policy targets to a shock in asset dispersion presupposed a declining HI or less asset concentration. Evidence reported in Figure 8a suggested an increase in the inter-bank rate in the first two months, but a progressive decline thereafter. It is important to stress that the decline in the call rate was larger than the decline attributed to an asset shock. Similarly, lending rates also declined in tandem with the decline in inter-bank call rate, and the decline was also larger with a composition shock. Consequently, claims on the private sector grew in response to the decline in rates, reinforcing the impact of the size shock. Again, the growth in credit was also larger with a composition shock than a size shock, supporting the positive impact of the CBN's intervention programmes.

Economic activities generally ramped up and much larger than the growth attributed to expansion in assets, as inflation generally declined in the first year, but rose after, justifying the massive liquidity injections. The cumulative effect of a composition shock (Figure 8b) was a significant decline in the average inter-bank rate from 15.05 per cent in the first year to 5.4 per cent in the second year. Lending rates declined by 0.68 per cent in the first year and 2.67 per cent in the second year. Private sector credit grew by 0.5 per cent in the first year and 0.9 per cent in the second year, and economic activities expanded by 1.04 per cent in the first year, but cumulatively by 1.0 per cent in the two years. The decline in inflation was 8.56 per cent in the first year, but cumulatively by 7.1 per cent in the two years. It was obvious that target variables responded more with the diversification of the Bank's assets than when they were concentrated.

Figure 8a: Impulse Responses of Economic Variables to a One Standard Deviation Shock to CBN Dispersion

Response to User Specified Innovations (HI)
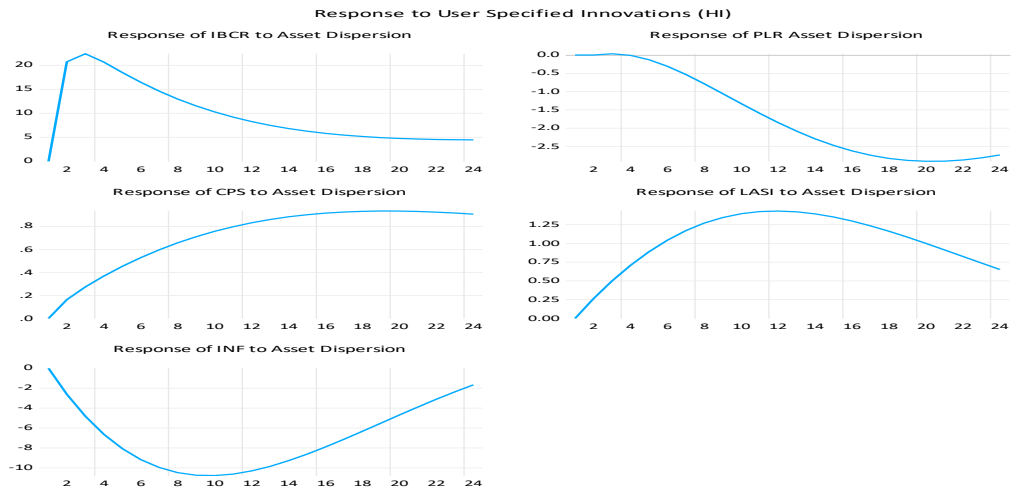
To demonstrate that, the same model was re-run with an asset concentration shock and the impulse responses were shown in Figure 8c. A shock to asset concentration caused a decline in the inter-bank call rate only in the first two months, but showed a persistent rise thereafter. Lending rate rose, while claims on the private sector declined. The rise in rates was due likely to excessive lending to government, crowded out the private sector. The consequent effect of these developments was a decline in economic activities and a rise in inflation, after one year. This reinforced the claim made so far, that where central bank assets are concentrated on a few classes, the economic impact of an expansion in those assets is insignificant, due to increased lending rates, reduced private sector credit, declining growth and a rise in inflation.

Overall, it is obvious that balance sheet policies led to desired outcomes of reduction in cost of credit, increase in bank lending, economic activities and a decline in inflation. However, relative size effects favour asset dispersion (credit easing), against growth in assets (quantitative easing). Literally, credit easing is more effective for the realisation of target variables than when assets are concentrated.

The implications for policy are obvious: the Central Bank of Nigeria can, in the short- to medium-term, sustain its intervention programmes on the economy. Essentially, the programmes are more effective when the CBN becomes more of a banker's bank than when it is a government's bank, as the latter crowds out private sector growth.

