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**Article**

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# MONETARY POLICY REACTION FUNCTION IN TURBULENT PERIOD: THE CASE OF NIGERIA<sup>1</sup>

*Elias A. Udeaja PhD<sup>2</sup>*

## ***Abstract***

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*This paper utilizes a modified structural VAR (SVAR-X) model to analyse the process of monetary policy reaction function in turbulent period compared to the period of tranquillity. The study finds that it is crucial to distinguish between the response of monetary policy to output growth and inflation and across turbulent period compared to periods of tranquillity. Equally deciphered from the finding of the study is the fact that monetary policy and its effectiveness, particularly in the context of Nigeria cannot be examined without taking into consideration the peculiarity of her economy's reliance on oil and oil prices. This among others, is an indication that the effectiveness of monetary policy in Nigeria is episodic and ignoring such episodic feature may not only undermine any inference drawn from analysis of monetary policy but by extension capable of leading to wrong policy prescription.*

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**Keywords:** Monetary Policy Reaction Function; Asymmetric; Uncertainty; Developing Economies

**JEL Classification:** E44, E52, E58

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<sup>1</sup>The views expressed in this paper are those of the author and do not in any way reflect the opinions of the Central Bank of Nigeria.

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## 1.0 INTRODUCTION

Monetary policy anywhere in the world usually involves a deliberate action(s) from the government and/or her agency geared towards price stability and macroeconomic growth. Thus, changes in monetary policy have implications for both the internal and external balance of an economy (Anwar & Nguyen, 2018). To put it differently, fluctuations in the monetary instruments such as interest rate and exchange rate have a direct bearing on financial markets, which in turn affect the price level and consequently the level of economic activity within the economy. To this end, the task of achieving the objectives of monetary policy cannot be in isolation of clear understanding of its reaction function. Consequently, there has been increasing efforts towards understanding the process of monetary policy reaction function (see for example, Anwar & Nguyen, 2018; Ekong & Ukoha, 2018; Stakėnas & Stasiukynaitė, 2017; Gitonga, 2015; Altunbas et al., 2014; Davoodi et al., 2013; Samba, 2013; Boivin et al., 2010; Tsangarides, 2010).

Notwithstanding the proliferation of studies on monetary policy, it is instructive to note that the literature is far from conclusive on how monetary policy affects the economy. The lack of consensus about monetary policy reaction function is often attributed to the different economic structures characterizing the different economies (Ekong & Ukoha, 2018). This difference in the structure of the economy manifests itself in the form of difference in balance sheet positions, financial sector technology, institutional quality and expectation concerning future policy. Thus, since any of these have the potential to alter the economic effects of a given monetary policy measure, then the central banks need to be alert to be able to continuously reinterpret the response of monetary policy. This observation seems to have particularly prompted in a new strand of debate in the literature, particularly on the extent to which the wave of unpredicted changes in the international economic environment occasioned by the 2007-2008 global financial crisis (GFC) have impaired the effectiveness of monetary policy response.

For instance, many central banks during the crisis eased monetary policy aggressively in order to alleviate financial market distress, boost output and stabilize price. But while the easing policy appears to be largely successful in mitigating financial market distress, the output and inflation on the other hand remained lower than expected, thus making the recovery process largely perceived as disappointingly sluggish (see Pain et al., 2014). To further validate or refute this position, literature on monetary policy appears to have moved beyond the obvious need to access the relative effectiveness of the different channels of monetary policy transmission to whether they are less effective in turbulent or crisis periods. Exploring a panel data -base VAR mode, Jannsen et al. (2015) use the case of developed countries to conclude that monetary policy reacts relatively more aggressive in the acute phase financial compared to the recovery phase.

Supporting the above position is the study by Egea & Hierro (2018). In their investigation of the effectiveness of monetary policy before and after the 2007 economic crisis, they found that, in the United States, monetary policy before and after the crisis have been effective, but only effective before the crisis in the case of the Eurozone. However, the bulk of the extant literature on this new strand of literature predominantly focused on the case of developed economies (see for example, Lenza et al., 2010; Peersman, 2011; Ciccarelli et al., 2013; Altunbas et al., 2014). The dearth of literature particularly in the context of developing economies may not be unconnected to the widespread view that the effect of GFC is relatively more severe in developed world when compared to the developing ones (see Bandara, 2010).

Partially in line with the aforementioned, the majority of studies on monetary policy in Nigeria (see for example, Uma et al., 2014; Adeoye et al., 2014; Obafemi & Ifere, 2015; Babatunde & Olatunji, 2017; Ekong & Ukoha, 2018) continued to ignore the relevance of the emerging literature on the likelihood

of monetary policy reacting differently in turbulent period compared to the period of tranquillity. Given the increasing integration of the global economy however, it might be empirically erroneous to assume that Nigeria is immune to the 2007-2008 financial crisis without a veritable evidence to that effect. The recent recessionary trends in the Nigeria economy is though attributed to the unrest in the oil-producing region of the country but coincided with the period of historically declining in international crude oil prices.

In view of the above, the Nigerian economy appears to be potentially vulnerable to both the internal and external unanticipated shock capable of undermining the effectiveness of monetary policy in the country. In this regard therefore, it is also relevant to revisit literature on monetary policy reaction function in Nigeria, and germane to this present study is whether monetary policy in Nigeria has been less effective in the turbulent period occasioned by the country's vulnerability to unanticipated shock. In their description of turbulent economic periods, D'ees & Brinca (2013); Bloom (2009); and Reinhart & Rogoff (2008) Reinhart & Rogoff (2008); Bloom (2009); and D'ees & Brinca (2013) refers to it as that episode that usually require the intervention of monetary policy via an effective channel(s). Hence, the novelty in the context of this study is to explore both the domestic and global perspectives to offer new insights on the extent to which the turbulent periods undermine or amplify the effectiveness of monetary policy in Nigeria.

In addition to this introductory section, the remainder of the paper is organized as follows: Section two presents a brief literature review on the subject matter. Section three presents the model and as well explains the suitability of the econometric method employed. Section four presents the data and discusses the findings. Section five concludes the paper.

