
Empirical Analysis of Monetary Policy Channels and the Nigerian Economy

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Abstract:

Purpose: *The study empirically analyses monetary policy channels and the Nigerian economy, with a view to examine the effect of monetary policy channels on the economy as well as how it determines the causal relationship between various channels of monetary policy and macroeconomic aggregates of the economy.*

Design/Methodology/Approach: *The VAR impulse-response and variance decomposition and Granger causality tests were considered as analytical techniques of the study with time series data spanning in the period of 1985-2018.*

Findings: *The findings through the impulse-response and variance decomposition results reveal that interest rate channel is the most effective and dominant monetary policy channel in Nigeria, while the causality tests also confirm the existence of causal relationship between the monetary policy channels and the Nigerian economy with the traditional interest rate channel Granger causes the Gross Domestic Product and the consumer price index respectively but not causally related to the country's reserves.*

Practical implication: *Based on the findings, the study recommends that to improve the effectiveness of monetary policy the monetary authorities in Nigeria should take cognizance of channels of monetary policy that impacted positively on the economy particularly those found to be causality related to macroeconomic indicators of the economy.*

Originality/Value: *The study provides the missing link by examining the various channels of monetary policy that affect the Nigerian Economy using selected macroeconomic aggregates and also determines not mere relationship but causal relationship between monetary policy channels and macroeconomic aggregates with expanded scope from 1985 to 2018. This makes the study unique from others considered in the literature.*

Keywords: VAR model, monetary policy, transmission channels, macroeconomic aggregates, Nigeria.

JEL Classification: E4, E5, E6, E7.

Paper Type: Research article.

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1. Introduction

Economies across the world engage monetary policies as major tools of controlling specific variables such as inflation and output, these attempted controls are usually done by Apex bank in every country while the Central Bank of Nigeria (CBN) was specifically designed to indirectly control some specific variables using the intermediate variables known as transmission channels, which the CBN (2011) defines as *“a chain of economic events that link a change in monetary policy to changes in prices and output”*. Adeoye, Ojapinwa and Odekunle (2014) also defines transmission channels as *“the rule and action adopted by the central bank to achieve the objectives of full employment, domestic and financial stability, normal operation of foreign payments as well as price stability.”*

The CBN usually rolls out various monetary policies through Monetary Policy Committee (MPC) to stimulates the economy, the effects of these policies are usually felt by the economy via various policy transmission mechanisms or channels of monetary policy. The various channels of monetary policy identified in the literature includes the traditional interest rate channel, other asset price channels, exchange rate channel and credit channel which is sub-divided into bank lending channel and the balance sheet channel (Mishkin, 2004; CBN, 2011). Others are share price channel (Tahir, 2012) and investment channel (Souza-Sobrinh and Minella, 2008).

2. Literature Review

Controversies abound in the literature on the best transmission mechanism that will affect concerned macroeconomic aggregates and the economy at large, while the causal relationship between monetary policy channels and macroeconomic aggregates also constitutes another unsettled issue in the existing literature. Extant studies have also shown that economies across the world are affected differently by various monetary policy channels identified in the literature. For instance Smets and Wouters (1998) while examining the exchange rate channel of monetary transmission mechanisms in Germany using VAR model with data period 1974-1997, conclude that a monetary tightening situation leads to a strong and prolonged appreciation of the exchange rate. This also has a strong effect on prices of imported goods and net exports.

Carpenter and Demiralp (2010) also analyze the strength of the bank lending channel using bank-level data in a Vector Autoregressive framework for the US economy. The results also indicate that bank loan supply does not respond to changes in monetary policy through a bank lending channel, irrespective of how the banks are grouped. In similar studies conducted by Suardi, (2001), Arnostova and Hurnik, (2005), interest rate channel was reported to be more effective than other transmission channels in most European countries like Czech Republic, UK, Sweden, Belgium, Spain, Germany, France, Italy, and The Netherlands among

others. Chirinko and Kalkreuth (2002) conducted a study on the importance of interest rate and credit channels on business fixed investment in Germany using data covering 1988-1997. The findings from the results reveal that credit (for a subset of firms) and interest rate channels are significant for the German economy.

Sautis and Surico (2013) while analysing credit channel of monetary policy in Germany, France, Spain and Italy using data 1999-2011 found the effect of monetary policy on bank lending more significant and heterogeneous in Germany and Italy, which are characterized by a large number of banks but very weak in Spain and more homogeneous in France, where the banking industry has a higher degree of market concentration. Mengesha and Holmes (2013) also in their own contribution to the discourse examine the monetary policy transmission mechanisms in Eritrea economy using the Vector Autoregressive modeling with data spanning the period 1996-2008 and discover that interest rate and the official exchange rate channels are operational and functional in the economy. The results also indicate that the effective exchange rate and credit channels exist through the black foreign exchange market and credit issued to the government sector in the country.

