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Monetary Policy Cyclicality, Industrial Output and Economic Growth Interactions in Nigeria

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Abstract

This paper examined whether monetary policy is acyclical, procyclical or countercyclical and the implications of the interaction of such cyclicality with industrial output on real economic growth in Nigeria. After determining the time series properties of the variables and based on conventional cyclicality measures, the fully modified ordinary least square method was used to examine the impact of monetary policy cyclicality and industry output on economic growth. Granger Causality test was used to examine the causal relationship between the monetary cyclicality and output growth. The results showed that monetary policy is countercyclical on economic growth in Nigeria. Monetary policy cyclicality had significant impact on economic growth and the causality test also indicated that monetary policy has a direct effect and indirect effect through industrial output growth on real economic growth in Nigeria. The findings are consistent with similar studies in other countries, and the policy implication of the results is that despite the recent doubt, monetary policy is still a potent stabilization policy that can be used to stimulate industrial-output growth and counter the recent downturn in real economic activities in Nigeria.

Keywords: Monetary Policy Cyclicality, Industrial Output, Economic Growth.

JEL Classifications: E52, E60, L16, O40.

1. Introduction

The efficacy of macroeconomic policies in driving economic activities has generated mixed propositions from both theoretical literatures and empirical literatures. Acemoglu, Liabson and List (2014), Celina (2014)

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and Chikezie, Joe and Tarila (2017) contended that macroeconomic policies impact on economic growth is neutral and the major determinants of growth are structural characteristics of the economy which they could be market structure, property right enforcement, market mobility etc. They stated that control of institutions in economic policy renders the relationship between macroeconomic policy fluctuations and economic growth inconsequential. However, Onyeiwu (2012), Aghion, Farhi and Kharroubi (2013) Aghion and Kharroubi (2013), Aghion, Hemous and Kharroubi (2014) and Adigwe, Echekoba and Onyeagba (2015) argued that macroeconomic policy potency does impact the economic growth significantly. They contended that the view that macroeconomic policy does not impact economic growth is not academic but rather an explanation of the inconsequential effect macroeconomic policy has on economic growth when policymakers try to stabilize the price at the expense of employment and economic growth.

Apart from the potency of macroeconomic policy on economic growth, macroeconomic policy cyclicality impact economic growth significantly (Aghion and Kharroubi, 2013; Duncan, 2013). Firms that are constrained by finance have borrowing strength that is constrained by earnings; during boom the firms' earnings are high so also their capacity for expansion but during a recession, the firms' earnings are low which constrict their capacity for expansion. The contraction of firms' productivity during a recession may further lead to deeper recession and their expansion during boom may lead to more economic boom (Bech, Gambacorta and Kharroubi, 2012; Aghion and Kharroubi, 2013 and Aghion et al., 2013).

The cyclicality of macroeconomic policies especially monetary policy is more countercyclical in developed economies than developing economies. In developing economies, the monetary policy cyclicality is either acyclical or procyclical, this acyclical or procyclical causes higher fluctuations in aggregate output (Duncan, 2013; Aghion and Kharroubi, 2013; Aghion et al., 2013).

While many empirical studies focus extensively on the direct effect of macroeconomic policy on economic growth in Nigeria, they failed to examine the impact of macroeconomic cyclicality on economic growth. Thus, the response of macroeconomic variables to the

movement of the business cycle and its impact on economic growth in Nigeria has been poorly examined. The paucity of literature undermines the conclusiveness of the macroeconomic policy debate in Nigeria. It is this gap in the literature that this study intends to empirically breach. This study focus on a part of macroeconomic policy cyclicality; monetary policy cyclicality. Thus, this paper examined the monetary policy cyclicality, industry output and economic growth interactions in Nigeria.

The contribution of this paper to the existing stock of knowledge is in fourfold. First, the computation of monetary policy cyclicality will be examined through GDP gap and GDP growth rate. Second, the impact of the interaction between monetary policy cyclicality and industry output on economic growth in Nigeria are examined. Third, the impact of monetary policy cyclicality and industry output on economic growth and fourth, the causal effect between monetary policy cyclicality and economic growth, the interaction between monetary policy cyclicality and industrial output and economic growth and industry output and economic growth in Nigeria.

