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Exchange Rate Misalignment and Monetary Policy Reaction in Nigeria

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Abstract: The study examined the effect of the exchange rate misalignment on monetary policy reaction in Nigeria. Specifically, the study examined how the monetary policy rate responds to exchange rate misalignment using monthly data from January 2011 to June 2020. The study augmented the Taylor policy rule by incorporating the exchange rate misalignment variable. The study employed the generalised method of moments and two-stage least square estimation techniques for its analysis. The results show that the monetary authority targets price stability in formulating monetary policy in Nigeria, with lesser consideration for exchange rate misalignment and output gaps. This implies that exchange rate misalignment has a negligible effect on the conduct of monetary policy in Nigeria. Instead, monetary policy reacts more to the rate of inflation. Thus, the study recommends that the monetary authority pay considerable attention to exchange rate misalignment and the output gap, given their capacity to induce inflationary or deflationary pressures on the economy. The study underscores the fact that the high output gap and continuous misalignment of the exchange rate to its long-run equilibrium that is not addressed would eventually render the monetary policy thrust ineffective.

Keywords: Output gap; Inflation; Taylor rule; GMM; 2SLS

JEL Classification: E5; E31; C36; F31; E23

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1. Introduction

The study of the exchange rate in Nigeria has generated serious contention and argument from analysts and stakeholders. Analysts and macroeconomists are at loggerhead as to what the accurate response of the monetary authority should be as touching the problem of the exchange rate in Nigeria. There are divergent views on the impact of exchange rate misalignment on the economy. Empirical evidence by Ali, Ajibola, Omotoso, & Adeleke (2015) observed that exchange rate misalignment adversely affects the economy, while Tipy, Breitenbach, & Zerihun (2018) found a positive effect of exchange rate misalignment on the economy. Consequently, it is not clear what the reaction of the monetary authority is in the period of exchange rate misalignment, especially as Nigeria's economy continues to suffer from depreciation and devaluation of its currency.

In this paper, we advance the body of literature on Nigeria's exchange rate and monetary policy reaction. In recent times studies have neglected the influence of exchange rate alignment on the response of the monetary authority. It is not clear what is influencing the Central Bank of Nigeria's actions, which has resulted in much contention from Nigerians and policymakers as the exchange rate devaluation continues the downward spiral, inflation on the rise, and economic growth instability the order of the day. Thus the study attempt to study the conduct of monetary policy in Nigeria by incorporating the exchange rate misalignment term into the forward-looking Taylor's rule. By doing this, we can estimate responses of the monetary authority to exchange rate devaluation, output gap, and anticipated inflation, which is different from the interest rate rule in most studies on monetary policy reaction in Nigeria.

Exchange rate policies are very controversial and delicate in emerging and developing economies, primarily caused by a lack of requisite structural changes. The structural demand for import reduction and export promotion induces nominal exchange rate depreciation. More often than none, this damages the economy due to the short-term effect on domestic demand and prices. In Nigeria, for example, the period before the Structural Adjustment Programme of 1986 witnessed Nigeria's stable and superior exchange rate against the US dollar. Specifically, in 1981, 1983, and 1985, one US dollar to naira was ₦0.64, ₦0.75, and ₦0.99. This period of the stable naira against the dollar was cut short by the 1986 Structural Adjustment Programme (SAP) due to its structural transformation demands, which led to the naira depreciation against the dollar. The downward movement of the value of the naira continued and culminated in an exchange rate problem over time. As of December 5th, 2020, the official exchange rate stood at ₦379, while the parallel market rate ranges between ₦475 and ₦500 against the US dollars. The continuous depreciation of the exchange rate from the SAP era halted the economy's growth (Anyanwu, Ananwude, &Okoye, 2017). The challenges posed by this exchange rate

movement and the declining international oil prices have seriously damaging effects on macroeconomic variables and the economic growth of Nigeria (Onuorah & Osuji, 2014).

Interestingly, the optimal monetary policy response to macroeconomic instability depends on the source of the shock, which further underscores why it is crucial to characterise the response of monetary policy to exchange rate devaluation, output gap, and anticipated inflation. This study's main objective is to examine how the monetary authority responds to exchange rate misalignment in Nigeria. That is to characterise the behaviour of the conduct of the monetary authority, whether the monetary authority in Nigeria responds to exchange rate misalignment or not.