Also, in a related study by Demchuk, Tomasz, Przystupa, Sznajderska and Wróbel (2012) on the behaviour of some transmission mechanisms in Poland using data from 1998 to 2011 with Vector Autoregressive and structural models, the results reveal that only the interest rate channel is important to the economy, while both the interest rate and credit channels are only relevant for investment purposes. The study conducted by Montiel (2013) examines the monetary transmission mechanisms in the Uganda economy using Vector Autoregressive methods, and data from December 2001 to June 2011. The results show that exchange rate and bank lending channels are significant while the impact of monetary policy appears to be more significant and powerful on bank lending rate and exchange rate than the price level or real activity of the economy. Hu (2014) in his own analysis on the monetary transmission mechanisms in pre-war China using Spearman rank-order correlation and Structural VAR model, with data from January 1929 to December 1935, also concludes that exchange rate channel worked more significantly in the first pre-war period while monetary channel performs better in the second pre-war period.

In a similarly study carried out by Ono (2015) considers whether a bank lending channel exists in the monetary policy transmission mechanism in Russia using bank-level data from 2005 to 2012. The study confirms that banks with less capital tend to react more sensitively to changes in monetary policy. Das (2015) took different dimension to examine the credit channel of monetary policy transmission in India using step-wise estimation of Vector Error Correction Models, with data from end-March 2002 to end-October 2014. The study finds among other things a significant but slow pass through of policy rate changes to bank interest rates in India. The results also indicate that asymmetry adjustments to monetary policy with lending rate adjusts more quickly to monetary tightening than loosening, while the speed of adjustment of deposit and lending rate to changes in the policy rate in India

increased over time. Adeoye *et al.* (2014) while expounding the main models of the credit channels of monetary transmission in Nigeria, using Vector Autoregressive (VAR) model with quarterly time series data from 1986 to 2010 conclude that there is a close relationship between the bank credit and the aggregate demand, which suggests a stronger monetary transmission system via credit channels and investment multiplier in the country.

Okaro (2011) explored the empirical importance of credit in Nigeria using the Vector Autoregressive model approach with an attempt to disentangle loan supply from loan demand shift in the credit channel. The findings reveal that credit channel exerts greater influence on investment in the entire economy. This also affirms credit channel as important part of the transmission process in Nigeria. Ishioro (2013) also examines monetary transmission mechanism in Nigeria using a Granger causality test with data spanning the period 1982-1997 and concludes that both interest rate and exchange rate channels are important to the Nigerian economy. In Adekunle *et al.* (2018) study on monetary policy transmission in Nigeria, with the question of how important is Asset Prices Channel the study confirms that exchange rate channel is the most useful tool in influencing the economy while Nwoko (2016) in his own study on the impact of monetary policy on the economic growth of Nigeria reveals that money supply is an important variable in the economy.

Apere and Karimo (2014) while investigating monetary policy effectiveness output growth and inflation in Nigeria over the period 1970-2011, using a Vector Autoregressive model discover bank lending rate channel as important to the economy while Ogun and Akinlo (2010) examine the effectiveness of bank credit channel of monetary policy transmission in Nigeria, using the Structural Vector Autoregressive (SVAR) technique with secondary data spanning the period 1986-2006. The results show that bank deposits, securities holdings and total loans and advances respond slowly to monetary policy shock during the simulation period, while the monetary policy shock contributes very little to the forecast errors of the bank balance sheet variables.

The study also confirms that bank credit channel is ineffective in Nigeria. Going by the review of related studies, where most of the authors dwelt extensively on the isolated effects of specific transmission channels on the economy, without considering the effect of other channels on the economy while only a relatively few studies considered the relationship between monetary policy channels and the economy.

Therefore, this study seeks to fill these gaps by examining the various channels of monetary policy that affect the Nigerian Economy using selected macroeconomic aggregates and also determines not mere relationship but causal relationship between monetary policy channels and macroeconomic aggregates of the economy, with expanded scope from 1985 to 2018.

3. Methodology

3.1 Theoretical Framework and Model Specification

Keynes' theory postulates that since monetary policy controls interest rates or the money supply, the IS-LM model can possibly help policy makers to predict what will happen to aggregate output and interest rates if they decide to increase money supply. This occurs by postulating that changes in the money supply causes the LM curve to shift, thereby affecting the equilibrium output (aggregate output is positively related to money supply). It also assumes that the price level is fixed such that the real and nominal quantities are the same. The theory also pointed out that the less interest-sensitive money demand, the more effective monetary policy, and also if the LM curve is more stable than the IS curve, a money supply target is preferred in the economy.

