The Balance Sheet Channel of Monetary Policy Transmission: Evidence from Nigeria[1]

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This paper assesses the existence of a balance sheet channel of monetary policy transmission in Nigeria by examining whether variation in the official interest rate, with respect to the 2007- 2008 global financial crisis, feeds through to the deposit money banks (DMBs) balance sheets, and ultimately reflects in output and prices. Using quarterly macroeconomic data and stock from 2002 to 2012, the study employs an ordinary least squares (OLS) and autoregressive (VAR) framework to investigate the linkages between policy, DMB balance sheet, output and price. The results reveal the existence of a balance sheet channel in Nigeria with a significant impact of DMBs balance sheet composition on output growth and price. However, output and price did not react homogeneously to changes in monetary policy variations due to the global financial crisis.

Keywords: Balance sheets Channel; Deposit Money Bank; Financial Crisis; Monetary Policy; Output; Price

JEL Classification: E31, E44, E52, E58

1.0 Introduction

Balance sheet channel defines the role and the financial position of a commercial bank in the transmission mechanism of monetary policy. It arises as official interest rates generate variations in capital and interest income which have an effect on micro and aggregate expenditure, output and prices of economic mediators, given that they affect the balance sheet items of the accounts of commercial banks directly (Boivin *et al.*, 2010).

According to Bacchetta and Ballabriga (2000), there are at least three proposed views of the role of banks in monetary transmission. First is the standard *money view,* where bank loans have no special role: here, monetary shocks affect output through changes in monetary aggregates. The second view is the *narrow credit channel or the bank lending channel*, where

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monetary policy changes directly affect bank's balance sheet with reduction in bank loans, which in turn affect output: – here, output changes are directly caused by changes in bank loans. And the third view is the *broad credit channel* or *the balance sheet channel:* here, monetary policy affects interest rates and output in a way similar to the money channel or influences output via a different channel.

In Nigeria, DMBs always show greater sensitivity during periods of tight or loosed monetary policy with greater effect on those that are potentially financially-constrained. Hence, based on the balance sheet theory[3], where the status of balance sheets affects the economy's response to monetary and other shocks (Melander, 2009; Kashyap and Stein, 1994), the study builds on the assumption that aggregate DMBs' balance sheet variables change with policy rate, and also reflects on output and prices. Focus is on examining how variation in the official interest rate, feeds through to the DMBs balance sheets, and ultimately reflects in output and prices, with specific recourse to the 2007- 2008 global financial crisis. The results of this expedition are expected to enunciate on the possible existence or otherwise of a balance sheet channel of monetary policy transmission in Nigeria.

The rest of the paper is so structured that the second section described the evolution and characteristics of monetary policy and DMBs balance sheet to the global financial crisis. The third section presents the literature review on DMBs response and other related studies on the balance sheet channel. Section four presents the study methodology, while the fifth section presents the results of the investigations. The concluding remarks and policy implication are given in section six with valid references of similar studies.

2.0 Stylized Fact on Monetary Policy and DMBs Balance Sheet in Nigeria

It is argued that a change in official interest rates may either weaken or strengthen bank's balance sheet, reflect in aggregate demand and, ultimately, in output and prices(Allen *et al.* 2002). It is also anticipated that financial crisis occurs when there is a plunge in demand for financial assets[4]. In

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[3] An economy's resilience to a range of shocks, including financial shocks, hinges in part on the composition of the country's stock of liabilities and assets (see Allens *et al.*, 2002).

[4] The deterioration of Financial Institutions' Balance Sheets was one of the major causes of the financial crisis (Soludo, 2009). If the state of banks' balance sheets is compromised, the

Nigeria, DMBs are generally known to play a major role in the financial markets activities as they are well positioned to engage in information-producing activities which produce productive investments for the economy. Howbeit, they are also influenced by the adjustment of the Central Bank of Nigeria's (CBN) target for a short-term nominal interest rate. This influence does reflect not only in the volume of the DMBs' activities but also in the composition of their assets and liabilities[5].

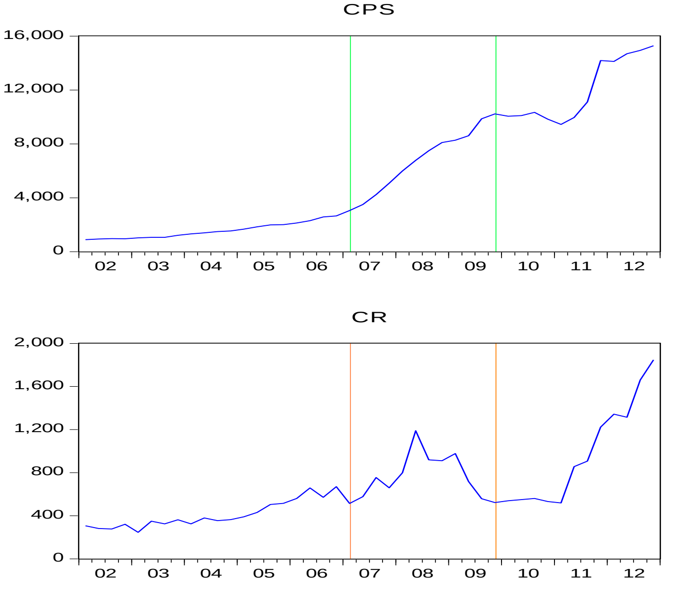

Figure 1: DMBs Balance Sheet Characteristics before, during and after the Crisis
***Source**: Central Bank of Nigeria Statistical Bulletin.*
*(**Note:** Balance sheets positions is proxied by both credit to private sector (CPS) and capital reserve (CR) from 2002 – 2006; 2007 – 2009 and 2010 – 2012)*

Thus, during the global financial crisis that started in 2007, there was widespread credit contraction, causing financial institutions in various countries to tighten their credit standards in light of deteriorating balance sheets at the first quarter of 2008 and by the fourth quarter of 2008, the spilled

balance sheets are likely to suffer substantial contractions in their capital. These would therefore lead to decline in lending, and consequently result in a decline in investment spending, thereby slowing down economic activity (http://www.slidefinder.net/F/Financial_Crises/5965800).