## 2.0 LITERATURE REVIEW

Literature on the effectiveness of monetary policy is usually associated with analysis of its reaction function. While examining the effectiveness of monetary policy in India, Aleem (2010) takes cognizance of the external constraints on monetary policy in its estimation of a series of vector auto regression models. The empirical result suggests that the lending rate initially increases in response to a monetary tightening with banks playing an important role in the response of monetary policy to shocks due real sector. Using the Eritrea dataset, Mengesha & Holmes (2013) in their analysis of monetary policy identified with interest rate and exchange rate as the appropriate channels for enhancing the effectiveness of monetary policy response. Monte (2013) analyses the effect of credibility on the conduct of monetary policy and found inflation targeting as an important strategy for the achievement of a more stable macroeconomic environment. For Bhattacharya (2014), the study used the case of Vietnam to argue that understanding the drivers of inflation matters for the effectiveness of monetary policy.

In a more recent study using Vietnam dataset, Hai & Trang (2015) found that money demand and interest rate fluctuations account for a large proportion of variation in aggregate output (see also, Anwar & Nguyen, 2018). For Stakenas & Stasiukynaites (2017), they explore a comparative approach to analysing the effectiveness of monetary policy in the euro area with Lithuanian economy the focal point. They found that the effectiveness of monetary policy is relatively more pronounced for the Lithuanian economy compared to the entire euro area. For Mahathanaseth & Tauer (2019), they identified banking lending channels as the most appropriate for enhancing monetary policy effectiveness in Thailand. On whether the degree of household indebtedness can affect the effectiveness of monetary policy, Kim & Lim (2019) premised on an interacted panel VAR approach to obtain several interesting findings, such as the responses of consumption and investment to monetary shock were stronger in high levels of household debt.

Similar to the trends of literature across the globe, Uma et al. (2014) use the case of Nigeria to show that interest rate, credit channels and exchange rate are among the channels of monetary policy that matters for enhancing the response of monetary policy to the economy. In the case of Adeoye et al. (2014), they link the effectiveness of monetary policy response in Nigeria mainly to the credit channel of monetary policy transmission and their finding suggests there is a relationship between credit supply and aggregate demand through investment decisions in the economy (see also, Obafemi & Ifere (2015). For Babatunde & Olatunji (2017), they inferred that when the concern is about the transmission of monetary policy, that the consideration should be given to effective response of monetary policy.

Investigating the lingering issue of monetary policy transmission, Ekong & Ukoha (2018) utilized a two-way technique of VAR and ARDL to report as thus; monetary policy does not respond to economic activity. Ezeaku et al. (2018) investigated monetary policy and industrial sector growth in Nigeria and they found that private sector credit, interest rate, and exchange rate channels of monetary policy respond negatively to real output growth, both in the long run and in the short run.

In recent time however, the focus of the literature has since been expanded to capture the extent to which turbulent period matter for the effectiveness or otherwise of monetary policy partially due to the 2007/2008 global financial crisis episode (see Engen et al., 2015; Baumeister & Benati, 2013; Chung et al., 2011). Lenza et al. (2010) for example, found a positive effect of the ECB's unconventional monetary measures on credit after the start of the financial crisis (see also Ciccarelli et al., 2013). In the case of Altunbasa et al., (2014) and Jimenez et al., (2009), they explored the risk-taking channel to uniformly conclude that tightening monetary policy usually induces risk aversion thus motivating agents to wanting to disinvest in risky assets.

Worthy of note, however, is the fact that, beyond the dearth of the literature from the view point of developing countries, Nigeria inclusive, a number of the extant studies mainly incorporate observation related to the pre –crisis period and, therefore, failed to separate between the pre- and post-crisis periods (see for example, Wang, 2016). To bridge this gap, Egea & Hierro (2018) use the case of the U.S and the euro area to analyse the effectiveness of monetary policy and its transmission channel both in the period before and after the 2007/2008 economic crisis. They find the risk-channel of monetary policy transmission to be effective in the case of the U.S. both in the pre- and post-crisis period. For the euro area, their finding of the credit channel as effective channel of monetary policy is only viable in the pre-crisis period. However, empirical findings from studies such as Vavra (2014); Buch et al. (2014); Bouis et al. (2013); and Valencia (2013) seems to be suggesting that monetary policy is less effective during turbulent periods.

It is in the midst of the above mixed findings regarding the effectiveness or otherwise of monetary policy in turbulent period, that this present study is providing the literature with new insights on the effectiveness or otherwise of monetary policy in Nigeria. Unlike previous studies, this present study defines turbulent period to include the period of 2007/2008 global financial crisis (GFC), the negative oil price shock in 2014 and the subsequent economic recession in Nigeria in 2016. One of the main innovations of this paper is, therefore, to view turbulent periods from both global and domestic perspectives.

### 3.0 THE MODEL

#### 3.1 The SVAR-X model

Although there are different channels of transmission of monetary policy identified in modern financial systems, the interest rate channel however, remains the workhorse in the literature. Consequently, the three variable SVAR-X model in equation also rooted on the interest rate channel of monetary reaction function.

$$A_0 Y_t = \Pi_0 + \Pi_1 Y_{t-1} + \Pi_2 Y_{t-2} \cdots + \Pi_p Y_{t-p} + \lambda X_t + \varepsilon_t \quad (1)$$

The monetary reaction function in equation (1) is in line with the traditional Taylor's rule, which predicts the potential of monetary policy to react to shocks due to variation in price level (i.e. inflation) and output growth, respectively. Such that;  $y_t = [g_t, \pi_t, \Delta i]'$  is a 3x1 vector of endogenous variables,  $A_0$  is a 3x3 matrix of contemporaneous effects, the term  $\Pi_0$  on the one hand denote 3x1 vector of constant, while  $\Pi_i$  is a 3x3 matrix of coefficients for lagged variables. Quite an important component of the specification is  $\forall i > 0; X_t$  which is a 3x1 vector of fixed regressors accounting for turbulent periods such as seasonal effects from both the global domestic perspectives, while  $\lambda$  is a 3x3 matrix in diagonal form for the coefficients associated with the fixed regressors. The term  $\varepsilon_t$  is a 3x1 vector of error terms while the  $p$  terms on the other hand is the optimal lag usually determined via the SIC lag selection criteria.