3.2 Model Specification

This study employs Vector Autoregressive Model (VAR) based on Keynes IS-LM model to analyse the monetary policy transmissions (MPTMs), while the specification of the VAR model is specified thus:

$$Z_t = A(L)Z_{t-1} + B(L)X_t + u_t \quad (1)$$

where $A(L)$ and $B(L)$ are the polynomial matrices for the lag operator L . Z_t is a vector of endogenous variables, X_t is a vector of exogenous variables and u_t is a vector of random error terms.

3.2.1 The Baseline Model

The baseline model includes the consumer price index, Gross Domestic Product, and reserves which can be expressed as:

$$Z_t = [Y_t P_t R_t] \quad (2)$$

where P_t is the Consumer Price Index, Y_t is the Gross Domestic Product and R_t is the reserves while the basic model modifying the various policy variables that serve as a measure of monetary policy tools are specified as in the following models.

3.2.2 The Interest Rate Channel

The baseline model was modified with a variable that serves as a measure of the interest rate – the interbank rate and the monetary policy rate. Comparing the impact of monetary policy shocks in the basic model and the extended model on output and price would give an idea of the importance of the channel influencing the latter variables in a way that:

$$Z_t = f [Y_t, P_t, R_t, I_t, M_t] \quad (3)$$

where I_t is the Interbank rate and M_t is the Monetary Policy rate, monetary policy is then allowed to respond to shocks on reserves, output, interbank rate and price.

3.2.3 The Credit Channel

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

$$Z_t = f [Y_t, P_t, R_t, C_t] \quad (4)$$

where C_t represents credit to the core private sector. The credit channel remains the kernel variable in the credit view and it seems to situate the roles which the deposit money banks (DMBs) play in the transmission of monetary policy impulses to output and prices.

3.2.4 The Exchange Rate Channel

The baseline model is appended with the real effective exchange rate (a measure of exchange rate). Comparing the response of output and price to monetary policy shocks in the extended model to give an idea of the importance of exchange rate channel in influencing the output and price variables, the extended model is represented thus:

$$Z_t = f [Y_t, P_t, R_t, RE_t] \quad (5)$$

where RE_t represents the real effective exchange rate, the real exchange rate is assumed to respond contemporaneously to shocks in most variables.

3.2.5 The Other Assets Price Channel

On the path of investment the vector of endogenous variables consist of the real GDP, CPI and reserves augmented with the All Share Index (ASI) to determine the path of transmission to the economy as specified thus:

$$Z_t = f [Y_t, P_t, R_t, ASt] \quad (6)$$

where ASt represents the All Share Index, which is allow to respond to shocks on output, prices and reserves.

3.3 Data and Variables Definition

The study variables include Consumer Price Index (P_t) measured in percentage change, Gross Domestic Product (Y_t) measured in Billions of Naira, Reserved (R_t) measured in Billions of Naira, Inter-bank Rate (I_t) measured in percentage change, Monetary Policy Rate (M_t) measured in percentage change, Credit to Core Private Sector (C_t) measured in Billions of Naira, Real Effective Exchange Rate (RE_t) measured in percentage change and All Share Index (ASt) also measured in

percentage change. The time series data on each variable from 1985 to 20018 were sourced from various editions of Central Bank of Nigeria (CBN) Statistical Bulletin.

3.4 Estimation Technique

The Impulse-Response and Variance Decomposition methods from VAR model was used to test the responsiveness of Gross Domestic Product (Yt) to each of the monetary policy channels, while the VAR Granger Causality test was also used to ascertain the causal relationship between the monetary policy channels (RINT, MPR, LCPS, REER and ASI) and macroeconomic aggregates (LGDP, CPI and LRES) in Nigeria. The study relies on the condition for causality between variables only when the probability value from the Block Exogeneity Wald Tests is not greater than 10%.

4. Presentation of Results

4.1 Unit Root Analysis

The nature of the data used (time series) in this study has necessitated the need to carry out unit root test or stationary test to ensure that stochastic process is stationary (Iyoha and Ekanem, 2002). Therefore, the study engaged both the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1981) and the Phillip-Peron (PP) test (Phillips and Perron, 1988) as follows:

Table 1. *The Result of Augmented Dickey-Fuller (ADF) Test*

Variable	Level	First Difference	Order of Integration
LGDP	-1.75 (-2.97)	-3.53** (-2.97)	I(1)
CPI	-2.51 (-2.97)	-3.47** (-2.99)	I(1)
LRES	-0.49 (-2.98)	-2.82** (-1.95)	I(1)
RINT	-5.42** (-2.97)		I(0)
MPR	-2.86 (-2.96)	-6.73** (-3.01)	I(1)
LCPS	-0.53 (-2.97)	-4.28** (-2.97)	I(1)
REER	-6.09** (-2.97)		I(0)
ASI	-0.90 (-2.97)	-5.11** (-2.98)	I(1)