[5] Banks might not lend out to private sector even if they have a good risk, thereby resulting in a drop in cash flow. Hence, adverse selection and moral hazard problems may become more severe, impacting lending, investment, and overall economic activity.

over effect spread into consumer and other credits (Sanusi, 2010). Albeit, it could be seen from Figure 1 that there was rather a positive influence on the DMBs lending where credit to private sector (CPS) expanded though with a gradual contraction in the capital reserve (CR) from the first quarter of 2009 up to the fourth quarter. These were not unconnected with the cuts in interest rate and injections of liquidity as some of the varying measures taken by the Nigerian Central Bank to restore liquidity, as well as the fiscal stimulus packages that stimulated aggregate demand (see, for example, Soludo, 2009).

3.0 Review of Literature

In the aftermath of the 2007 financial crisis, Ajakaiye and Fakiyesi (2009) reported that the gravity and depth of the crisis in the banking sector were not fully certified by citing some indicators as evidence. The cited indicators include bank lending that witnessed growth of about 60.9%, indicating that Nigerian banks were doing well in the face of the crisis. But Olowe (2011) rejected the hypothesis of asymmetry and leverage effect after investigated the volatility of interbank call rates in Nigeria.

Aliyu (2012) reported that the Nigeria's stock market reacted to the monetary policy shocks over the period January, 2007 to August, 2011, showing a destabilizing effect on Nigerian stock exchange's returns through an unanticipated component of policy innovations on broad money (M2) and monetary policy rate (MPR).

Atuanya and Obodo (2012) reported also that Nigeria was facing complex bank lending crisis and went further to expressed the claim by financial analysts that Nigerian banks aversion to lending to the real sector was a complex problem with no easy solutions, and that finding a way for DMBs to lend innovatively to Nigerian businesses had become a hard nut to crack. Perhaps the lending increased during the crisis and dropped afterwards due to CBN intervention, but whether or not it reflected on output and prices was still an opened problem.

There are several other empirical studies that have investigated bank- and firm-balance sheet channels independently and in combination. See, for example, Bernanke and Blinder (1992), Kashyap and Stein (2000), Kishan and Opiela (2000), Jayaratne and Morgan (2000), Ashcraft (2006), Gan (2007), Khwaja and Mian (2008), Black *et al.* (2009), Chaney *et al.* (2009), among others, on the bank; Gertler and Gilchrist (1994) and Bernanke *et al.*

(1996), among others, on the firm side, as well as Jiménez *et al.*(2011) on both.

Some of these studies approached the issue by looking at the relationship between money and output, and bank loans and output either through correlations or Granger-causality tests (King, 1986 and Ramey, 1994), or by examining the role of bank loans using autoregressions (see Bernanke and Blinder, 1992).

Cappelletti *et al.* (2011) used banks' balance sheet assets and liabilities to examine how crisis impacted on interbank funding relationships. The analysis showed that the crisis had a clear negative impact on interbank funding, though there was no drastic fall in the overall interbank activity.

Shabbir (2012), following the theoretical setup presented by Bernanke and Gertler (1995), used data of non-financial listed firms over a period of 1999 – 2010 to investigate the effectiveness of balance sheet channel of monetary transmission mechanism in Pakistan.

Angelopoulou and Gibson (2007) examined the sensitivity of investment to cash flow using a panel of UK firms in manufacturing with a view to shedding some light on the existence of a balance sheet channel or financial accelerator. In addition to examining the impact of cash flow in different subsamples based on company size or financial policy (dividend payouts, share issues and debt accumulation), they also investigated the extent to which investment becomes more sensitive to cash flow in periods of monetary tightness.

Allen *et al.* (2002) designed an analytical framework for understanding crises in emerging markets based on examination of stock variables in the aggregated balance sheet of a country and the balance sheets of its main sectors (assets and liabilities).

Bacchetta and Ballabriga (2000) provided systematic evidence on the evolution of banks' balance sheets and output in response to a monetary shock by examining 13 European countries in addition to the US.

Mínguez (1997) opined that monetary policy effects on the soundness and composition of the private non-financial sector balance-sheet and on its cash-flow can affect the willingness of credit institutions to lend to those agents, which emphasizes the role of asymmetric information in financial markets, since borrowers have an informational advantage over lenders concerning their quality as agents demanding loanable funds.

Following Bacchetta and Ballabriga (2000), we considered the balance sheet channel with expectation that monetary tightening will reduce DMB's cash flow, thereby magnifying the impact of monetary policy on output and prices.

4.0 Methodology

The existence and importance of balance sheet channel in Nigeria is considered in this study using statistical and econometric techniques. Thus, we evaluated the balance sheet channel in three procedures. These methods sought to provide systematic evidence on the progress of output and price in relation to variations in policy rate, given the 2007 -2008 global financial crisis in Nigeria.

First, we analyzed the impact of the crisis on those segments of the DMBs activities which are more exposed to counter party risk. *A priori*, the composition of the DMBs balance sheets is expected to change as monetary policy stance changes, thereby impacting in output and price. Thus, we adapted a standard regression model:

$$Y_i = \beta_1 + \beta_2 X_{2i} + \cdots + \beta_k X_{ki} + u_i \quad (1)$$

$$= \boldsymbol{X}_i' \beta + u_i, \; i = 1, \cdots, n \quad (2)$$

where $X_i = [1, X_{2i}, \cdots, X_{ki}]'$ is a $k \times 1$ vector of explanatory variables, $\beta = (\beta_1, \cdots, \beta_k)'$ is a $k \times 1$ vector of coefficients, and u_i is a random error term.