First, the findings of this study reveal that the monetary policy cyclicality in Nigeria is countercyclical and has a negative impact on economic growth; the monetary authority responds to a recession by increasing the money supply and reducing nominal interest rate and respond to boom by reducing the money supply and increasing interest rate. Further, the impact of the interaction between monetary policy cyclicality & industry output on economic growth is negatively significant. Further, the industry output impact economic growth significantly and the causality between monetary policy cyclicality and economic growth is statistically significant; there is a bi-directional causal relationship between economic growth and monetary policy cyclicality. However, economic growth only causes industry output while there is a bi-directional relationship between the interaction of monetary policy cyclicality & industry output and economic growth.

The findings of this study deviated from findings of Duncan (2013) that monetary policy is mostly pro-cyclical for developing economy. As Duncan (2013) asserted (when there is a high level of corruption and low level of institutional quality, monetary policy may be procyclical) we expected the monetary policy for Nigeria to be

procyclical as there is a high level of corruption in the country, however, the result is otherwise. Monetary policy is countercyclical in Nigeria because during the period of boom interest rate was raised to curtail inflation while during the period of recession interest rate was reduced to expand economic activities.

The rest of the paper is organized as follows. Section 2 literature review Section 3 presents model specification, data, and method of estimation. Section 4 presents the results of the model and robustness test while in section 5 presents, summary, conclusion, implications and recommendation from the findings.

2. Literature Review

Nigeria economy is characterized by series of macroeconomic policies though; the efficacy of these policies on economic growth is contentious in the empirical literature. Celina (2014) concluded in his findings after examining the effect of the money supply, interest rate, exchange rate on economic growth from 1981-2012 that monetary policy does not impact economic growth significantly in Nigeria.

However, Amassoma et al. (2011), Onyeiwu (2012) and Adigwe et al. (2015) employed Ordinary Least Square Method to show that monetary policy impact economic growth significantly in Nigeria with the control of instrument like money supply, nominal interest rate, external reserves and exchange rate system. In a similar vein, Fasanya (2013) examined the effect of stochastic shocks of interest rate, exchange rate and external reserve on economic growth and confirmed that the shocks of the monetary variables drive economic growth in the long-run.

While as at the time of writing this paper, we hardly find Nigeria literature that examined the relationship between monetary policy cyclicality (the movement of monetary policy along with the business cycle) and economic growth but we did find foreign literature like Duncan (2013), Bech et al. (2012) Aghion and Kharroubi (2013) and Aghion et al. (2013).

3. Model Specification

The model specification builds on a specification of demand for goods and service equation. The demand equation specification follows the

aggregate demand equation specified by Mankiw (2010). In this model aggregate demand y_t is used as a proxy for economic growth, the equation is given as:

$$y = \bar{y} + \varphi(r_t - \rho_t) + \varepsilon_t \qquad \varphi < 0 \tag{1}$$

The aggregate output y_t in equation 1 depends on the potential output$\bar{y}$, real interest rate r_t and natural level of interest rate ρ_t and demand shockε_t.

$$r_t = i_t + \epsilon_t \pi_{t+1} \quad \epsilon_t \pi_{t+1} < 0 \tag{2}$$

Equation 2 is a simplified version of Fisher equation which relates real interest to nominal interest rate and expected inflation. The intuition behind this is to eliminate the real interest rate from aggregate output function in (1) and then substitute it into equation 2. The expectation of future inflation is measured by current inflation; the substitution of the second term on the left-hand side of equation 2 to current inflation is based on the assumption of adaptive expectation which says that the expectation of future event (t+1) in the year (t) is proxy by the activities of the current year (t) (Mishkin, 2011). Thus,

$$\epsilon_t \pi_{t+1} = \pi_t \tag{3}$$

The measure of monetary policy cyclicality is given as the regression of nominal interest rate on output gap which is stated below in equation 4. The formulation of the measure of monetary policy cyclicality depends on the measure of monetary policy cyclicality developed by Duncan (2013). Following Duncan (2013), the paper expressed nominal interest as i_t a function of output gapy_{gapt}. The paper adopts this measure because it is more amenable and plausible to estimation. More importantly, the approach offers an opportunity through which the paper can examine the nature of monetary policy response to output gap; whether it is pro-cyclical, countercyclical or acyclical in Nigeria.

$$i_t = \beta_0 + \rho_t + \alpha_y(y_{gapt}) \;\; \beta_0 > 0 \; and \; \alpha_y \leq, \geq 0 \tag{4}$$

i_t is the nominal interest rate, y_{gapt} is the output gap, ρ_t is natural level of interest, while $\beta_0 \; and \; \alpha_y$ are parameter estimate. Where $y_{gapt} = (y - \bar{y})/\bar{y}, \; y = actual \; output, \bar{y} = potential \; output$. The

equation 4 above is abridged version of Taylor's Monetary Policy Rule. $\frac{di_t}{dy_{gapt}} = \alpha_y$ is the measure of monetary cyclicality. While β_0 regression constant. If $\alpha_y > 0$ monetary policy is pro-cyclical, $\alpha_y < 0$, it is countercyclical while $\alpha_y = 0$ is acyclical.