Note: *The values in the parenthesis () are the critical values at 5% (t-values); (**) indicates significant at 5% level; LGDP, RINT, REER, MPR, CPI, ASI, LRES, LCPS represent natural log of gross domestic product, real interest rate, real effective exchange rate, monetary policy rate, consumer price index, all share index, natural log of reserves and natural log of credit to private sector respectively.*

Source: *Authors' computations, 2019.*

Table 2. *The Result of Phillip-Peron (PP) Test*

Variable	Level	First Difference	Order of Integration
LGDP	-1.58 (-2.97)	-3.55** (-2.97)	I(1)
CPI	-2.51 (-2.97)	-6.00** (-2.97)	I(1)
LRES	1.86 (-1.96)	-4.55** (-1.95)	I(1)
RINT	-5.42** (-2.97)		I(0)
MPR	-2.85 (-2.97)	-6.78** (-2.97)	I(1)
LCPS	-0.56 (-2.97)	-4.30** (-2.97)	I(1)
REER	5.48** (-2.97)		I(0)
ASI	-0.77 (-2.97)	-5.12** (-2.97)	I(1)

Note: *The values in the parenthesis () are the critical values at 5% (t-values); (**) indicates significant at 5% level; LGDP, RINT, REER, MPR, CPI, ASI, LRES, LCPS represent natural log of gross domestic product, real interest rate, real effective exchange rate, monetary policy rate, consumer price index, all share index, natural log of reserves and natural log of credit to private sector respectively.*

Source: *Authors' computations, 2019.*

Table 1 and Table 2 show the ADF and the PP tests results of log of Gross Domestic Product, log of reserves, log of credit to private sector, consumer price index, all share index and monetary policy rate, being all stationary at first difference while real interest rate and real effective exchange rate were stationary at levels. The results of unit root tests informed the study of the application of Vector Autoregression (VAR) model, since it could accommodate variables of different orders of integration i.e., stationary at first difference and at levels.

4.2 Monetary Policy Channels' Effect on the Nigerian Economy

4.2.1 Impulse-Response Analysis

The impulse- response of Vector Autoregression (VAR) model was adopted to examine the effect of monetary policy channels on the Nigerian economy. Figure 1 shows the positive and significant response of GDP to one standard deviation innovation in the past values of GDP in both short and long run. The results also show that GDP responded positively and contemporaneously to one standard deviation innovation in the real interest rate in both short and long run periods, while the effect of real interest rate on GDP increased in the short run before assuming an oscillatory movement in the long run. This further reveals the significant impact of real interest rate on GDP. Similarly, the response of GDP to one standard deviation shock to monetary policy rate is also significantly positive in both short and long run except in the second period when the shock exerts negative effect on GDP.

Thus, the results depict a vibrant channel of monetary transmission mechanism (traditional interest rate channel). Moreover, the response of GDP to one standard deviation shock to credit to private sector (bank lending channel) appears very small and negative in the long run, this is evident in its oscillatory movement. In the same vein, GDP respond negatively to one standard deviation shock to real effective

exchange rate in both short and long run, while the response of GDP to one standard deviation shock to all share index shows negative in both short and long run. The oscillatory movement in real effective exchange rate and all share index around the negative values justify the inappropriateness of exchange rate channel as monetary transmission mechanism in Nigeria.