The rest of this study is divided into five sections. The first section introduces the study, while the second section provides an overview of Nigeria's exchange rate and monetary policies. The following section describes the theoretical and empirical literature review relevant to this study. Section four covers the methodology and data-related issues, while the five-section presents the data analysis, and section six discusses the results. The last section concludes the study and proffers workable recommendations.

2. Exchange Rate Policies in Nigeria

Nigeria's exchange rate started on a good note, with the naira competing strongly with the US dollars. Before the Structural Adjustment Programme (SAP) of 1986 witnessed Nigeria's stable and superior exchange rate against the US dollar. With the introduction of SAP and its demand, the naira began to depreciate against the dollar. Specifically, in 1986, one dollar exchange for ₦3.32 continued the trend up to the present period, majorly due to the crippling economic growth and the SAP policy's aftermath. Given the subsequent dependence on the oil price and neglect of the other formerly vibrant sectors like the Agricultural sector, the decline of the exchange rate has been alarming. Adjusting for the dwindling foreign reserve and oil price volatility due to the aftermath of the Coronavirus Pandemic, the naira was as of February 2021 devalued to N410/1$US at the official market.

In terms of regimes, Nigeria's exchange rate, from independence in 1960, has experienced several changes. The fixed exchange rate regime of 1959 and 1968 created an overvalued naira against the dollar in the foreign exchange market. This regime was supported by the exchange control regulations, which led to the distortion of the economy and gave rise to excess importation of goods, which significantly affected the domestic industries, the position of the balance of payment, and foreign exchange reserve.

Following the foreign exchange rate liberalisation policy of 1986, Nigeria has adopted varying forms of the flexible exchange rate regime of which the managed

floating exchange rate is predominant. In 1995, the Autonomous Foreign Exchange Market (AFEM) system was introduced as a significant element of the flexible system. The system aims to achieve a privately sourced foreign exchange at the market rate and government or official transactions conducted at the fixed exchange rate. Similarly, the inter-bank foreign exchange market (IFEM) of 1999 attempted to free the exchange rate further, reduce rent-seeking activities and restore stability to the market. Nonetheless, these various flexible exchange rate policies failed and led to the reintroduction of the Dutch Auction System (DAS) in 2002. The DAS has three specific objectives: restoring the value of naira exchange, conserving the country's external reserve, and reducing the premium of the parallel market (Imoisi, Uzomba & Olatunji, 2010). The naira exchange rate has been relatively stable since 2003 as the DAS stabilises the exchange rate, conserves the foreign reserve, reduces the tendencies of speculation of the dealers and the widening premiums. To further liberate the forex market and reduce the premium between the bureau de change division and the official inter-bank, the CBN introduced the Wholesale Dutch Auction System (WDAS) in 2006. This policy was to strengthen the achievements of the DAS further and deepen the foreign exchange market to stabilise naira in the market. However, the inability of the WDAS to meet the demand pressures on the naira exchange rate led to the reintroduction of the Retail Dutch Auction System (WDAS) between 2013 and 2015, after which the monetary authority closed the exchange market official window, and all demand was moved to the interbank market.

In more recent times, the Monetary authority introduced the Investors and Exporters Windows (I& E FX) to the foreign exchange market of Nigeria in April 2017. This has created multiple exchange rate systems in the country (Ajibola *et al.*, 2020). The NAFEX rate, the I&E FX rate, the BDC rate, and the parallel market rate. While the essence was to create liquidity in the system and prompt response to business FX needs, the system has created many challenges for the country, including arbitrage and round-tripping. Hence, Nigeria'smonetary authority is always on the lookout for policies that can strengthen and manage the exchange rate market for stability and growth of the economy.

3. Literature Review

The relationship between exchange rate and monetary aggregate has been a long-term research interest in financial and international economics. Economic theory suggests that contractionary monetary policy leads to an exchange rate appreciation while expansionary monetary policy leads to an exchange rate depreciation. Many studies have examined the relationship between exchange rate movement and monetary policy. Others highlight the channels through which exchange rate movement affects monetary policy and how monetary policy responds to exchange

rate movement. Wei & Kuhelika (2018); Ufoeze et al. (2018) found that exchange rate depreciation has expansionary and inflationary effects. Akosah, Alagidede, &Schaling (2019) observed that tight policy stance is a significant policy response to exchange rate depreciation and ease of policy stance accompanies exchange rate appreciation in Ghana.