Figure 8b: 12 Months Cumulative Responses of Target Variables to a Standard Deviation Shock to CBN Assets Dispersion
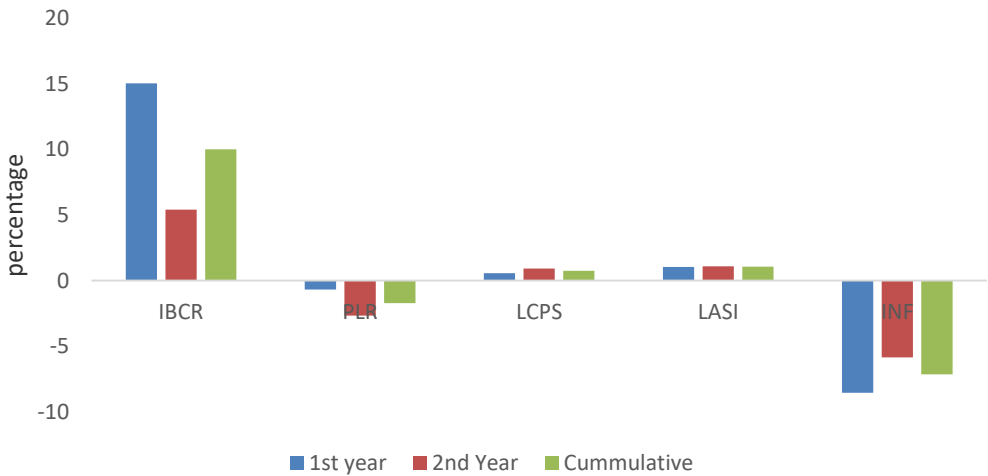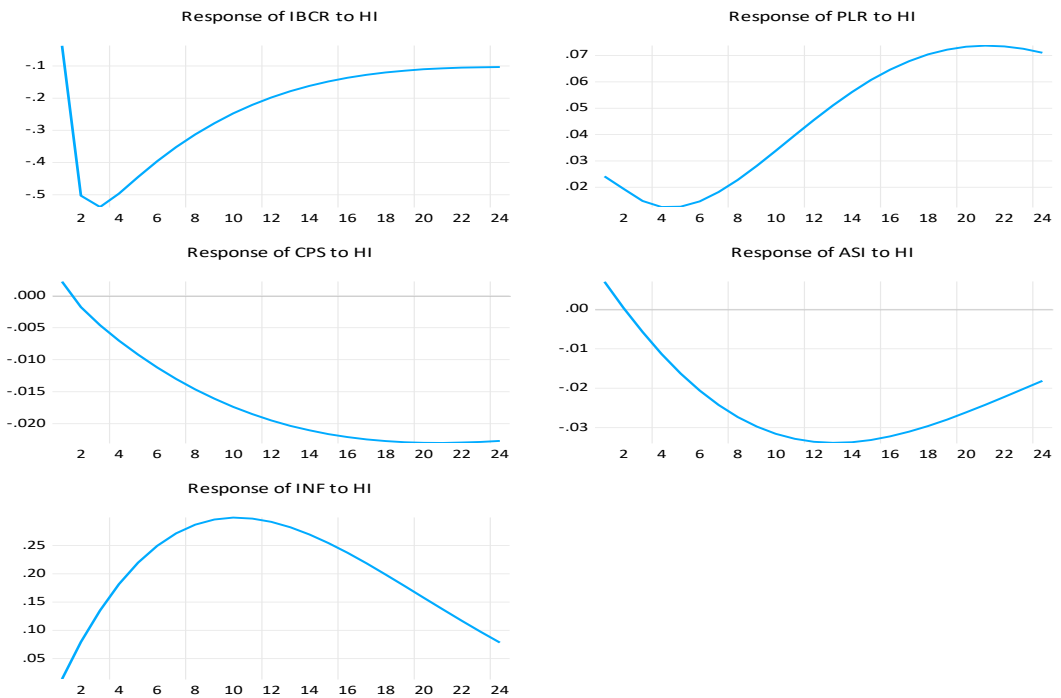
Figure 8c: Impulse Responses of Economic Variables to a One Standard Deviation Shock to CBN Asset Concentration

Response to Cholesky One S.D. (d.f. adjusted) Innovations

VI. Summary and Conclusion

The paper sets out to ascertain the role of the CBN balance sheet in monetary policy implementation. It looked at growth in assets and its composition since the change in the monetary policy implementation framework, most

importantly, since the period of global financial crisis of 2007-2009. The objective was to consider the quantitative effects of balance sheet policies on target policy objectives. The paper observed that while CBN's assets expanded, considerably, following measures to stabilise the banks in the wake of the Bank's consolidation exercise and global financial crisis along with measures to facilitate real sector production, there was also a considerable change in assets composition, which we incorporated in the empirical methodology. The VAR method was applied, using monthly data from January 2006 to December 2017 and impulse response and variance decomposition of target variables presented and analysed. Results revealed that the Bank's balance sheet policies had been effective at influencing monetary policy outcomes, namely; the inter-bank rates, credit to the private sector, economic activities and inflation. Subject to the limitations of the study, the paper established that balance sheet policies led to reduction in cost of credit, increases bank lending, economic activities and reduces inflation. However, the relative size effects favour asset dispersion (credit easing) against growth in assets (quantitative easing).

The implications for policy are obvious: the Central Bank of Nigeria can, in the short- to medium-term, sustain its intervention programmes on the economy. But the programmes would be more effective when the CBN becomes more of a banker's bank, given that increased holdings of traditional securities in an economic downturn crowd out private sector growth.

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