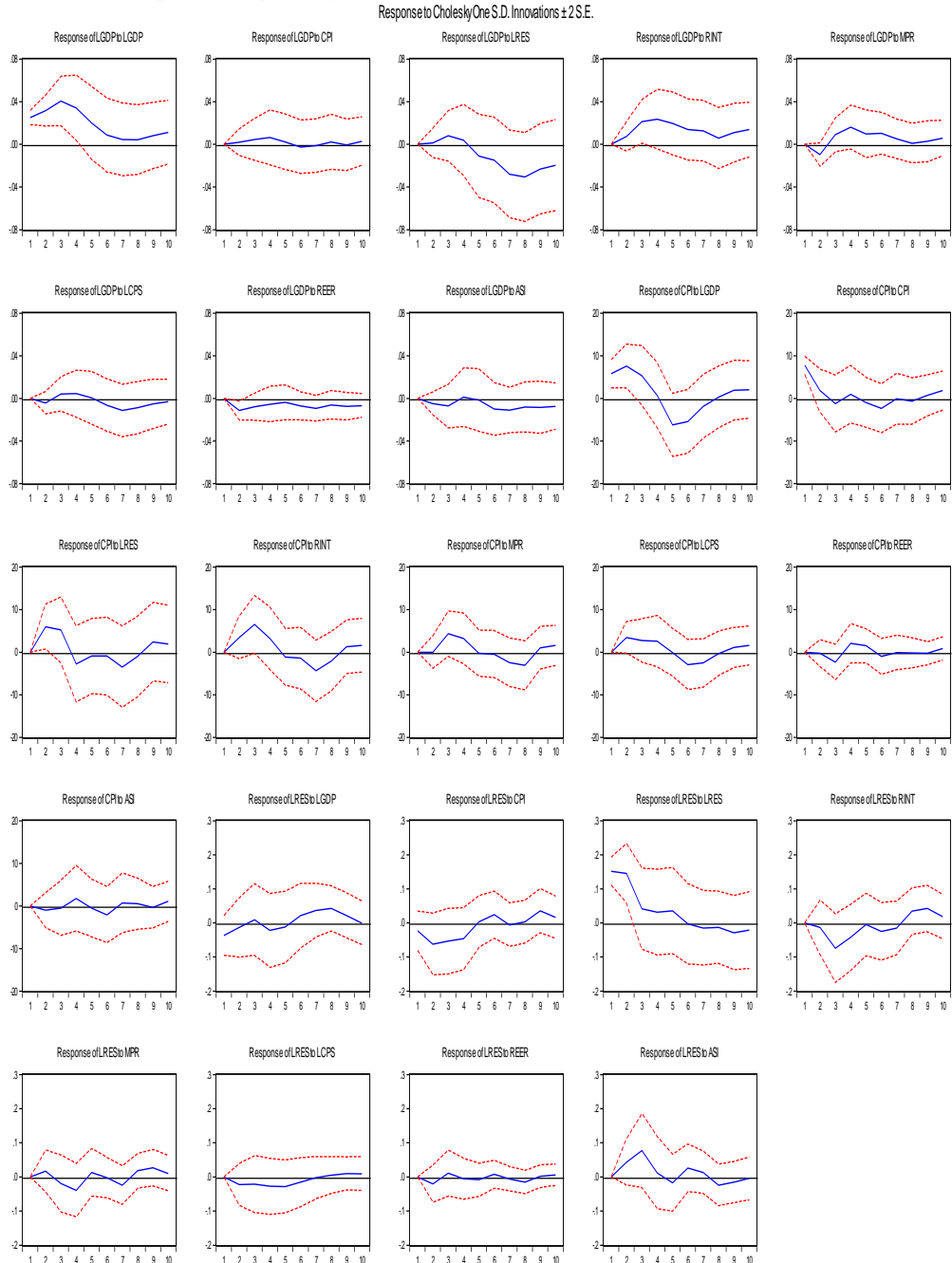
The results also indicate positive response of consumer price index to one standard deviation innovation in the GDP in the short run before being negative in the medium run, and later positive and upward movement in the long run, while the result of consumer price index response to one standard deviation innovation in the past values of consumer price index shows significant positive in the short run before an oscillatory movement around negative values in the long run. In other words, consumer price index is affected contemporaneously by the shocks from its past values but diminishes over time. Moreover, the response of consumer price index to one standard deviation shock to real interest rate shows significant positive in the short run and oscillates around negative values in the medium run and positive in the long run. The consumer price index also respond significantly positive to one standard deviation shock to monetary policy rate in the short run while the shock exerts a significant negative effect on consumer price index in the long run.

Thus, the significance of the effects of shocks to real interest rate and monetary policy rate is a confirmation of traditional interest rate channel of monetary policy as dominant in the economy. Furthermore, the response of consumer price index to one standard deviation shock to credit to private sector (bank lending channel) also oscillating around the negative values in both short and long run. The oscillatory movement in credit to private sector as a monetary policy variable confirms that it is an ineffective channel of transmission of monetary policy. In the same vein, the response of consumer price index to one standard deviation shock to real effective exchange rate and all share index shows insignificant in both short and long run. This justifies the inappropriateness of exchange rate as monetary policy channel in Nigeria.

The response of current reserves also as a macroeconomic variable to a one standard deviation innovation in the past values of reserves itself shows significant positive in the short run and negative in the long run, while the response of reserves to one standard deviation innovation in the real interest rate is significantly negative in the short run and exerts a significant positive effect in the long run. This is also an indication of the dominance of traditional interest rate channel in Nigeria. Similarly, the response of reserves to one standard deviation shock to all share index appears positive in the short run and oscillates around negative values in the long run. This indicates relative importance of all share index in explaining the level of reserves in the economy; it also explains that other asset price channel might be relatively important considering reserves as a macroeconomic variable. However, the response of reserves to one standard deviation shock to credit to private sector, real effective

exchange rate and monetary policy rate shows insignificant in both short and long run.