Adeoye &Saibu (2014) observed that monetary policy variation influences the exchange rate movement in the short run without the monetary authority's influence but rather through self-correcting processes. The core implication of the study is that money supply, inflation, interest rate, and reserves devalue and drive exchange rate volatility in Nigeria. This strengthens the notion that exchange rate management is a significant monetary policy factor. Osigwe & Madichie (2015) added remittance inflows to the relationship between exchange rate and monetary policy in Nigeria. Their study revealed that exchange rate and interest rate causes remittance, and also exchange rate causes money supply. Also, Omojolaibi &gbadebo (2014) observed that foreign exchange intervention is not thoroughly sterilised in Nigeria and harms the economy. Dybowaki, Hanisch, &Kempa (2017) captured the role of the exchange rate in Canadian monetary policy using the time-varying parameters Bayesian structural vector autoregression model with stochastic volatility. The study found that the interest rate rule links policy rate to the output gap, exchange rate, and inflation, explaining only a tiny part of the sample beginning from the mid-1980s but explaining a considerable part of samples from the mid-1990s.

Abhishek & Pradyumna (2018) examined the role of exchange rate regimes in explaining the spillover of monetary policy across advanced economies and emerging market economies. The authors found that advanced economies' flexible exchange rate regime protects against spillover than emerging market economies managed floating exchange rate regime. It also observed that spillover is time-varying and significantly influenced by risk-taking, signal channels, and portfolio rebalancing in emerging market economies but not advanced countries. Also, Wei &Kuhelika (2018) examined how real exchange rate depreciation affects the US economy, focusing on the monetary policy using the factor augmented vector autoregression model. The study extended the FAVAR framework of Bernanke, Boivin, &Eliasz (2005) to analyse the exchange rate depreciation and the US economy. The authors observed that exchange rate depreciation has expansionary and inflationary effects on the broad US economy and the US economy conforms to the J-curve hypothesis.

Similarly, Mateane &Proano (2018) examined whether monetary policy responds asymmetrically or not to exchange rate misalignments in South Africa. The study augmented the forward-looking Taylor policy rule with an accurate exchange rate misalignment term. It found that the South African central bank responds asymmetrically to undervalue real exchange rates. Also, the study found that the

South African central bank allocates the lowest weight to exchange rate, lower weight to output gap stabilisation, and higher weight to expected inflation stabilisation.

Akosah, Alagidede, &Schaling (2019) investigated the effectiveness of monetary policy and the role of the exchange rate in policy rate determination in Ghana, found that policy rate and exchange rate are the net transmitters of shocks while output gaps and inflation are the net receivers of shocks in the economy. They suggested that exchange rate stability harden general macroeconomic stability and spillover dynamics extent from policy rate to targeted macro-variables moderates in the long run. In the same year, Georgiadis & Zhu (2019) examined the validity of the impossible trinity with a large sample of emerging and advanced economies in the 2000s using Taylor's type monetary policy reaction function. The study explored the sensitivity variations of local to base-country policy rates with different degrees of capital control and exchange rate flexibility and found that the sensitivity of an economy with a flexible exchange rate is stronger when the country has harmful exposure of foreign currency due to portfolio debt and liabilities of banks in its external balance sheet. However, such sensitivity also occurs when the monetary policy of the base country is tight. One deduction from the study is that it is optimal for local monetary policy to follow the example of the tight base-country policy, thereby muting the exchange rate variation in the local country.

Understanding the adjustment process of domestic prices to exchange rate movement enables a proper prediction of the effect on inflation and the probable monetary policy response (Revelli, 2020). Revelli (2020) examined Kenya's exchange rate pass-through extent and Cameroon's consumer price index. The study showed that the exchange rate pass-through is incomplete. In Kenya, the exchange rate pass-through varied between 0.18 and 0.58 over a year, and it varied between 0.53 and 0.89 in the same period in Cameroon. The pass-through exchange rate was 1.06 in Kenya and 0.28 in Cameroon in the long run. This study implied that the exchange rate movement is a significant source of inflation in both Kenya and Cameroon. Also, Keefe &Shadmani (2020) examined the foreign exchange market conditions and the asymmetric monetary policy response in 30 emerging and developing economies. The study used a panel threshold regression analysis and found that the monetary policy authority reacts strongly and significantly with an increase in interest rate to depreciation but reacts inactively during appreciation. Nonetheless, during appreciation, the monetary authority reacts more to deviations in output. Thus, the study suggested that during high volatility in the exchange rate, the monetary policy authority responds with higher interest rates to maintain stability in the economy and lessen capital outflows.