Further, we examined the interaction between monetary policy cyclicality and industry output. We examined this to detect how the effect of monetary policy cyclicality affects economic growth through its effect on industrial output. The use of this approach depends on the method used by Duncan (2013) to detect interactions between institutional quality and monetary policy cyclicality. Thus, equation 5 is stated as follows:

$$i_t = \beta_0 + \beta_1(y_{gapt}) \times ind_t \quad (5)$$

where ind_t is industrial output and is β_1 the measure of interaction between monetary policy cyclicality and industry output. To derive the model that explains impact of monetary policy cyclicality and interaction between monetary policy cyclicality and industry output on economic growth we substituted equation 2 and 4 into the aggregate output equation, then we have:

$$y_t = \bar{y} + \varphi\beta_0 + \varphi\alpha_y y_{gapt} + \theta_1 ind_t + \varphi\pi_t + \varepsilon_t \quad (6)$$

If $\bar{y} + \varphi\beta_0 = \theta_0$, $\varphi\alpha_y = \vartheta$ and industrial output is extracted from the demand shock ε_t to examine its distinct impact on economic growth then equation 6 becomes:

$$y_t = \theta_0 + \vartheta y_{gapt} + \theta_1 ind_t + \varphi\pi_t + \varepsilon_t \quad (7)$$

Equation 7 is the baseline equation to be estimated to examine the effects of cyclicality and industrial output effect on economic growth

In line with Duncan (2013), the paper also incorporated an interactive term to capture the possible indirect effect of the cyclicality of monetary policy through industrial output on economic growth in Nigeria. The interactive term $\alpha_{yind}(y_{gapt}) \times ind_t$ is added to equation 7 to have the full model estimated as:

$$y_t = \theta_0 + \alpha_y(y_{gapt}) + \theta_1 ind_t + \alpha_{yind}(y_{gapt}) \times ind_t + \varphi\pi_t + \mu_t \quad (8)$$

The degree of cyclicality is measured as $\frac{\partial i_t}{\partial y_{gapt}} = \alpha_y + \alpha_{yind} \times ind_t$ that is, the monetary policy cyclicality is an increasing function of industry output provided that $\alpha_{yind} > 0$

The equation 7 which is the baseline equation measures the individual impact of monetary policy cyclicality α_y and industry output θ_1 on economic growth while equation 9 measures the impact of monetary policy cyclicality, industry output and interaction between monetary policy cyclicality and industry output α_{yind} on economic growth.

In order to determine the direction of causal nexus, equation 8 was also expressed in Granger-Causality model as follows:

$$X_{it} = \alpha_{0i} + \sum_{i=1}^{k} \alpha_{1i} y_{t-j} + \sum_{j=1}^{l} \alpha_{2i} y_{gapt-j} + \sum_{j=1}^{m} \alpha_{3i} ind_t + \sum_{j=1}^{k} \alpha_{4i} (y_{gapt-1}) \times ind_{t-1} + u_{it} \quad . \qquad (9)$$

$X_{it} = y_t, \alpha_y y_{gapt}, ind_t$ and $(y_{gapt-1}) \times ind_t$ i=1,2,3,4. $\alpha_0, \alpha_1, \alpha_2, \alpha_3 \; and \; \alpha_4 > 0,$ while $u_{1t} \; and \; u_{2t}$ are stochastic disturbance terms.

Measurement of Output Gap and Monetary Cyclicality

Equation 4, 7, 8 and 9 were estimated based on the time-series data sourced from Central Bank of Nigeria Statistical Bulletin for the period 1981-2015. The output gap was computed as, $(y - \bar{y})/\bar{y}$, and potential output is $\bar{y}$ calculated using Hodrick-Prescott Filter (HPF) method in line with conventional practice in the literature.