Figure 1. Impulse-response functions



Source: Authors' computations through Eviews 9, 2019.

4.2.2 Variance Decomposition Analysis

Variance decomposition analysis provides avenue to determine the relative importance of shocks in explaining variations in the variable of interest in the VAR model. Tables 3, 4 and 5 show the results of variance decomposition of variables used in the model.

Table 3. Variance Decomposition of Log of Gross Domestic Product (LGDP)

Period	S.E.	LGDP	CPI	LRES	RINT	MPR	LCPS	REER	ASI
1	0.03	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.04	83.24	0.20	0.08	2.76	4.75	0.94	6.81	1.22
3	0.07	75.24	0.56	1.48	11.67	3.95	0.81	4.53	1.77
4	0.08	68.98	1.01	1.22	16.51	6.68	0.83	3.55	1.21
5	0.09	64.90	0.94	2.66	19.39	7.05	0.72	3.26	1.09
6	0.09	59.54	0.92	5.09	19.80	7.66	1.16	3.57	2.26
7	0.10	51.52	0.81	12.49	18.72	6.87	2.38	3.99	3.22
8	0.10	46.02	0.76	19.87	16.98	6.12	2.84	3.90	3.50
9	0.11	43.10	0.71	22.94	16.69	5.72	2.88	4.10	3.86
10	0.11	41.18	0.73	24.43	17.05	5.60	2.76	4.19	4.06

Source: Authors' Computations through Eviews 9, 2019.

The results in Table 3 show that CPI, LRES, RINT, MPR, LCPS, REER and ASI did not explain variations in GDP (LGDP) in the short run and first period. However, real interest rate explains 2.76%, 19.39% and 17.05% variations in GDP in the second, fifth and tenth periods, which is the long run period. Similarly, monetary policy rate explains 4.75% in the second period and increased to 7.05% in the fifth period and decreased to 5.60% in the tenth period. This implies that real interest rate and monetary policy rate have substantial power to predict GDP fluctuation compared to other monetary policy variables in the medium and long run, while both have limited predictive power in the short run. This is consistent with the impulse-response results, confirming the traditional interest rate channel as important channel of monetary policy in the economy.

However, the effect of credit to private sector also explains about 0.94%, 0.72% and 2.76% in the second, fifth and tenth periods respectively. This shows that credit to private sector has limited power to predict variation in GDP in the medium and long run but with no predictive power in the short run. Moreover, real effective exchange rate explains 6.81%, 3.26% and 4.19% variations in the second, fifth and tenth period. The all share index also explains 1.22% in the second, 1.09% in the fifth and 4.06% in the tenth period respectively. This indicates that all share index has more predictive power in the long run. The results finally reveal that LGDP's own shocks accounted for 100%, 64.9% and 41.18% variations in itself in the first, fifth and tenth period respectively. This explains that LGDP own shocks fade out in the long run, which is also in line with the impulse-response results.

Table 4. Variance Decomposition of Consumer Price Index (CPI)

Period	S.E.	CPI	LGDP	LRES	RINT	MPR	LCPS	REER	ASI
1	9.70	64.75	35.25	0.00	0.00	0.00	0.00	0.00	0.00
2	14.63	29.92	42.02	16.62	5.52	1.76E-06	5.39	0.04	0.48
3	18.57	19.03	34.29	18.25	15.57	5.39	5.46	1.64	0.37
4	19.70	17.14	30.60	18.20	16.42	7.45	6.52	2.53	1.14
5	20.80	15.59	36.45	16.53	15.03	6.69	5.85	2.78	1.09
6	22.03	15.05	38.57	14.93	13.83	6.02	7.02	2.70	1.88
7	23.10	13.70	35.74	15.84	16.26	6.59	7.62	2.46	1.80
8	23.45	13.36	34.69	15.56	16.62	8.18	7.41	2.39	1.79
9	23.74	13.12	34.47	16.19	16.50	8.17	7.43	2.35	1.77
10	24.16	13.23	33.98	16.24	16.36	8.30	7.58	2.40	1.91

Source: Authors' Computations through Eviews 9, 2019.

Table 4 shows the results of variance decomposition of consumer price index (CPI), which also reveal the real interest rate explaining about 5.5% variation in the second period, increased to 15.0% and 16.4% in the fifth and tenth period respectively. In the same vein, monetary policy rate explains 0.0% in the second period, about 6.69% in the fifth period and 8.3% in the tenth and long run period. This shows that real interest rate and monetary policy rate have substantial power to predict fluctuations in consumer price index in the medium and long run but with limited predictive power in the short run.