In order to evade unit root problem in the specification, the endogenous variables, namely; output growth ( $g_t$ ); inflation rate ( $\pi_t$ ) and change in interest rate ( $\Delta i$ ) are measured as the first difference of the log of industrial production index, first difference of the log of consumer price index, and changed in nominal interest rate proxied via prime lending interest rate, respectively. For the sake of convenience, we further rewrite the fixed regressors in equation (1) in a diagonal matrix as follows:

$$\lambda X_t = \begin{bmatrix} \lambda_1 & 0 & 0 \\ 0 & \lambda_2 & 0 \\ 0 & 0 & \lambda_3 \end{bmatrix} \begin{bmatrix} X_{1t} \\ X_{2t} \\ X_{3t} \end{bmatrix} \quad (2)$$

However, the fact that analysing with SVAR also depends on the identification of the model, we further impose some restrictions based on the  $[n(n-1)/2]$  condition and also follow the recursive approach to estimating the SVAR model as indicated in Table 1 below.

**Table 1:** The  $A$  matrix restriction table

The Endogenous Variables	Variables for Contemporaneous Effect		
	$g_t$	$\pi_t$	$\Delta i$
$g_t$	*	0	0
$\pi_t$	1	*	0
$\Delta i$	1	1	*

Theoretically, table 1 is fundamentally structured as follows: (i) That output growth in the current period do not respond to inflation nor interest rate; (ii) That monetary policy using current interest rate react directly to variation in output growth and not price level (inflation); and (iii) That there is monetary policy rule in which interest rate react to variation in both current output growth and inflation, respectively. Besides, the inclusion of  $X$  for instance the  $d_t$  term in the model was to capture the peculiarity of the economy and some inherent features of the series.

The above VAR-X model is indeed structural in the sense that it explicitly allows for instantaneous interaction between the endogenous variables through contemporaneous coefficient matrix,  $A$ . Thus, the model can be further rewritten as follows:

$$Y_t = B(L)Y_t + e_t \quad (3)$$

where  $L$  is a polynomial lag operator and it must be pointed out that the omission of the fixed term in equation (3) is mainly for notational convenience., such that;  $B(L)Y_t = A_0^{-1}(\Pi_1 L_1 Y_{t-1} + \Pi_2 L_2 Y_t + \dots + \Pi_p L_p Y_t)$  and  $e_t = A_0^{-1} \varepsilon_t$ . Recall the recursive story illustrated in table 1 rest on the theory of Taylor's rule, hence; the "orthogonalization" of the reduced form residuals involving Cholesky decomposition is therefore necessary in the context of this study. As a result, the matrix in equation (4) is the initial impulse response of output growth and inflation to monetary policy shock.

$$\begin{bmatrix} e_t^g \\ e_t^\pi \\ e_t^{\Delta i} \end{bmatrix} \setminus = \begin{bmatrix} a & 0 & 0 \\ b & c & 0 \\ d & e & f \end{bmatrix} \begin{bmatrix} \varepsilon_t^{\text{supply}} \\ \varepsilon_t^{\text{demand}} \\ \varepsilon_t^{\text{monetary}} \end{bmatrix} \quad (4)$$

The shocks in this system are given the names supply shock ( $e_t^g$ ), demand shock ( $e_t^\pi$ ) and monetary/interest rate shock ( $e_t^{\Delta i}$ ). Theoretically, deciphered from equation (4) is that output growth is neither responding to contemporaneously to output growth nor to interest rate. This may not be unconnected to the operational rigidities in the production process. However, the price level (i.e. inflation) is expected is predicted to respond contemporaneously to variation in output growth since the assumption of rigidity in the production process do not hold in that instance. On the whole, the response of monetary policy to inflation often comes with some lags especially when the transmission channel is production channel. To this end, both the supply and demand shocks are usually predicted

as likely to result to an unanticipated monetary policy action so as to mitigate their probable long run consequences (see Yakubu et al., 2019).

## 4.0 DATA AND EMPIRICAL RESULTS

### 4.1 Data and preliminary results

The data frequency is quarterly ranging from the first quarter of 2000 to the fourth quarter of 2018. In line with the objectives of this study, the sample period is divided into full-sample, pre-GFC-sample and post-GFC-sample. The two sub-sample periods are particularly meant to assess in relative terms, the transmission of monetary policy and its effectiveness in the period before and during or aftermath of the GFC. We further employ a dummy variable process to capture the turbulent periods not only from the perspective of GFC but also the 2016 economic recession in Nigeria. The turbulent periods in this regard are captured via the X component of the SVAR-X model as seasonality effects from global (SE\_Global) and domestic (SE\_Domestic) perspective, respectively. On the whole, the variables under investigation are interest rate ( $i$ ) measured as changes in nominal interest rate proxied using prime lending rate. Other variables of interest considered in the context of this study are inflation rate ( $\pi$ ) and output growth ( $y$ ). The latter is measured using the log of the first difference of industrial production index (IPI), while the former is measured using the log of the first difference of consumer price index. The log of the first difference of exchange rate was also used as measured for alternative channel of monetary policy in addition to interest rate. Finally, we control for the role oil price to capture the peculiarity of the investigated economy measured as first difference of the log of Brent crude oil prices (op).