Assumption 1: We assumed that the classical assumptions of the linear regression model in Equation (1) hold:

$$Y_i = \boldsymbol{X}'_i \hat{\beta} + \hat{u}_i, \quad i = 1, \cdots, n \quad (3)$$

where $\hat{\beta} = (\boldsymbol{X}'\boldsymbol{X})^{-1}\boldsymbol{X}'\boldsymbol{Y}$; $\hat{u}_i = Y_i - \boldsymbol{X}'_i\hat{\beta}$; $\hat{\sigma}^2 = \frac{\hat{u}'\hat{u}}{n-k}$ and $var(\hat{\beta}) = \hat{\sigma}^2(\boldsymbol{X}'\boldsymbol{X})$.

Under this assumption, we considered the influences of DMBs' balance sheets variables (using credit to private sector (CPS) and capital reserves (CR) as proxies) and policy rate (MPR) on output and price (see also Özlü and Yalçın, 2010). The dependent variables in the regression equation – Industrial Production Index (IPI), and Consumer Price Index (CPI), were employed as proxies for output and price, respectively. The representative models explaining the variables are as shown in Equations (6) and (7).

We introduced a time period dummy D to reflect the variations in monetary conditions. This dummy was constructed based on MPR variations due to external shocks and the global financial imbalances believed to have ended up with a contraction in the overall economic activity of some countries. The dummy variable took the value of 1 when the data referred to the loose period $(i.e., when\ t = 2007Q1 - 2008Q1, and\ 2008Q3 - 2011Q3)$ and zero for the tight period, and was interacted with all the regressor variables in the models. This was to allow us examine the existence of balance sheet channel via the relation of MPR variations from a tight to a loose period on output and price. Recall that the DMBs' balance sheets variables are theoretically believed to vary with MPR homogeneously.

Assumption 2: The classical assumptions of the linear regression model in Equation (1) do not hold:

Under this assumption, several residual diagnostics statistical and econometric tests were carried out following Bacchetta and Ballabriga (2000) and Agha *et al.* (2005) to examine the dynamics of the balance sheet channel of transmission mechanism in Nigeria. All the five variables were incorporated into a VAR system where the variance-covariance matrix of the VAR system was diagonalized using a triangular orthogonalization scheme called Choleski scheme (see also Lin, 2008). Generally, this scheme relies on a particular ordering of variables and has the advantage that shocks to the VAR system can be identified as shocks to the endogenous variables.

Thus, a multivariate VAR with n variables and k lags over time t was considered as follows:

$$Y_t = \sum_{k=1}^{K} Z^{-1}(\beta^k Y_{t-k} + \mu_t) \tag{4}$$

$$= \sum_{k=1}^{K} A^k Y_{t-k} + \mu_t \tag{5}$$

where Y_t is a $n \times 1$ column vector of observations at time t on all the five variables (*IPI, CPI, CPS, CR, MPR);* $A^k \equiv Z^{-1}\beta^k$ is the matrix coefficients to be estimated. This implies that $ZY_t = \sum_{k=1}^{K} \beta^k Y_{t-k} + \varepsilon_t$ where $Z\ is\ a\ n \times n$ contemporaneous coefficient matrix; $\beta^k\ is\ a\ n \times n$ matrix polynomial in the lag operator k while $\varepsilon_t\ is\ a\ n \times 1$ column vector of random disturbances assumed to be non autocorrelated over time.

The model representations of the variables of interest using the logarithm of all the variables except the policy rate were obtained as:

$$LIPI_{it} = f(LCPS_{it}, LCPS_{it} * D_i, LCR_{it}, LCR_{it} * D_i, MPR_{it}, MPR_{it} * D_i) \quad (6)$$

$$LCPI_{it} = f(LCPS_{it}, LCPS_{it} * D_i, LCR_{it}, LCR_{it} * D_i, MPR_{it}, MPR_{it} * D_i) \quad (7)$$

following assumption 1, and

$$Y_t = f(IPI_t, CPI_t, CPS_t, CR_t, MPR_t) \quad (8a)$$

following assumption 2.

Secondly, we examined the response of other variables that can influence the balance sheet channel of transmission mechanism to a shock to MPR, which include the GDP growth rate (GDPG), changes in CPI (P), growth rates of credit to private sector (CPSG) and net credit to government (NCGG), as well as the prime lending rate (PLR). The model representation is given under assumption 2 as:

$$X_t = f(GDPG_t, P_t, CPSG_t, NCGG_t, PLR_t, MPR_t) \quad (8b)$$

4.1 Diagnostic Tests

Prior to the VAR system analysis, the time series properties of the variables were determined using some statistical and econometric tests. Under assumption 2, the Augmented Dickey Fuller (ADF) test was conducted using a standard equation of the form:

$$\Delta Y_t = \beta_1 + \beta_{1t} + \alpha Y_{t-1} + \gamma \sum_{t=1}^{n} \Delta Y_{t-1} + \varepsilon_t \quad (9)$$

In other word, a unit root test was carried out on the coefficient of Y_{t-1} in the regression for the existence of unit root in variable Y_t. The unit root test was conducted in two cases: with intercept only and with intercept and trend, to take into account the impact of trend in the series (Table 4).