Hence, the traditional interest rate channel remains a viable channel of monetary policy in Nigeria. Moreover, the variation in CPI explained by credit to private sector is relatively stable with explanation of about 5.39%, 5.85% and 7.58% variations in the second, fifth and tenth period respectively. This also signifies that credit to private sector has relatively substantial power to predict consumer price index in the medium and long run periods. The real effective exchange rate also explains about 0.04% in the second period, 2.78% in the fifth period and decreased to 2.4% in the tenth period, while all share index accounted for 0.48% 1.09%, and 1.91% variations in the second period, fifth period and tenth period respectively. This implies that real effective exchange rate and all share index have very limited predictive power to explain variation in CPI in both short and long run periods in the economy. The results also reveal that CPI's own shocks accounted for 64.8%, 15.6% and 13.2% variations in itself, in the first, fifth and tenth period respectively, which also explains that CPI own shocks fade out in the long run. This also agrees with the impulse-response results.

Table 5. Variance Decomposition of Log of Reserves (LRES)

Period	S.E.	LRES	LGDP	CPI	RINT	MPR	LCPS	REER	ASI
1	0.16	92.26	5.55	2.19	0.00	0.00	0.00	0.00	0.00
2	0.23	82.65	2.92	8.29	0.32	0.54	0.96	0.80	3.53
3	0.27	64.95	2.34	10.35	8.13	0.94	1.36	0.76	11.16
4	0.28	59.59	2.74	12.08	9.60	2.86	2.21	0.72	10.20

5	0.29	59.07	2.83	11.67	9.29	2.97	3.14	0.79	10.23
6	0.29	57.23	3.26	11.98	9.75	2.89	3.33	0.83	10.72
7	0.29	55.74	4.72	11.65	9.70	3.50	3.24	0.85	10.59
8	0.30	53.29	6.47	11.11	10.55	3.67	3.11	1.07	10.73
9	0.31	51.19	6.59	11.81	11.79	4.21	3.03	1.01	10.37
10	0.31	50.99	6.50	11.91	11.96	4.26	3.08	1.03	10.26

Source: Authors' Computations through Eviews 9, 2019.

The results in Table 5 indicate variance decomposition of log of reserves showing the real interest rate explaining about 0.32% variation in the second period, 9.29% in the fifth period and 11.96% in the tenth and long run period. The monetary policy rate also shows 0.54% variation in the second period, increased to 2.97%, 4.26% variations in the fifth and tenth period. This shows that real interest rate and monetary policy rate have substantial power to predict fluctuations in reserves in the medium and long run but with limited predictive power in the short run. Hence, the traditional interest rate channel remains a dominant channel of monetary policy in the country.

Moreover, the variation in reserves explained by credits to private sector is relatively stable with explanations of 0.96%, 3.14% and 3.08% in the second, fifth and tenth period respectively. This implies that credit to private sector has limited predictive power to explain variations in reserves in the medium and long run periods in Nigeria. Also, the real effective exchange rate explains about 0.8%, 0.79% and 1.04% variations in reserves in the second, fifth and tenth period. This also reflects the limited predictive power of real effective exchange to explain variation in reserves in both short and long run periods, whereas all share index accounted for 3.58%, 10.23% and 10.26% variations in reserves in the second, fifth and tenth periods. This indicates that all share index has substantial predictive power to explain variation in reserves in both short and long run period in Nigeria. The results also show that reserves own shocks accounted for 92.26%, 59.07% and 50.99% variations in itself in the first, fifth and tenth period respectively. This implies that reserves own shocks fade out in the long run as earlier proved by impulse-response results.

4.3 Causal Relationship between Monetary Policy Channels and the Nigerian Economy

The VAR Granger Causality or Block Ergogeneity Wald Tests was specifically adopted in order to understand the causality between the monetary policy channels, measured by monetary variables (RINT, MPR, LCPS, REER and ASI) and Nigerian Economy, measured by macroeconomic variables (LGDP, CPI and LRES).