**Table 2:** Summary statistics

	INTR	IPI	CPI	ER	OP
<b>Mean</b>	18.2253	107.3563	113.7672	162.3225	64.6948
<b>Std. Dev.</b>	2.5794	10.8141	67.0477	60.6524	30.6373
<b>N-Std. Dev.</b>	0.1415	0.1007	0.5893	0.3737	0.4736
<b>Skewness</b>	1.4359	0.1208	0.7866	1.6162	0.3494
<b>Kurtosis</b>	4.5380	1.6240	2.6905	4.3513	1.9046
<b>J-B test</b>	33.6079*** (0.0000)	6.1807** (0.0454)	8.1400** (0.0170)	38.8689*** (0.0000)	5.3466* (0.0690)

**Note:** Std. Dev. denotes standard deviation while N-Std. Dev. on the other hand implies normalized standard deviation calculated as (Std. Dev./Mean). The asterisk \*\*\*, \*\* and \* denote significance at 1%, 5% and 10% level of significance. Equally instructive is the fact that the variables for the sake of descriptive statistics are expressed in their level form (i.e. no transformation) in their unit of measurement. The values in parenthesis are the p-value of the J-B test

The summary statistics in Table 2 shows that the average prime interest rate in Nigeria for the period under consideration is 18%, while the average index for consumer prices at 113.7 is higher than the index for industrial production over the same period of time. Also, as much as 162 Naira on average was required in exchange for one unit of dollar. Although, a look at the conventional standard deviation would have revealed interest rate as the least volatile and other series as highly unstable, but when normalized we find the standard deviation value to be consistently small for all the series. Relatively, the CPI is the most volatile followed by oil prices with the IPI the least volatile. With respect to the distribution statistics, all the series are positively skewed, but the result is mixed for the kurtosis statistic.



The fact that the p-value associated with the Jarque-Bera (JB) test which takes information from skewness and kurtosis further affirms the fact that the series are not normality distributed statistically.

## 5.0 EMPIRICAL RESULT AND DISCUSSION OF FINDING

### 5.1 Contemporaneous effect

Presented in Table 3 is the contemporaneous response of interest rate to changes in output and inflation obtained from the different SVAR-X system under consideration. Notable in table is the likelihood of monetary policy measured as changes in interest rate reacting differently in the pre-GFC period compared to its reaction in turbulent period (i.e. GFC or post-GFC). For instance, the contemporaneous effect of output on interest rate is positive in the pre-GFC but negative in the turbulent period. Also, the magnitude of the effect seems relatively more pronounced during or after the GFC both in terms of magnitude and level of significance. We also find the contemporaneous response of interest rate to inflation to be statistically viable but mainly when the X component of the SVAR-X model changes in oil price. Deciphered from this later finding is the sensitiveness of the transmission process of monetary policy in Nigeria to its peculiarity as an oil dependent economy.

**Table 3:** Contemporaneous effect via interest rate channel

Response variable	Contemporaneous variable								
	Full sample			Pre-GFC sample			Post-GFC sample		
	$g_t$	$\pi_t$	$\Delta i$	$g_t$	$\pi_t$	$\Delta i$	$g_t$	$\pi_t$	$\Delta i$
$g_t$	-	0	0	-	0	0	-	0	0
$\pi_t$	-0.1423 (0.1259)	-	0	-0.1147 (0.1753)	-	0	-0.1105 (0.1606)	-	0
$\Delta i$	-0.2085 (0.2978)	-0.3378 (0.2743)	-	0.5071* (0.2936)	-0.4989 (0.3035)	-	-2.0807*** (0.3100)	0.2650 (0.2860)	-
	Seasonal Effect Global			Seasonal Effect Domestic			Oil prices		
$g_t$	-	0	0	-	0	0	-	0	0
$\pi_t$	-0.1334 (0.1260)	-	0	-0.1435 (0.1244)	-	0	-0.1367 (0.1234)	-	0
$\Delta i$	-0.2323 (0.2970)	-0.3604 (0.2736)	-	-0.2029 (0.2970)	-0.3666 (0.2768)	-	-0.2081 (0.2892)	-0.4533* (0.2719)	-

**Note:** The standard error values are in parenthesis while

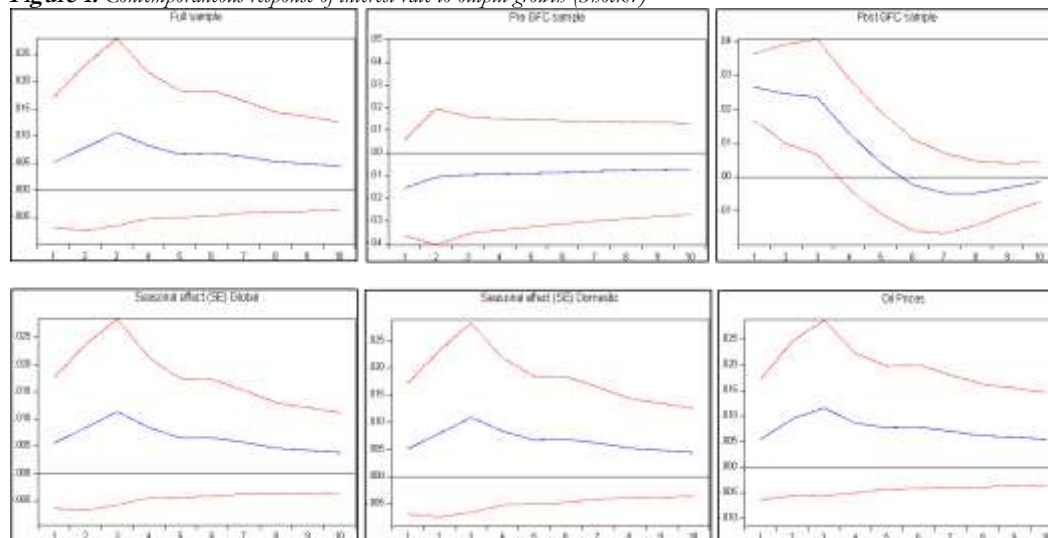
\*\*\*, \*\* & \* statistically represents 1%, 5% & 10% levels of 1%, 5% and 10% level of significance.