4. Methodology

4.1. Theoretical Framework

This study is based on the theoretical proposition of the Taylor rule, which is named after John B. Taylor, who presented the policy rule in his 1993 work – "Discretion vs Policy Rule in Practice." A monetary policy that is based on discretion, according to Taylor, gives no restrictions to policy. However, a rule-based policy restricts the authority's discretion in favour of some underlying condition in the system. The rule-based policy is responsive to macroeconomic variables (Dwyer, 1993; Taylor, 1993). The original Taylor rule explains monetary policy formulation in a closed economy. The rule was presented in a linear form as shown below:

Taylor rule: $r_t = p + 0.5y + 0.5(p-2) + 2$

Where: r is the federal reserve rate, p is the inflation rate over some quarters, y is the rate of deviation of output from its potential level, 2 in p-2 is the target inflation, and +2 is the natural interest rate. Thus, he posited that the federal fund rate depends on the inflation expectation and output gap.

In 1998, he modified the rule by using π^* for inflation target, r_t^f for natural interest rate and using variables for the weighted 0.5. Thus, he stated the functional form as:

Modified Taylor rule $r_t = \pi t + \alpha y_t + \beta(\pi t - \pi^*) + r_t^f$

Another major modification to the Taylor rule is the consideration of nonlinearities in the disposition of monetary policy on the back of divergence in preferences or differences in the economy's structure. The augmented version of the Taylor rule also incorporated exchange rate movement into the model. The argument for the exchange rate is that incorporating the exchange rate into the rule lowers the exchange rate and output variation. That is, monetary policy formulation that factors in price stability, exchange rate movement, and GDP growth tend to create a better outcome in the economy. A combination of monetary and exchange rate policy is an essential instrument to correct internal and external imbalances (Chuanglian, Shujie, &Jinghua, 2016).

4.2. Model Specification

According to Taylor (2000), developing and emerging economies should conduct monetary policy in response to deviations of inflation and output from their targets and in response to movements in the real exchange rate. Thus, the study adopted Taylor's (1993) model. First, we assume that the monetary authority has a nominal short term interest rate target per period which can be stated as:

$$r_t^* = \bar{r} + \propto [\, E\,(\pi_{t+k}|\Omega_t) - \pi^*] + \beta E(x_t|\Omega_t) \quad (1)$$

Where: r_t^* is the targeted short-term nominal interest rate.

$\bar{r}$ is the desired nominal interest rate at which output and inflation reached their target levels.

$E\ (\pi_{t+k}|\Omega_t)$ is the expression for the expectation of inflation between time t and t+k formed at time t based on the information set Ω_t.

$E(x_t|\Omega_t)$ is the expression for the expectation of output gap at time t based on the information set Ω_t.

To obtain an estimable form, we generate another variable by defining $\lambda = \bar{r} - \propto \pi^*$ and re-express equation (1) as:

$$r_t^* = \lambda \ + \propto E(\pi_{t+k}|\Omega_t) + \beta E(x_t|\Omega_t) \quad (2)$$

However, since the movement of the exchange rate from PPP tends to mean something for inflation targeting rules, we incorporate another term that captures the misalignment of the real exchange rate in the short-term rate rule:

$$r_t^* = \lambda \ + \propto E(\pi_{t+k}|\Omega_t) + \beta E(x_t|\Omega_t) + \eta_p E(\widehat{m}_t|\Omega_t) \quad (3)$$

Where; $\widehat{m}_t$ is the relative deviations from the PPP, which is the exchange rate misalignment term adjusted for inflation and η_p is the coefficient of relative deviations of PPP. A positive value of this parameter is the domestic undervalued exchange rates since it implies the domestic equivalent of foreign inflation is overvalued compared with the domestic general inflation rate.