A Lagrange Multiplier (LM) statistic of the form:

$$LM = T^{-2}\sum_{i=1}^{T} S\,(t)^2/f_0 \qquad (10)$$

was also carried out for residual serial correlation, where T is the sample size, S(t) is the partial sum of residuals, and f_0 is an estimator of the residual spectrum at frequency zero.

Other econometric tests included the multivariate extensions of the Jarque-Bera residual normality test (Jarque and Bera, 1980), which compared the third and fourth moments of the residual's distribution to those from the normal distribution based on the estimated moments of the residuals given by $\mu_i = 1/T\sum_{t=1}^{T}\varepsilon_t^i,\ \ i = 1,2,\cdots$; and such that

$$T\left[\frac{\mu_3^2}{6\mu_2^3}+\frac{1}{24}\left(\frac{\mu_4}{\mu_2^2}-3\right)^2+\frac{3\mu_1^2}{2\mu_2}-\frac{\mu_3\mu_1}{\mu_2^2}\right]\sim\chi^2_{(2)} \qquad (11)$$

where μ_1 is the estimated mean of the residuals, μ_2 is the estimated variance, μ_3 is the third moment that measures skewness, and μ_4 is the fourth moment that measures kurtosis.

Cumulative sum of squares (CUSUM) tests were also carried out to validate parameter stability in the estimation of Equations 6-7, while a variance decomposition and impulse response functions that traced the effects of a shock to one endogenous variable on to the other variables in the VAR system was used to evaluate the overall influence of monetary policy on output and price for the periods under consideration. This test gave the expected time path of the dependent variable(s) that would result when a shock is added to a model in steady state.

4.2 Data and the Choice of Variables

In this study, we considered the following five variables: DMBs capital reserves, *CR;* DMBs credit to private sector, *CPS;* monetary policy rate, *MPR;* industrial production index, *IPI;* and consumer price index, *CPI,* as balance sheet channel variables following several authors in the literature. Further variables like the GDP growth rate (GDPG), changes in CPI (P), growth rates of credit to private sector (CPSG) and net credit to government (NCGG), as well as the prime lending rate (PLR) were also considered for robustness check. All quarterly data were extracted from the CBN statistical bulletins of 2002Q1 – 2014Q1.

5.0 Empirical Results and Discussion

5.1 Statistical Analysis

The results of the regression estimates are presented in Tables 1 – 3. The

percentage variations of output and price explained by the impact of MPR variations from a tight to a loose period and the response of CPS and CR was given by the $R^2 = 0.638$ and 0.967, respectively, while the proportion of the variability that was due to DMBs balance-sheets specific components was explained by the adjusted $R^2 = 0.579$ and 0.960, respectively.

Table 1: Regression Estimate for LIPI Model

Dependent Variable: LIPI				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LCPS	0.155469	0.057138	2.72093	0.0099
CPS_D	-0.12409	0.081837	-1.516251	0.138
LCR	-0.22645	0.094363	-2.399798	0.0216
CR_D	0.179304	0.122106	1.468428	0.1504
MPR	0.023921	0.006316	3.787457	0.0005
MPR_D	-0.01806	0.021081	-0.856865	0.397
C	4.778752	0.27202	17.56767	0.0000
R-squared	0.638355	Mean dependent var		4.866042
Adjusted R-squared	0.57971	S.D. dependent var		0.095725
S.E. of regression	0.062058	Akaike info criterion		-2.57658
Sum squared resid	0.142495	Schwarz criterion		-2.29273
Log likelihood	63.68469	Hannan-Quinn criter.		-2.47131
F-statistic	10.88504	Durbin-Watson stat		0.885468
Prob(F-statistic)	0.000001			

Table 2: Regression Estimates for LCPI Model

Dependent Variable: LCPI				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LCPS	0.327293	0.065856	4.969823	0.0000
CPS_D	0.061409	0.094324	0.651047	0.519
LCR	0.024356	0.108761	0.223941	0.824
CR_D	-0.142039	0.140737	-1.009251	0.3194
MPR	-0.02078	0.00728	-2.854526	0.007
MPR_D	0.02602	0.024298	1.070886	0.2912
C	1.820313	0.313524	5.805973	0.0000
R-squared	0.965619	Mean dependent		4.364705
Adjusted R-squared	0.960044	S.D. dependent var		0.357831
S.E. of regression	0.071527	Akaike info		-2.29257
Sum squared resid	0.189296	Schwarz criterion		-2.00872
Log likelihood	57.4366	Hannan-Quinn		-2.18731
F-statistic	173.1965	Durbin-Watson stat		0.833753
Prob(F-statistic)	0.0000			

The statistical significance of the regression was captured by the F-statistics of 10.88 in Table 2 and 173.19 in Table 3 which are high enough to reject the null hypothesis of non-significance of the estimation parameters. These results indicate the existence of balance sheet channel but also establish non significance impact of the global financial crisis on output and price through DMBs' balance sheets in Nigeria. The non-significant impact of the crisis was in consonance with Ajakaiye and Fakiyesi (2009). In particular, the existence of balance sheet channel was underscored following the statistically significant effect of CPS, CR and MPR on output, as well as CPS and MPR on price. This also implies that the variations in MPR influence economic response indirectly.

Before drawing conclusions from the estimated regressions, a stability test was conducted to make sure that the assumptions of the classical linear regression model were satisfied. The tests results indicated no episode of instability in the variables used as the residual variance remained generally stable within a 5 percent critical band (Figures 1 and 2).