### 5.2 Impulse response analysis

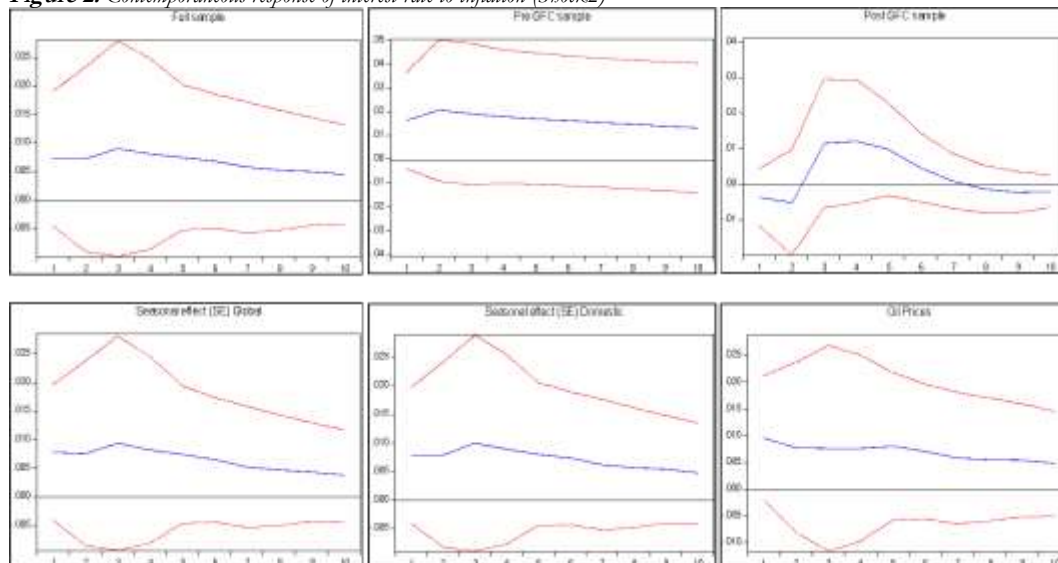
Presented in Figure 1 is the reaction of the interest rate transmission of monetary policy in Nigeria to changes in output growth (supply-side shocks) and changes in the price level (inflation) denoted as demand -side shocks. Starting with the full sample period, a shock to output growth prompted a positive response from the interest rate channel of monetary policy transmission, but at a declining rate starting from the third quarter period. When the sample is partitioned into pre- and post-global financial crisis, the interest rate responds negatively to supply shock (output growth) in the pre-crisis period, but the finding is however, mixed in the post-crisis period where the response is positive in the first to sixth period, but negative from the seventh to tenth period. Except for the magnitude of the response, the

direction of the response seems consistent even when the shock is coming from the demand-side of the economy (inflation), but for the post-GFC period.

**Figure 1:** Contemporaneous response of interest rate to output growth (Shock1)



**Figure 2:** Contemporaneous response of interest rate to inflation (Shock2)



### 5.3 Variance decomposition

The variance decomposition result in Table 4 enables us to make inference over the proportion of the forecast error variance of interest rate attributable to shocks due to the supply-side (output growth) and demand-side (inflation) of the economy. Although, when compared to the full-sample period, we find

little or no difference in the portion of variation in interest rate that is due to the supply shock and demand shock when the hypothesized seasonality effects are captured as exogenous variable (for instance, the X in the estimated extended SVAR model). But when the sample period is split into pre- and post-financial crisis, the magnitude of the variation in interest rate that is due to the change in output and inflation seems overwhelming. This appears to have further ascertained our hypothesis of the probable of monetary policy transmission process reacting differently in the turbulent related period compared to period of tranquillity.

**Table 4:** *Variance decomposition of interest rate*

Period	Full-sample			Pre GFC sample			Post GFC sample		
	S.E	Shock1 ( $g_t$ )	Shock2 ( $\pi_t$ )	S.E	Shock1 ( $g_t$ )	Shock2 ( $\pi_t$ )	S.E	Shock1 ( $g_t$ )	Shock2 ( $\pi_t$ )
1	0.0200	1.0036	2.0142	0.0342	6.7847	7.7032	0.0130	49.1089	0.9524
2	0.0217	1.7694	2.1143	0.0359	5.1939	10.4052	0.0137	45.4842	1.3863
3	0.0230	2.8987	2.6474	0.0360	4.6440	11.1086	0.0153	48.7069	4.4176
4	0.0237	3.1008	2.8688	0.0360	4.3955	11.4373	0.0156	48.6560	7.5204
5	0.0240	3.1213	3.0364	0.0360	4.2442	11.6399	0.0157	47.7338	9.5232
10	0.0242	3.3671	3.2669	0.0361	3.9494	12.0329	0.0159	47.2077	9.8835
Seasonal Effect Global				Seasonal Effect Domestic			Oil prices		
	S.E	Shock1 ( $g_t$ )	Shock2 ( $\pi_t$ )	S.E	Shock1 ( $g_t$ )	Shock2 ( $\pi_t$ )	S.E	Shock1 ( $g_t$ )	Shock2 ( $\pi_t$ )
1	0.0200	1.1964	2.2928	0.0201	0.9984	2.3232	0.0201	1.1572	3.6235
2	0.0218	2.0916	2.3994	0.0219	1.7794	2.5026	0.0218	2.4939	3.1956
3	0.0231	3.3673	2.9931	0.0232	2.9181	3.1720	0.0229	3.6792	3.0764
4	0.0237	3.5889	3.2464	0.0238	3.1231	3.4391	0.0234	3.7820	3.1212
5	0.0240	3.6036	3.4284	0.0241	3.1432	3.6136	0.0236	3.8229	3.2988
10	0.0243	3.8511	3.6604	0.0244	3.3864	3.8685	0.0238	4.1013	3.4043

Both output and inflation in table 4 account for at least 6.8% and 7.7% of the variation in interest rate in the first period of the pre-GFC episode. Starting from the second period however, the portion of the variation caused by output growth tends to be declining while the shock due to inflation became larger and increasing. For the post-financial crises period, the variation is mostly explained by output growth with as much as 45%-49% of the variation in interest rate attributable to shocks due to the supply side of the economy. associated with shocks due to the supply-side of the economy.

## 5.4 Robustness check

Similar to our finding of monetary policy reacting differently in turbulent period compared to the period of tranquillity is the study by Yakubu et al. (2019). Our finding also find support in Jannsen et al. (2015), whose study conclude that monetary policy reacts relatively more aggressive in the acute phase financial compared to the recovery phase (see also, Bekaert et al., 2013; Basu & Bundick, 2012; Bloom, 2009). For consistent and robustness purposes however, we further subject our findings to robustness check. The essence is to determine whether, the extent to which the transmission of monetary policy and its effectiveness vary for the period of turbulent and tranquillity is sensitive to the channel of transmission that is under consideration. One of such alternative channels of monetary policy transmission is the exchange rate.