If we assume the possibility of the monetary authority smoothening changes in a nominal rate, we can include lag of the nominal short-term rate as:

$$r_t = (1-\gamma)r_{t-1}^* + \gamma r_{t-1} \ + \epsilon_t \quad (4)$$

Articulating the short-term interest rate specifications in the obtainable future terms and substituting for the target short term rate, we reform equation (4) as:

$$r_t = (1-\gamma)(\lambda \ + \propto \pi_{t+k} + \beta x_t + \eta_p \widehat{m}_t) + \gamma r_{t-1} \ + \epsilon_t \quad (5)$$

Where: ϵ_t is a composite error term of the inflation rate, output gap, and exchange rate forecast errors as well as the exogenous interest rate white noise term. Equation (5) represents the standard augmented monetary policy rule/model for this study, which captures the exchange rate misalignment suggested by Clarida (2014). Thus, we can re-express the model as shown in equation (6).

$$MPR_t = (1-\gamma)(\lambda \ + \propto INF_{t+k} + \beta OUTPUTG_t + \eta_p \widehat{PPP_t}) + \gamma MPR_{t-1} \ + \epsilon_t \quad (6)$$

Where MPR_t is the desired nominal interest rate (r_t); INF is the inflation rate (π); $OUTPUTG_t$is the output gap (x); and $\widehat{PPP_t}$ is the relative deviations from the PPP, which is the exchange rate misalignment term (m).

Equation 6 represents the baseline model this study adopts to examine the effect of exchange rate misalignment on monetary policy formulation.

4.3. Data and Sources

Nigeria monthly data from January 2011 to June 2020 will be used to analyse this study. The study obtained data on the inflation rate, output gap, broad money (M2) growth, the Real Effective Exchange Rate change, and relative Purchasing Power Parity (PPP) deviations. The study used the Monetary Policy Rate (MPR) as the monetary policy instrument/rate since it is the benchmark interest rate for the economy. The data for MPR were obtained from the CBN. The study generates its potential output using an HP filter. It also used the changes in the exchange rate to capture the relative deviation of PPP, which is the real exchange rate misalignment term. Changes in the nominal exchange rate and money supply were used as control variables. All data were sourced from the Central Bank of Nigeria's Statistical Bulletin (CBN, 2019) and the National Bureau of Statistics (NBS, 2020).

4.4. Estimation Technique

The parameters of interest in the specified model are $\lambda, \propto, \beta, \gamma, and\ \eta_p$. The model captures the monetary authority's reaction to changes in the inflation rate, output gaps, and exchange rate misalignment and whether the policy response to exchange rate can be isolated. We use $\widehat{m}_t$ to capture the reaction of the monetary authority to exchange rate misalignment. Specifically, the study proxy exchange rate misalignment with relative PPP deviations (changes in the real exchange rate). Meanwhile, the Generalised Method of Moments (GMM) and Two-Stage Least Square (2SLS) were employed to estimate the parameters of the equation. These estimation techniques were employed to correct possible endogeneity problems since the dependent variable's lag is included in the regressors and the possibility of bi-directional causality between exchange rate and monetary policy reaction based on literature. These are known to be significant causes of endogeneity problems. We compare findings from two instrumental variable methodologies for the robustness of the result. Unit root tests were conducted first to test the stationarity of the data set using Augmented Dickey-Fuller (ADF) and to inform the kind of cointegration test. The results of these pre-estimation tests were considered in the process of estimation, and post-estimation tests were also conducted to check the validity and reliability of the models.

5. Analysis of Data

5.1. Descriptive Statistics and Normality Test

The descriptive analysis of the study presented in Table 1 below shows that the mean of the variables in the data set lies within their respective maximum and minimum values. The standard deviation values for all the variables show that they are all within bounds. The study also reveals that all the variables are positively skewed except MPR. Specifically, real effective exchange rate, inflation rate, broad money supply, output gap, and relative purchasing power parity deviation are positively skewed while the monetary policy rate is negatively skewed. The positive values of kurtosis for all the variables: monetary policy rate, real effective exchange rate, inflation rate, broad money supply, output gap, and relative purchasing power parity deviation indicate that these variables are all leptokurtic. Conversely, the Jarque Bera test reveals that the series is generally not distributed since each series' p-values are statistically significant at a 5% level of significance due majorly to the series' skewness. This further informs the check of the stationarity of the series to be sure the series is suitable for analysis.

One paramount importance of correlation analysis is that it helps detect high multicollinearity among the variable of estimates. Consequently, multicollinearity occurs when the correlation coefficient estimates are above 0.95. The correlation analysis results of this study show that no correlation coefficient among the independent variables is above 0.95. The implication is that the model is free from the problem of multicollinearity.