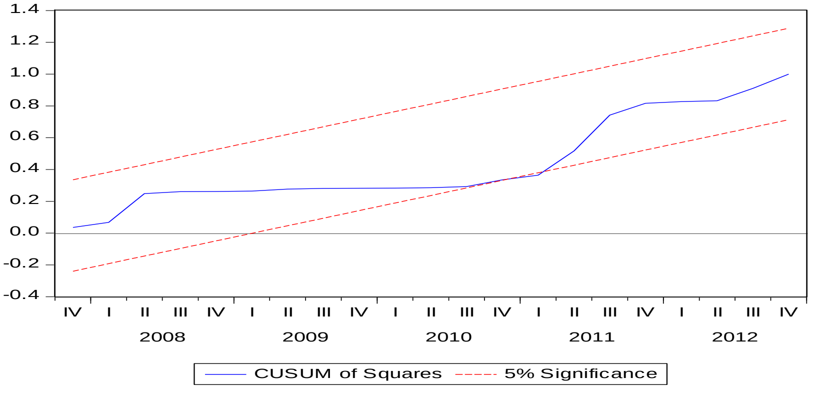

Fig. 1: Stability Test for IPI Model

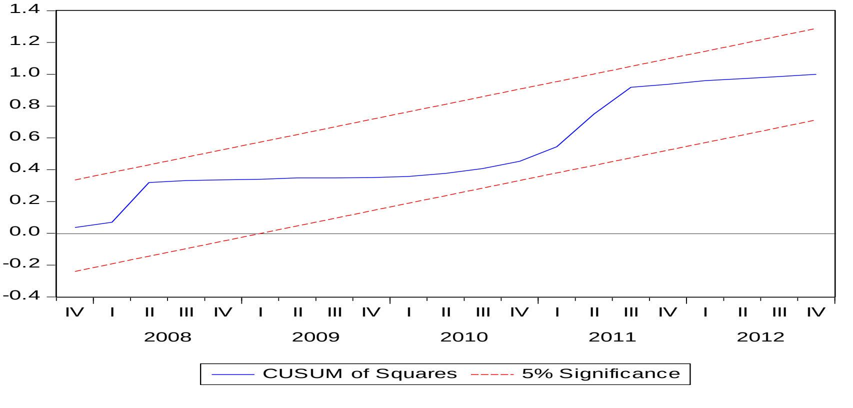

Fig. 2: Stability Test for CPI Model

This, by theoretical affirmation shows that the regression estimates $\hat{\beta}$ are consistent and asymptotically distributed with $var(\hat{\beta}) = \hat{\sigma}^2(\boldsymbol{X}'\boldsymbol{X})$.

Table 3: Regression Estimates for GDPG Model

Dependent Variable: GDPG				
	Coefficient	Std. Error	t-Statistic	Prob.
LCPS	3.946122	4.557644	0.865825	0.3916
CPS_D	0.218329	0.148898	1.466296	0.1502
LCR	-0.169099	0.123148	-1.37314	0.1772
CR_D	-0.00043	0.000574	-0.74784	0.4588
MPR	0.000502	0.023063	0.021779	0.9827
MPR_D	0.229049	0.293479	0.780463	0.4396
C	-0.102465	0.189966	-0.53939	0.5925
R-squared	0.136566	Mean dependent var		6.310545
Adjusted R-squared	0.01021	S.D. dependent var		3.588876
S.E. of regression	3.570508	Akaike info criterion		5.51733
Sum squared resid	522.6895	Schwarz criterion		5.790214
Log likelihood	-125.4159	Hannan-Quinn criter.		5.620453
F-statistic	1.080803	Durbin-Watson stat		1.706527
Prob(F-statistic)	0.389812			

5.2 Econometric Analysis

In examining the dynamic relation of MPR and the balance sheet variables via the VAR system, necessary econometric analyses were carried out. Firstly, the result of the ADF test used in examining the time series properties of the data showed that all the variables in the balance sheet channel (IPI, CPI, CPS, CR, and MPR) were integrated of order one, I(1) at both the five per cent and one per cent significance levels with and without trend except for CPS for the case of intercept with trend as shown in Table 4.

Although the system contained integrated or even cointegrated variables, ordinary least squares (OLS) was used in the context of potential long-run relationships (see also, Bacchetta and Ballabriga, 2000). Nevertheless, there was no issue of simultaneity.

Table 4: Unit Root Tests of the Selected Variables (2002:1 – 2012:4)

VARIABLE	ADF	1%	5%
CPI	-7.104094 (-7.053643)	-3.596616 (-4.192337)	-2.933158 (-3.520787)
CPS	-3.988816 (-3.954063)	-3.596616 (-4.192337)*	-2.933158 (-3.520787)
CR	-7.750726 (-7.745467)	-3.596616 (-4.192337)	-2.933158 (-3.520787)
IPI	-7.274252 (-7.375808)	-3.596616 (-4.192337)	-2.933158 (-3.520787)
MPR	-5.215923 (-5.787492)	-3.596616 (-4.192337)	-2.933158 (-3.520787)

*: Significant at 1%

Table 5: VAR Lag Order Selection Criteria (2002:1 – 2012:4)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-28.85433	NA	3.74e-06	1.692717	1.903827	1.769047
1	187.7009	368.1439*	2.62e-10*	-7.885045*	-6.618386*	-7.427061*
2	202.7999	21.89352	4.57e-10	-7.389994	-5.067785	-6.550357
3	229.0533	31.50408	5.05e-10	-7.452664	-4.074905	-6.231373

* indicates lag order selected by the criterion

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

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

A parsimonious lag order of 1 was also determined as the appropriate number of lags to be included in the VAR equation as shown in Table 5, and the null hypothesis of no serial correlation at lag order up to $k = 12$, was rejected while the data followed a distribution that features leptokurtosis arising from the asymmetries in the financial markets.

The VAR estimates in Table 6 shows a significant linkage among the variables defining, in part, the existence of balance sheet channel in Nigeria.