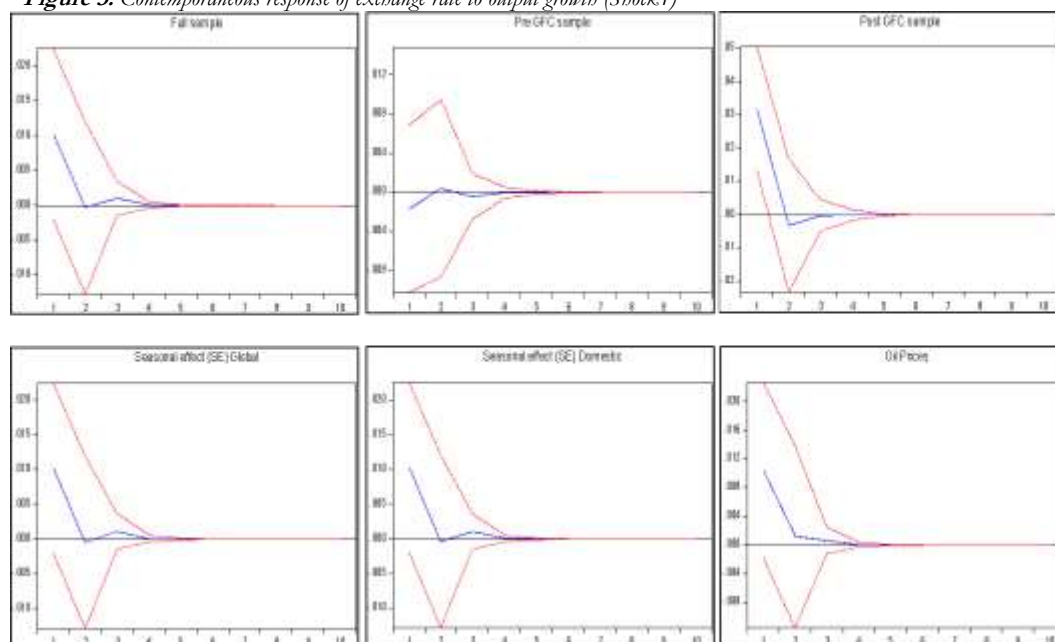
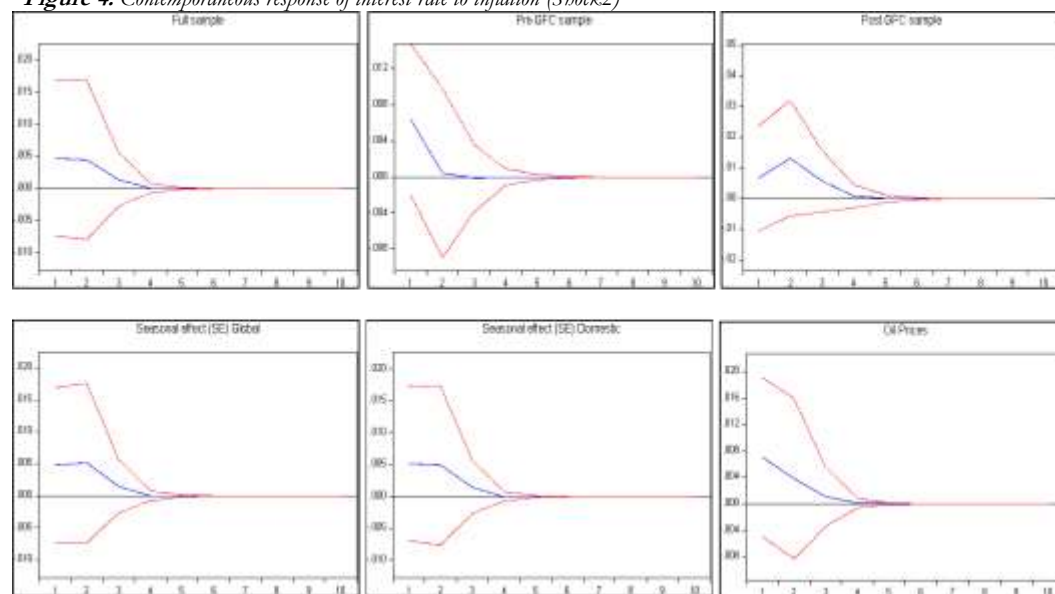
In a small open economy such as Nigeria, the exchange rate channel of enhancing the effectiveness of monetary policy is particularly as important as the interest rate channel. That is, same as the interest rate, the exchange rate has the potential to respond not only to aggregate demand but also to aggregate supply. This, therefore, is the motivation for our preference for exchange rate as the alternative channel to test the robustness of our findings. The study finds that similar to the interest rate channel, the exchange rate mainly responds significantly and contemporaneously to output growth in the post-GFC period and when X in the extended SVAR, is changes in oil prices. Also, the impulse response and the variance decomposition analysis of the exchange rate channel largely follow the same direction as earlier established in the case of interest rate but vary in terms of magnitude.

**Table 5:** Contemporaneous effect via exchange rate channel

Response variable	Contemporaneous variable								
	Full-sample			Pre-GFC sample			Post-GFC sample		
	$g_t$	$\pi_t$	$er$	$g_t$	$\pi_t$	$er$	$g_t$	$\pi_t$	$er$
$g_t$	-	0	0	-	0	0	-	0	0
$\pi_t$	-0.0826 (0.1103)	-	0	-0.1164 (0.1780)	-	0	0.0740 (0.1321)	-	0
$er$	-0.4143 (0.2560)	-0.2109 (0.2688)	-	0.0735 (0.1228)	-0.1932 (0.1250)	-	-2.2436*** (0.5941)	-0.5244 (0.6751)	-
	SE_Global			SE_Domestic			Oil price (OP)		
$g_t$	-	0	0	-	0	0	-	0	0
$\pi_t$	-0.0827 (0.1103)	-	0	-0.0817 (0.1099)	-	0	-0.0763 (0.1063)	-	0
$er$	-0.4097 (0.2537)	-0.2128 (0.2664)	-	-0.4153 (0.2547)	-0.2308 (0.2683)	-	-0.4150* (0.2521)	-0.3228 (0.2746)	-

**Note:** The standard error values are in parenthesis while

\*\*\*, \*\* & \* statistically represents 1%, 5% & 10% levels of 1%, 5% and 10% level of significance.