Table 1. Summary of Descriptive Information

Variables	CREER	INF	MPR	MSG	OUTPUTG	PPP
Mean	-0.0004	11.6654	12.5022	0.0095	-0.0027	0.0082
Std. Dev.	0.0507	3.0158	1.6420	0.0277	0.0490	0.0340
Skewness	6.2349	0.7043	-1.7411	1.6088	0.0863	5.5424
Kurtosis	49.235	2.6048	6.3382	8.7657	1.4986	38.361
Jarque-Bera	10797.07	10.1668	110.53	205.27	10.849	6466.0
Probability	0.0000	0.0062	0.0000	0.0000	0.0044	0.0000
Observations	113	114	114	113	114	113
Variable	**MPR**	**MSG**	**OUTPUTG**	**PPP**	**CREER**	**INF**
MPR	1					
MSG	-0.0546	1				
OUTPUTG	0.0299	0.1182	1			
PPP	-0.0240	0.1195	-0.0994	1		
CREER	-0.0225	0.0978	-0.0524	0.5553	1	
INF	0.3607	-0.0530	-0.0175	0.1202	0.1474	1

Source: Authors' computation, 2021

5.2. Unit Root Test

The study used Augmented Dickey-Fuller (ADF) test to examine the presence of unit roots in the data set. The study found that inflation rate and the output gap are the only variables stationary in their level I (0). However, after the first difference, all variables: monetary policy rate, real effective exchange rate, inflation rate and the output gap, broad money supply, and relative purchasing power parity deviation are stationary at a 1% level of significance using the ADF test. The result is presented in Table 2 below.

Table 2. Unit Root Results

Variable	Level	First Difference	Order of Integration
CREER	-9.893324*	-13.16092*	I (1)
MPR	-3.346998**	-10.15843*	I (1)
INF	-1.987596	-5.107853*	I (1)
MSG	-10.90610*	-11.04462*	I (1)
OUTPUTG	0.044516	-4.176639*	I (1)
PPP	-7.267011*	-11.75453*	I (1)

Note: The H0 is that a series is non-stationary against alternative hypothesis H1 of a series is stationary. The rejection of H0 for the ADF test is based on the MacKinnon critical values. The lag lengths were determined in accordance with the SIC.
* and ** denote statistical significance at 1% and 5% levels, respectively.

Source: Authors' computation, 2021

5.3. Cointegration Test

While the series may be stationary, there is a possibility that the linear combination of these variables may have a long-run/equilibrium relationship. Thus, the Engle-Granger two-step methodology was used to test the existence of a long-run relationship. The Engle-granger cointegration test, which is based on testing the significance of the residual of the regression model of the series in their level form, indicates that the equation is co-integrated as the residual is significant at a 1% level of significance. Thus, as presented in Table 3 below, there is cointegration among the variables.

Table 3. Engle-Granger Residual Base Cointegration Test

Variable	ADF @level	Critical Values		Remarks
ECT	-4.501438	1% level	-3.489659	Stationary*
	(0.0004)	5% level	-2.887425	
		10% level	-2.580651	

Notes: the series are CREER, MPR, INF, MSG, OUTPUTG, and PPP.
P-values at 5% statistical significance, the p-value is shown below the ADF t-statistics in the tables above.

Source: Authors' computation, 2021.

5.4. Estimation Results

5.4.1. Generalised Method of Moments (GMM) Estimate for the Monetary Policy Reaction

To give a valid interpretation of the estimates, the study diagnoses the explanatory power of the study. The adjusted R squared value of 0.93 suggests that the model is fitted, and the variation of the independent variables explains 93% of the variation in the monetary policy rate. The Durbin-Watson statistics, which fall within the acceptance region, show that the model is fairly free from autocorrelation. The lagged value of MPR, the dependent variable, is positive and statistically significant at a 1% level of significance. The implication is that change in the monetary policy rate in the current period depends on past monetary policy rates. Thus, a percent increase in the previous monetary policy rate would result in a 0.87% increase in the present monetary policy rate.

Similarly, the coefficient of the inflation rate is positive and significant at a 5% level of significance, implying that the monetary policy authority that set the monetary policy rate translates an increase in the inflation rate to a positive adjustment in the monetary policy rate. Specifically, a percent increase in the inflation rate would result in a 0.03% increase in the monetary policy rate in Nigeria. This conforms to a priori expectation and signifies that monetary policy reacts contractionary to inflationary pressure in Nigeria. The result could not establish the significance of exchange rate deviation from PPP on monetary policy in Nigeria.