Table 5: VAR Lag Order Selection Criteria (2002:1 – 2012:4)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-28.85433	NA	3.74e-06	1.692717	1.903827	1.769047
1	187.7009	368.1439*	2.62e-10*	-7.885045*	-6.618386*	-7.427061*
2	202.7999	21.89352	4.57e-10	-7.389994	-5.067785	-6.550357
3	229.0533	31.50408	5.05e-10	-7.452664	-4.074905	-6.231373

* indicates lag order selected by the criterion

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

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Table 6: VAR Estimates (2002:1 – 2012:4)

Vector Autoregression Estimates	DLIPI	DLCPI	DLCPS	DLCR	DMPR
DLIPI(-1)	0.804730	0.034947	0.165045	-0.24673	5.930483
	(0.13016)	(0.08210)	(0.14462)	(0.47851)	(2.88586)
	[6.18258]	[0.42566]	[1.14124]	[-0.51562]	[2.05502]
DLCPI(-1)	0.006399	0.911783	-0.051374	0.663651	1.141667
	(0.09583)	(0.06045)	(0.10648)	(0.35232)	(2.12480)
	[0.06677]	[15.0836]	[-0.48247]	[1.88368]	[0.53731]
DLCPS(-1)	0.018412	0.034153	0.891966	-0.05351	-0.96676
	(0.03656)	(0.02306)	(0.04062)	(0.13441)	(0.81061)
	[0.50360]	[1.48099]	[21.9577]	[-0.39812]	[-1.19263]
DLCR(-1)	-0.03283	-0.00878	0.170830	0.726561	0.943997
	(0.03784)	(0.02387)	(0.04204)	(0.13911)	(0.83894)
	[-0.86758]	[-0.36796]	[4.06333]	[5.22308]	[1.12523]
DMPR(-1)	0.003300	-0.0001	-0.018518	0.021179	0.743077
	(0.00512)	(0.00323)	(0.00569)	(0.01884)	(0.11359)
	[0.64417]	[-0.03110]	[-3.25304]	[1.12445]	[6.54153]
C	0.938651	0.018070	-0.489686	0.278158	-29.031
	(0.61711)	(0.38925)	(0.68566)	(2.26868)	(13.6823)
	[1.52104]	[0.04642]	[-0.71418]	[0.12261]	[-2.12179]
R-squared	0.777253	0.992937	0.997214	0.874966	0.927773
Adj. R-squared	0.746316	0.991956	0.996827	0.857601	0.917742
Sum sq. resids	0.084540	0.033635	0.104364	1.142559	41.55747
S.E. equation	0.048459	0.030566	0.053842	0.178151	1.074418
F-statistic	25.12368	1012.196	2577.324	50.38456	92.48604
Log likelihood	70.77689	90.13190	66.35294	16.09697	-59.373
Akaike AIC	-3.08461	-4.00628	-2.873949	-0.48081	3.112999
Schwarz SC	-2.83638	-3.75804	-2.625711	-0.23257	3.361238
Mean dependent	4.862217	4.365887	8.256825	6.352928	11.50000
S.D. dependent	0.096213	0.340805	0.955889	0.472100	3.746136
Determinant resid covariance (dof adj.)		1.43E-10			
Determinant resid covariance		6.62E-11			
Log likelihood		194.2292			
Akaike information criterion		-7.82044			
Schwarz criterion		-6.57925			

5.3 Variance Decomposition

Table 7a: Variance Decomposition for Output and Price, 2002:1 – 2012:4

$$Y_t = f(IPI_t, CPI_t, CPS_t, CR_t, MPR_t)$$

Variance Decomposition of DLIPI: 2002:1 - 2012:4

Period	S.E.	DLIPI	DLCPI	DLCPS	DLCR	DMPR
1	0.048459	100	0.0000	0.0000	0.0000	0.0000
2	0.063433	99.17083	0.004929	0.001462	0.591937	0.230847
3	0.072748	98.25416	0.027687	0.001387	1.274156	0.442613
4	0.07915	97.53098	0.075941	0.00148	1.823561	0.568036
5	0.083704	97.00673	0.151078	0.003952	2.214067	0.624177
6	0.086983	96.62847	0.250149	0.010117	2.472522	0.63874
7	0.089346	96.34599	0.367778	0.020329	2.633126	0.632776
8	0.091042	96.12356	0.497537	0.034221	2.725349	0.619338
9	0.092248	95.93861	0.632891	0.050977	2.772	0.605522
10	0.093098	95.77808	0.767842	0.069548	2.789947	0.594584

Variance Decomposition of DLCPI:2002:1 - 2012:4

Period	S.E.	DLIPI	DLCPI	DLCPS	DLCR	DMPR
1	0.030566	0.000537	99.99946	0.0000	0.0000	0.0000
2	0.041347	0.162479	99.61786	0.095865	0.123296	0.000504
3	0.048545	0.489111	98.91398	0.352435	0.216754	0.02772
4	0.053871	0.868537	97.97406	0.790875	0.240413	0.126119
5	0.058047	1.20369	96.83719	1.415681	0.219219	0.324222
6	0.061472	1.435873	95.51868	2.216604	0.197646	0.631193
7	0.064397	1.547229	94.02012	3.170705	0.221542	1.0404
8	0.066997	1.552713	92.33891	4.24497	0.329476	1.53393
9	0.069394	1.488043	90.47715	5.399688	0.548201	2.086921
10	0.071676	1.397424	88.44783	6.592456	0.890727	2.67156

$$Y_t = f(CPI_t, IPI_t, CPS_t, CR_t, MPR_t)$$

Variance Decomposition of DLCPI:

Period	S.E.	DLCPI	DLIPI	DLCPS	DLCR	DMPR
1	0.030158	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.040833	99.59662	0.191821	0.106639	0.104733	0.000189
3	0.047982	98.85877	0.556609	0.379629	0.182038	0.022951
4	0.053289	97.88238	0.974518	0.833650	0.198267	0.111185
5	0.057460	96.71503	1.344277	1.469115	0.177814	0.293762
6	0.060884	95.37773	1.604614	2.273526	0.162930	0.581199
7	0.063808	93.87522	1.735905	3.223172	0.196985	0.968719
8	0.066402	92.20577	1.751999	4.285455	0.316314	1.440461
9	0.068787	90.37029	1.688272	5.421948	0.545936	1.973551
10	0.071049	88.37888	1.589470	6.592024	0.897762	2.541859

Variance Decomposition of DLIPI:

Period	S.E.	DLCPI	DLIPI	DLCPS	DLCR	DMPR
1	0.047876	0.000104	99.99990	0.000000	0.000000	0.000000
2	0.062863	0.001927	99.25509	1.07E-06	0.491275	0.251706
3	0.072258	0.013309	98.42857	0.000799	1.061911	0.495414
4	0.078766	0.040814	97.77938	0.004154	1.523971	0.651686
5	0.083440	0.086647	97.31623	0.011272	1.853439	0.732417
6	0.086840	0.149519	96.99196	0.022574	2.071725	0.764221
7	0.089322	0.226043	96.76006	0.037847	2.207197	0.768855
8	0.091126	0.311854	96.58642	0.056437	2.284605	0.760687
9	0.092429	0.402376	96.44876	0.077429	2.323223	0.748216
10	0.093363	0.493337	96.33354	0.099803	2.337349	0.735973

Table 7a presents the forecast error variance decompositions (FEVD) for each variable at forecast horizons which gives an insight of the share of fluctuations in a given variable that are caused by different shocks. The columns represent the percentage of the variance due to each shock, with each row summing up to 100 percent. Changing the order of the variables could greatly change the results of the impulse response analysis. Howbeit, we estimate two possible alternative orderings and compare the results. The results indicate, in the first case, that, for the study period, 95.8 per cent of the total variation in output was mainly accounted for by its own shock after 10 quarters and was followed by CR with 2.8 per cent, while price and MPR explained 0.77 and 0.60 per cent, respectively. In the second case, the interest rate shock accounts for about 0.74 percent of the fluctuations in output, with its own shock accounting for most of the rest.

Table 7b: Variance Decomposition for Output and Price, 2002:1 – 2014:1

Variance Decomposition of GDPG:							
Period	S.E.	GDPG	P	NCGG	CPSG	PLR	MPR
1	3.5705	100.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	3.7098	96.9078	2.2248	0.5787	0.0083	0.2292	0.0513
3	3.7638	94.1972	4.4301	0.6271	0.0326	0.6052	0.1078
4	3.7992	92.8773	5.4240	0.6231	0.0665	0.8699	0.1392
5	3.8159	92.3483	5.7488	0.6179	0.1010	1.0309	0.1532
6	3.8223	92.1387	5.8267	0.6195	0.1306	1.1258	0.1587
7	3.8248	92.0419	5.8363	0.6250	0.1536	1.1826	0.1607
8	3.8260	91.9860	5.8336	0.6313	0.1703	1.2177	0.1612
9	3.8268	91.9483	5.8315	0.6371	0.1818	1.2400	0.1612
10	3.8274	91.9214	5.8314	0.6418	0.1895	1.2547	0.1612

Variance Decomposition of P:							
Period	S.E.	GDPG	P	NCGG	CPSG	PLR	MPR
1	3.0798	1.1372	98.8629	0.0000	0.0000	0.0000	0.0000
2	4.0243	10.0125	83.0917	6.4866	0.1628	0.2417	0.0048
3	4.4374	15.2108	77.2213	6.7686	0.4493	0.3365	0.0136
4	4.5965	17.1756	74.5129	6.9847	0.8038	0.4913	0.0316
5	4.6530	17.6669	73.3161	7.1326	1.1732	0.6585	0.0528
6	4.6753	17.6746	72.7081	7.2276	1.5147	0.8039	0.0711
7	4.6877	17.5920	72.3293	7.2774	1.8066	0.9107	0.0840
8	4.6967	17.5298	72.0570	7.2979	2.0439	0.9798	0.0916
9	4.7038	17.5001	71.8517	7.3022	2.2312	1.0195	0.0954
10	4.7095	17.4921	71.6964	7.2989	2.3760	1.0397	0.0969
Cholesky Ordering: GDPG P NCGG CPSG PLR MPR							

Again, the FEVD of price shows that 88.5 per cent of the variation was accounted for by its own shock while CPS explained 6.59 per cent, MPR explained 2.67 while output and CR explained 1.40 and 0.90 per cent, respectively. The implication of these results in both cases is that, comparatively, interest rate innovations are relatively strong determinant of fluctuations in economic activity with respect to price than output in the balance sheet channel in Nigeria.

The existence of the balance sheet channel, though not as significantly as was expected, could also be accounted for by the dual innovations of capital reserves for output and credit to private sector to prices.