**Figure 3:** Contemporaneous response of exchange rate to output growth (Shock1)**Figure 4:** Contemporaneous response of interest rate to inflation (Shock2)

**Table 6:** Variance decomposition of exchange rate

Period	Full-sample			Pre GFC sample			Post GFC sample		
	S.E	Shock1 ( $g_t$ )	Shock2 ( $\pi_t$ )	S.E	Shock1 ( $g_t$ )	Shock2 ( $\pi_t$ )	S.E	Shock1 ( $g_t$ )	Shock2 ( $\pi_t$ )
1	0.0237	3.6980	0.7950	0.0338	0.5380	7.3285	0.0145	23.7211	1.0320
2	0.0248	3.5918	1.4531	0.0361	0.5196	6.7660	0.0150	22.6065	4.8019
3	0.0248	3.6211	1.5234	0.0361	0.5477	6.7078	0.0150	22.4457	5.4790
4	0.0248	3.6212	1.5235	0.0361	0.5480	6.7039	0.0150	22.4419	5.4909
5	0.0248	3.6212	1.5235	0.0361	0.5481	6.7036	0.0150	22.4418	5.4909
10	0.0248	3.6212	1.5235	0.0361	0.5481	6.7036	0.0150	22.4418	5.4909
	Seasonal Effect Global			Seasonal Effect Domestic			Oil prices		
	S.E	Shock1 ( $g_t$ )	Shock2 ( $\pi_t$ )	S.E	Shock1 ( $g_t$ )	Shock2 ( $\pi_t$ )	S.E	Shock1 ( $g_t$ )	Shock2 ( $\pi_t$ )
1	0.0238	3.6867	0.8240	0.0238	3.7683	0.9526	0.0238	3.9030	1.7607
2	0.0249	3.5924	1.6995	0.0250	3.6655	1.7369	0.0249	3.8333	2.2050
3	0.0250	3.6294	1.7777	0.0250	3.6989	1.8090	0.0249	3.8432	2.2427
4	0.0250	3.6294	1.7777	0.0250	3.6990	1.8090	0.0249	3.8432	2.2433
5	0.0250	3.6294	1.7777	0.0250	3.6990	1.8090	0.0249	3.8432	2.2433
10	0.0250	3.6294	1.7777	0.0250	3.6990	1.8090	0.0249	3.8432	2.2433

## 5. CONCLUSION

In this paper, we use the case of Nigeria to analyse monetary policy reaction function in the turbulent period. Using an augmented SVAR for instance SVAR-X, this study suggests it is crucial to distinguish between the response of monetary policy to output growth and inflation, and across the period of turbulent compared to the periods of tranquillity. Equally notable is the fact that the effectiveness of monetary policy, particularly in the context of the Nigerian economy, cannot be in isolation of the peculiarity of the country such as her reliance on oil and oil prices. This among others, is an indication that the effectiveness or otherwise of monetary policy in Nigeria is episodic. Hence, ignoring such episodic feature in the analysis of monetary policy in Nigeria may not only undermine the accuracy of inference drawn from the analysis but also likely to lead to wrong policy prescription by extension. Thus, it is herein recommended that while responding to shocks due macroeconomic fundamentals such as output and inflation, monetary policy authorities in Nigeria should avoid generalizing the potential effectiveness of their response across both the turbulent and tranquillity periods.

## REFERENCES

- Adeoye, B., Ojapinwa, T. V. and Odekunle, L. (2014). Monetary policy framework and pass-through in Nigeria: A missing ring. *British Journal of Arts and Social Sciences*, 17(1), pp. 14-32.
- Aleem, A. (2010). Transmission mechanism of monetary policy in India. *Journal of Asian Economics*, 21, pp. 186-197.
- Altunbasa, Y., Gambacorta, L. and Marques-Ibanez, M. (2014). Does monetary policy affect bank risk? *International Journal of Central Banking*, 95–135.
- Anwar, S. and Nguyen, L.P. (2018). Channels of monetary policy transmission in Vietnam. *Journal of Policy Modeling*, <https://doi.org/10.1016/j.jpolmod.2018.02.004>
- Babatunde, A and Olatunji, S.A. (2017). Monetary policy transmission mechanism and macroeconomic aggregates in Nigeria. *Caleb Journal of Social and Management Sciences*, 3(2), pp. 115-134.
- Bandara, A. (2010). The impact of global financial and economic crisis on Africa: Transmission channel and policy implications. UNDP.
- Baumeister, C. and Benati, L. (2013). Unconventional monetary policy and the great recession: Estimating the macroeconomic effects of a spread compression at the zero lower bound. *International Journal of Central Banking*, 9, pp. 165–212.
- Basu, S. and Bundick, B. (2017). Uncertainty Shocks in a Model of Effective Demand. *Econometrica*, *Econometric Society*, 85, 937-958.
- Bekaert, G., Hoerova, M. and Duca, M.L (2013). Risk, uncertainty and monetary policy. *Journal of Monetary Economics* 60 (7), 771–788.
- Bhattacharya, R. (2014). Inflation dynamics and monetary policy transmission in Vietnam and emerging Asia. *Journal of Asian Economics*, 34, pp. 16-26.
- Bloom, N. (2009). The impact of uncertainty shocks. *Econometrica*, 77(3), 623–685.
- Boivin, J., Kiley, M.T. and Mishkin, F.S. (2010) How has the monetary transmission mechanism evolved over time? National Bureau of Economic Research, 15879.
- Bouis, R., Rawdanowicz, L., Renne, J.P., Watanabe, S. and Christensen, A.K. (2013). The effectiveness of monetary policy since the onset of the financial crisis. OECD Economics Department Working Paper No. 1081.
- Buch, C.M., Buchholz, M. and Tonzer, L. (2014). Uncertainty and international banking. Conference paper for the conference on nternational Banking: Microfoundations and Macroeconomic Implications” organized by the International Monetary Fund (IMF) and the Dutch National Bank (DNB).
- Chung, H., Laforte, J.P., Reifschneider, D. and Williams, J.C. (2011) Estimating the macroeconomic effects of the Fed’s Asset Purchases. Federal Reserve Bank of San Francisco, Economic Letter, 3.
- Ciccarelli, M., Maddaloni, A. and Peydro, J.L. (2013). Heterogeneous transmission mechanism: monetary policy and financial fragility in the eurozone. *Economic Policy*, 28(75), 459–512.
- D’ees, S. and Brinca, P.S. (2013). Consumer confidence as a predictor of consumption spending: Evidence for the United States and the euro area. *International Economics*, 134, pp. 1-14.
- Davoodi, H.R., Dixit, S. and Pinter, G. (2013). Monetary Transmission Mechanism in the East African Community: An Empirical Investigation. International Monetary Fund, working paper series, wp/13/39.
- Egea, B.F. and Hierro, L. (2018). Transmission of monetary policy in the US and EU in times of expansion and crisis, *Journal of Policy Modeling*, <https://doi.org/10.1016/j.jpolmod.2019.02.012>
- Ekong, U. and Ukoha, O. (2018). Monetary policy pass-through in Nigeria: An ARDL bound testing approach. *Atlantic Review of Economics (ARoEc)*, 1(2), ISSN 2174-3835
- Engen, E.M., Laubach, T.T. and Reifschneider, D. (2015). The macroeconomic effects of the federal reserve unconventional monetary policies. Finance and Economics Discussion series WP 2015-005.