Table 4. Empirical Results of System GMM Estimate

Dependent Variable: Monetary Policy Rate (MPR)			
Variables	**Coefficients**	**t-Statistic**	**p-value**
Constant (C)	1.393669*	3.000762	0.0034
Lagged Value of MPR (MPR (-1))	0.866768*	20.66367	0.0000
Relative PPP Deviations (PPP)	0.919848	0.782335	0.4358
Inflation Rate (INF)	0.030794**	2.330807	0.0217
Broad Money Supply (MSG)	1.932268	-1.641310	0.1038
Output Gap (OUTPUTG)	0.941555	1.198222	0.2336
Change in Real Effective EX (CREER)	-0.266968	-0.344578	0.7311
R-squared 0.932822			
Adjusted R-squared 0.928946.			
SE of regression 0.386561			
Durbin-Watson stat 1.932268			
Instrument rank 7			

Note: * and ** denote statistical significance at 1% and 5% levels, respectively.
Source: Authors' computation, 2021

5.4.2. Two-Stage Least Square (2SLS) Estimate for the Monetary Policy Reaction

To further revalidate the interpretation of the estimates, 2SLS's adjusted R squared of 0.93 also confirms that the model is fitted, and the variation of the independent variables explains 93% of the variation in the monetary policy rate. The F-statistics value of 226.1956 with a corresponding p-value of 0.0000 indicates that overall, the variables employed are suitable. The validity of the variables as being free from autocorrelation is revealed in the Durbin-Watson statistics of 1.9323, which is approximately equal to 2. To further strengthen the analysis, the study uses re-estimate the model using Two-Stage Least Square. The 2SLS confirms the significance of the lagged monetary policy rate and inflation rate on the current period monetary policy rate. However, the 2SLS found that broad money supply (MSG) also has a negative and significant effect on the monetary policy rate, consistent with theoretical predictions. Theoretically, an increase in money supply, all things being equal, should lead to a fall in interest rate. This is also synonymous with the findings from the GMM on the reaction of monetary policy on inflationary pressure. By implication, an increase in money supply likely to cause an inflationary pressure would generate a contractionary reaction from the monetary policy authority. Specifically, the study found that a unit increase in the broad money supply would result in a 3.19% decline in the monetary policy rate in Nigeria. Validating the result of the GMM estimates, the 2SLS found no significant relationship between exchange rate deviation from PPP and changes in the real effective exchange rate on monetary policy reaction in Nigeria. Monetary policy does not react to the output gap in Nigeria, as shown in both regression results.

Table 5. Empirical Results of the Two-Stage Least Square Estimates

Dependent Variable: Monetary Policy Rate (MPR)			
Variables	**Coefficients**	**t-Statistic**	**p-value**
Constant (C)	1.393669*	4.495584	0.0000
Lagged MPR (MPR (-1))	0.866768*	32.79852	0.0000
Relative PPP Deviations (PPP)	0.919848	0.704374	0.4828
Inflation Rate (INF)	0.030794**	2.316612	0.0225
Broad Money Supply (MSG)	-3.194690**	-2.376437	0.0193
Output Gap (OUTPUTG)	0.941555	1.252574	0.2132
Change in Real Effective EX (CREER)	-0.266968	-0.306074	0.7602
R-squared	0.932822		
Adjusted R-squared	0.928946.		
SE of regression	0.386561		
F-statistic	226.1956		
Prob(F-statistic)	0.000000		
J-statistic	0.000000		
Durbin-Watson stat	1.932268		

Note: * and ** denote statistical significance at 1% and 5% levels, respectively.