5.4 Impulse Response Functions

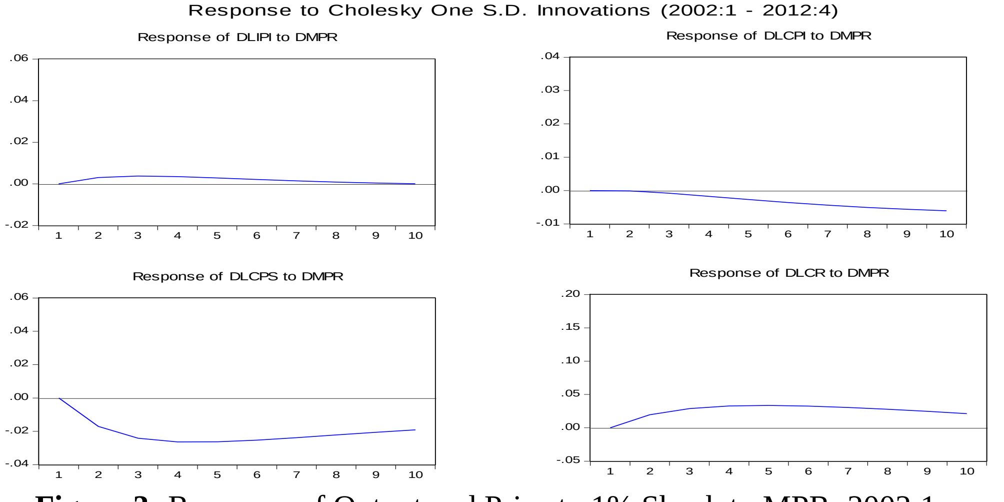

Figure 3: Response of Output and Price to 1% Shock to MPR: 2002:1 – 2012:4: $Y_t = f(IPI_t, CPI_t, CPS_t, CR_t, MPR_t)$

Theoretically, a shock to MPR via the balance sheet channel is expected to lead to rise in output and price, all things being equal. For the period 2002 to 2012, a positive shock to MPR led to a positive but low impact in output growth with a sluggish speed of adjustment to equilibrium in both ordering. However, a shock to MPR has a negative impact on price in both ordering from quarter 3 while it was at equilibrium initially from quarter 1 to 2. Also interesting in the results is that a positive shock to MPR also led to a positive impact on the DMBs' capital but negative on the volume of loan to private sector. The implication of these results is that the variations in official policy rate affect prices more than the output growth. This, may be due to the fact the private sectors may raise funds from other financial sectors other than the bank. This make the balance sheet channel in Nigeria not significant with respect to DBMs' balance sheet only.

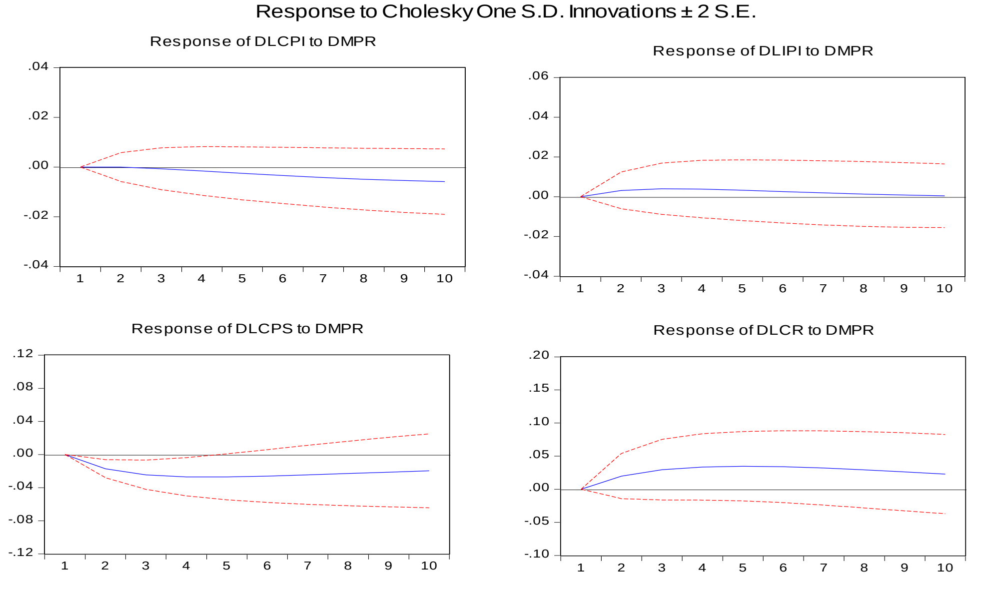

Figure 4: Response of Output and Price to 1% Shock to MPR

6.0 Conclusion and Policy Implication

Unlike traditional analysis, which is based on the examination of flow variables (such as current account and fiscal balance), this study considered the balance sheet approach and focused on the examination of credit to private sector and capital reserves of DMBs' balance sheet. From this perspective, the paper sought to establish the existence and relevance of banks' balance sheet channel in Nigeria, as well as examining the dynamic relation between monetary policy and DMBs' balance sheet components with respect to output and price effects due to the 2008 global financial crises. The salient facts shown in the analysis are as follows: (i) MPR variations influence economic activity indirectly through its impact on the value of DMBs' assets which translated into a gradual reduction in price pressures that eventually reduced the overall price level with a lag; (ii) there is no specific significant effect of the DMBs' balance sheet on output and price from expansionary monetary policy as a result of the global financial crises; and (iii) DMBs balance sheet variables (CPS and CR) did not react homogeneously to variations in monetary policy given the information asymmetries in credit markets that they face during the bank crisis.

The implication of these results is that monetary policy influences output and price indirectly by affecting the DMBs balance sheet composition since they are the primary source of loanable funds to some firms. In other words, the effects of a monetary contraction will be magnified by the reduction in loans supplied by DMBs, and ultimately amplifies the demand-side effects on expenditure decisions of the private sector if there is no external intervention. Hence, the extent to which a balance-sheet channel can be significance in Nigeria depends on the substitutability between internal and external sources of DMBs funds.

Looking forward, improvements in using more than DMBs' balance-sheets are essential steps for unclogging the wheels of balance sheet transmission mechanism and improving the mechanism of monetary policy in Nigeria.

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