- Ezeaku, H.C., Ibe, I.G., Ugwuanyi, U.B., Modebe, N.J. and Agbaeze, E.K. (2018). Monetary policy transmission and industrial sector growth: Empirical evidence from Nigeria. *SAGE Open*, pp. 1-2, doi:10.1177/2158244018769369
- Gitonga, M.V. (2015). Analysis of interest rate channel of monetary transmission mechanism in Kenya. *International Journal of Business and Commerce*, 4(4), pp. 38-67.
- Hai, B.V. and Trang, T.T.M. (2015). The transmission mechanism of monetary policy in Vietnam: A Var Approach. Graduate Institute of International and Development Studies, Working Paper Number: IHEIDWP15-2015. Available at [http://repec.graduateinstitute.ch/pdfs/Working\\_papers/IHEIDWP15-2015.pdf](http://repec.graduateinstitute.ch/pdfs/Working_papers/IHEIDWP15-2015.pdf)
- Holmes, J.A. and Neumann, R.M. (2002). Evidence on the cross-country transmission of monetary shocks. *Applied Economics*, 34(15), 1837-1857,
- Jannsen, N.P., Galina, W. and Maik, H. (2015). Monetary policy during financial crises: Is the transmission mechanism impaired? *Economics Working Papers 2015-04*, Christian-Albrechts-University of Kiel, Department of Economics.
- Jimenez, G., Ongena, S.R.G., Peydro, J. and Salas, J.S. (2009). Hazardous Times for Monetary Policy: What Do Twenty-Three Million Bank Loans Say about the Effects of Monetary Policy on Credit Risk-Taking? Banco de Espana Working Paper No. 0833.
- Kim, Y. and Lim, H. (2019). Transmission of monetary policy in times of high household debt. *Journal of Macroeconomics*, article in press, doi: <https://doi.org/10.1016/j.jmacro.2019.103168>
- Lenza, M., Pill, H. and Reichlin, L. (2010). Monetary policy in exceptional times. *Economic Policy*, 25(62), 295-339.
- Mahathanaseth, I. and Tauer, L.W. (2019). Monetary policy transmission through the bank lending channel in Thailand. *Journal of Asian Economics*, 60, pp. 14-32.
- Mengesha, L. G. and M. J. Holmes (2013). Monetary policy and its transmission mechanisms in Eritrea, *Journal of Policy Modeling* 35, 766–780.
- Monte, G.C. (2013). Credibility and monetary transmission channels under inflation targeting: An econometric analysis from a developing country. *Economic Modelling*, 30, pp. 670-684
- Obafemi, N.F. and Ifere, E.O. (2015). Monetary policy transmission mechanism in Nigeria: A comparative analysis. *Research in World Economy*, 6(4), pp. 93-103.
- Pain, N., Lewis, C., Dang, T.T., Jin, Y. and Richardson, P. (2014). OECD forecasts during and after the financial crisis: A post-mortem. *OECD Economics Department Working Paper No.1107*.
- Peersman, G. (2011). Macroeconomic effects of unconventional monetary policy measures in the euro area. *ECB Working Paper No. 1397*.
- Reinhart, C.M. and Rogoff, K.S. (2008). Is the 2007 US sub-prime financial crisis so different? an international historical comparison. *American Economic Review*, 98(2), pp. 339–344.
- Stakėnas, J. and Stasiukynaitė, R. (2017). Monetary policy transmission: the case of Lithuania. *Baltic Journal of Economics*, 17(1), pp. 1-24.
- Samba, M.C. (2013). Monetary policy effectiveness under the CEMAC area: An empirical evaluation. *International Journal of Advances in Management and Economics*, 2(4), pp. 55-64.
- Tsangarides, C. (2010). Monetary Policy Transmission in Mauritius using a VAR Analysis, IMF working paper series wp/10/36
- Uma, K.E., Ogbonna, B.M. and Paul, O.C. (2014). Monetary policy transmission mechanism in Nigeria: An overview. *International Journal of Economics, Commerce and Management*, III(8), pp. 363-375.
- Valencia, F. (2013). Aggregate uncertainty and the supply of credit. *IMF Working Paper 13/241*.
- Vavra, J. (2014). Inflation dynamics and time-varying volatility: New evidence and an Ss interpretation. *Quarterly Journal of Economics*, 129(1), 215–258.
- Wang, L. (2016). Unconventional monetary policy and aggregate bank lending: Does financial structure matter? *Journal of Policy Modeling*, 38(6), 1060-1077.



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