Source: Authors' computation, 2021

The findings of the estimators give insight into the reaction of the monetary authority in Nigeria. This study found a positive and significant relationship between the lagged value of the monetary policy rate and the monetary policy rate in Nigeria. The study demonstrates that the lagged value of the monetary policy rate is one of the factors responsible for adjusting the monetary policy rate in Nigeria. The positive effect of the lagged value of monetary policy rate on monetary policy rate implies that the monetary authority adjusts the MPR with significant consideration for the previous rate. This suggests that adjustment in the monetary policy rate can be predicted based on its lagged rates. In line with theoretical and empirical literature, the positive and significant effect of inflation on the monetary policy rate in Nigeria implies that the monetary authority placed high weight on inflation rate stabilisation than exchange rate stabilisation using the monetary policy rate. The central bank of Nigeria appears to be inflation targeting. This is consistent with Mateane &Proano (2018), who made a similar conclusion. When the authority is in a situation to adjust the interest rate in response to market fundamentals, they tend toward stabilising the inflation rate by setting the official monetary policy rate in response to the inflation rate or expected inflation rate with little negligible consideration for output gap and exchange rate deviations. The significance of inflation over exchange rate also shows that Nigeria's monetary authority is often reluctant to absorb exchange rate deviations, which these authors believe can further destabilise the inflation rate the authority is targeting. The relative PPP deviation captures the foreign inflation expressed in domestic currency. From the monetary authority's perspective, adjusting the monetary policy rate in such instances allows other rates to adjust to capture the effect of inflation, which can trickle down to the real sector of the economy.

The positive but insignificant relationship between the relative deviation of PPP and monetary policy rate can imply that the monetary authority responds asymmetrically to the deviation of the exchange rate. The monetary authority does not follow an effective predetermined mechanism responding to exchange rate misalignment. This finding contradicts Keefe &Shadmani (2020). However, it is consistent with findings of Adeoye &Saibu (2014), Omojolaibi &Gbadebo (2014), Dybowaki, Hanisch, &Kempa (2017). They established that the exchange rate movement has limited or negligible influence on monetary policy rule. However, these authors believe that as domestic inflation responds to foreign inflation in terms of relative PPP deviation through the import bills, monetary policy response to inflation rate indirectly captures the response to exchange rate deviation. Also, the positive and significance of money supply on monetary policy rate further strengthen the conclusion that the monetary authority is inflation targeting.

5.5. Post Estimation Tests

To examine the validity of the GMM and the two-stage least square results, the study strengthened the estimates with diagnostic checks using Durbin-wu-Hausman for the Endogeneity test, Cragg-Donald test for instrument diagnostics, Breusch-Godfrey Serial Correlation LM Test for serial correlation, and Breusch-Pagan-Godfrey for Heterogeneity test. As presented in Table 6 below, the result of the endogeneity tests show p-values of 0.3030041 and 0.5820, which are not significant at a 5% level of significance, suggesting the acceptance of the null hypotheses of no endogeneity for GMM and 2SLS variables, respectively. The result also shows that the Breusch-Godfrey Serial Correlation LM Test p-value of 0.8554 implies accepting the null hypothesis of no serial correlation. Lastly, the Breusch-Pagan-Godfrey test p-value of 0.1744 shows that the study is free from the heteroscedasticity problem.

Table 6. Diagnostic Checks

Estimate	Technique	t-stat	Prob. value
GMM's Endogeneity Test	Durbin-Wu-Hausman Test	0.303041	0.5820
2SLS Endogeneity Test	Durbin-Wu-Hausman Test	0.232147	0.6299
Instrument Diagnostics	Cragg-Donald Test	1431.951	
Serial correlation	Breusch-Godfrey Serial Correlation LM Test	0.312319	0.8554
Heterogeneity	Breusch-Pagan-Godfrey	1.533712	0.1744

Source: Authors' computation, 2021

6. Conclusions

The broad objective of this study was to examine the monetary policy response to exchange rate misalignment. While the study fails to reject the hypothesis that monetary authority follows forward-looking Taylor-like policy rule that integrates inflation rate, the study rejected the hypothesis that the monetary authority follows a forward-looking Taylor-like policy rule that includes exchange rate misalignment term. The study found that one period lagged monetary policy rate, inflation rate, and money supply significantly influenced the adjustment of the monetary policy rate in Nigeria. In contrast, the exchange rate misalignment term has negligible influence on the official interest rate, while the output gap does not influence the monetary policy rate. The main observation from this study is that the monetary authority accord higher considerations for inflation and trend of interest rate, lesser consideration for the money supply, and no consideration for exchange rate misalignment in Nigeria.

Thus, the study recommends that as much as the Nigerian monetary authority is targeting inflation, considerable attention should be given to other factors such as exchange rate misalignment given the importance of exchange rate in Nigeria as an

import-dependent economy and to output gap given its influence on creating further inflationary or deflationary pressures on the economy when setting the monetary policy rate. This, by implication, means that the problem of low economic complexities/productive capacity has to be addressed. Further studies in this area can consider the reaction of other macroeconomic variables to exchange rate misalignment or incorporate other determinant factors of the monetary policy rule.

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