Table 6. The results of VAR Granger Causality or Block Exogeneity Wald Tests

	LGDP	CPI	LRES	RINT	MPR	LCPS	REER	ASI	ALL
LGDP		5.23 [0.07]***	0.32 [0.85]	2.75 [0.25]	12.12 [0.0023]*	0.72 [0.70]	7.08 [0.0]**	1.11 [0.58]	45.86 [0.000]*
CPI	10.11 [0.0064]*		1.89 [0.39]	2.23 [0.33]	12.46 [0.0020]*	10.42 [0.0055]*	0.60 [0.74]	0.62 [0.74]	48.94 [0.0000]*
LRES	1.28 [0.53]	0.06 [0.97]		1.07 [0.59]	1.79 [0.41]	0.28 [0.87]	2.75 [0.25]	2.63 [0.27]	30.42 [0.0067]*
RINT	4.23 [0.12]	2.12 [0.3464]	0.58 [0.75]		17.60 [0.0002]*	3.12 [0.21]	11.89 [0.00]**	4.67 [0.10]***	54.72 [0.0000]*
MPR	0.045 [0.98]	6.69 [0.04]**	3.10 [0.21]	0.74 [0.69]		1.39 [0.50]	7.11 [0.0]**	1.70 [0.43]	39.24 [0.0003]*
LCPS	6.34 [0.042]**	4.75 [0.09]***	2.51 [0.29]	3.34 [0.19]	2.67 [0.26]		1.08 [0.58]	1.51 [0.47]	21.92 [0.08]***
REER	0.66 [0.72]	7.91 [0.02]**	2.99 [0.22]	0.22 [0.90]	2.07 [0.36]	0.56 [0.75]		0.08 [0.96]	23.95 [0.05]**
ASI	3.18 [0.21]	0.09 [0.95]	3.38 [0.18]	0.96 [0.62]	0.17 [0.92]	1.41 [0.49]	1.62 [0.45]		11.64 [0.64]

Note: ***, **, and * indicate significance at 1%, 5%, and 10%. *LGDP, CPI, LRES, RINT, MPR, LCPS, REER and ASI* represent, natural log of GDP, consumer price index, natural log of reserves, monetary policy rate, natural log of credit to private sector, official real effective exchange rate, and all share index respectively. Figures in the squared parentheses “[]” represent probabilities values of the Chi-square.

Source: Authors' Computations, through Eviews 9, 2019.

Table 6 presents the results of the VAR Granger causality, explaining the causal relationship among variables of the study. The results show that monetary policy rate (MPR), official real effective exchange rate (REER) and consumer price index (CPI) Granger-cause gross domestic product (LGDP) at 1%, 5% and 10% respectively. This implies that monetary policy rate (traditional interest rate channel), official real effective exchange rate (exchange rate channel) and consumer price index have predictive power to explain changes in gross domestic product in Nigeria. The results also show that all the variables together Granger-cause LGDP, that is a unidirectional causality running from MPR (traditional interest rate channel) to Log of GDP which is consistent with the findings of Kelikume (2014), Onanuga and Onanuga (2014), Olorunfemi and Faloye (2008), and Ihezukwu (2011).

Similarly, the results show the existence of causal relationship between REER (exchange rate channel) to Log of GDP, which also agrees with the findings of Ishioro (2013), Ogunsakin, (2014), and Nwosa and Saibu, (2012). The results further show that monetary policy rate (MPR), credit to private sector (LCPS) and GDP Granger-cause gross domestic product (LGDP) at 10% level respectively, while all the variables together Granger-cause Consumer Price Index (CPI). The result also signifies the existence of causal relationship between monetary policy rate (traditional interest rate channel), credit to private sectors (credit channel) and GDP and with the predictive power of all the variables to explain changes in consumer price index in Nigeria.

However, none of the variables Granger-causes the country reserves, while all the variables together Granger-cause reserves at 10% level. The results further show that MPR, REER and ASI Granger-cause real interest rate at 10%, 10% and 1%

respectively. Since MPR is the CBN short term interest rate that determines all other rates of interest, therefore the causal relationship between MPR and RINT is expected. The official real effective exchange rate (REER) and consumer price index (CPI) Granger-cause monetary policy rate (MPR) at 5% level each, LGDP and CPI also Granger-cause credit to private sector at 5% and 1% respectively, while the CPI Granger-causes REER at 5% level. It is obviously clear from the results that none of the variables Granger causes all share index, while all the variables together not Granger-cause all share index (ASI), which means that the joint effect of all the variables could not determine the all share index (ASI).

5. Conclusion and Policy Recommendations

This study empirically analyses the monetary policy channels and the Nigerian economy, with a view to examine the monetary policy channels that affect the Nigerian economy and also determines the causal relationship between monetary policy channels and the economy. The study considered the VAR impulse-response and variance decomposition, and Granger causality tests as analytical methods. The findings through impulse-response and variance decomposition results show the interest rate channel as most effective and dominant monetary policy channel in Nigeria, while the causality tests show that causal relationship exists between the monetary policy channels and the Nigerian economy, with the traditional interest rate channel Granger causes the GDP and the consumer price index but without causal relationship with the country reserves.

The study concludes that interest rate channel remains the dominant channel of monetary policy in Nigeria especially when Gross Domestic Product, Consumer Price Index and the Country's Reserves are considered as macroeconomic variables. Hence, other monetary policy channels apart from interest rate channel do not significantly affect monetary policy and macroeconomic variables in Nigeria. The study recommends that to improve the effectiveness of monetary policy, the monetary authorities in Nigeria should take cognizance of channels of monetary policy that impacted positively on the economy, and also particular on those found to be causality related to macroeconomic indicators of the economy.

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