The actual output value, potential output and the deviation between the two named cycles are shown in figure A1 in the appendix. Equation 4 was estimated by regressing MPR on output gap as the measure of cyclicality because is y_{gapt} a de-trended measure of growth and a forward-looking Monetary authority will respond to downward trend rather to an upward trend in monetary rate. Monetary policy cyclicality is therefore captured as the fitted value of equation 4. The method of estimation is Fully Modified Ordinary Least Square Method and Pairwise Granger Causality Test after carrying out the entire necessary time series property unit root test and also checks the robustness of the models

4. Empirical Results

The potential source of concern is to test for the serial correlation of the variables which is mostly the major problem of time variability model. Not only we test for serial correlation, we also test for problems like model specification, heteroscedasticity, and unit-root. The method used for a unit root is Augmented Dickey-Fuller Test, Heteroscedasticity test is Breusch-Pagan-Godfrey Test, Serial Correlation is Breusch-Godfrey Serial Correlation LM Test and Model Specification Test is Ramsey Reset Test. The Augmented-Dickey Fuller test revealed that all the variables are stationary at their first difference while only output Growth stationary at its original state. The implication of this stationary state of the data is that the variables are viable for long-run prediction. The Breusch-Pagan-Godfrey Test results failed to reject the null hypothesis that there is no heteroscedasticity since the returned probability values for the two models are more than 1%, 5% and 10% significant level. Also, Breusch-Godfrey Serial Correlation LM test and Ramsey Reset tests failed to reject the null hypothesis that there is no serial correlation and model is well specified respectively for Model 1 and Model 2 since the returned probability values for the two models are more than 1%, 5% and 10% significant level.

The starting point of the analysis is to estimate monetary policy cyclicality. As earlier indicated, equation 4 was estimated and the results are presented Table 1.

Table 1: Dependent Variable: Monetary Policy Rate

Variables	Coefficient	P-Values	R-Square	F Stats P-values
Output gap	-0.89873	0.0456	0.1156	0.045576
GDP Growth	0.010219	0.1795	0.053912	0.179534

Source: Authors' Computation

The output gap coefficient of -0.9 explains that monetary policy cyclicality is countercyclical in Nigeria and significant at 5% and 10% level, using the output growth. The cyclicality though positive 1.0% but was insignificant. This shows that monetary policy cyclicality is acyclical when measured by output growth rate. Figure 1 shows the trend of monetary policy cyclicality for the period under study. The

trend confirmed the estimates in table 1 and show that monetary policy in Nigeria is not procyclical that is monetary policy does not have a positive relationship with the business cycle and at best countercyclical based on the output gap approach.

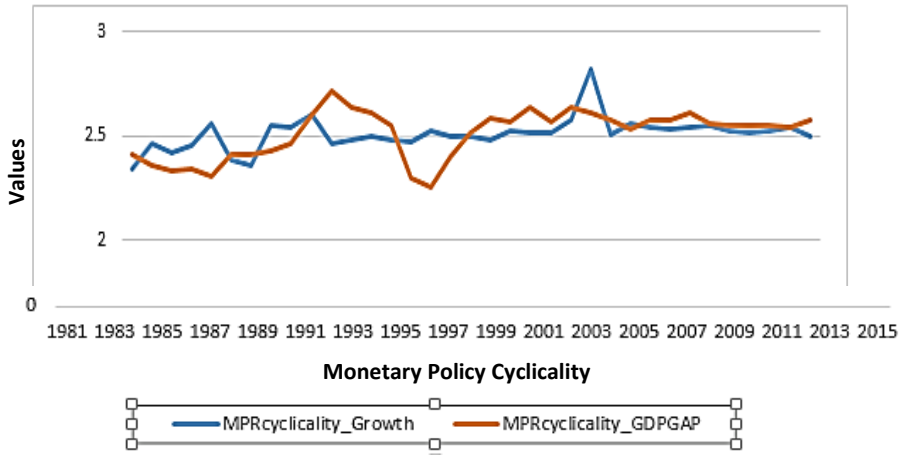

Figure 1: Monetary Policy Cyclicality in Nigeiria

Source: Authors' Computation

The results of estimation of equation 7 and 9 are presented in table2. The monetary policy counter-cyclicality in table 3 is negatively correlated with economic growth but with an insignificant probability value at 1%, 5%, and 10%. The industry impact on growth is significant at 5% level also inflation impact is negative by 0.3% and significant at 5% and 10%. The joint impact of monetary policy counter-cyclicality, Industry and Inflation on growth is 99.7% and the significant level of the f-statistics explains that there is a linear relationship between the variables.

The impact of the interaction between monetary policy cyclicality and industry output on economic growth is positive by 61.2% and significant at 1%, 5%, and 10% level. The implication of this is that the impact of monetary policy cyclicality on economic growth through industry performance is procyclical; that is when industry performance is high there is low monetary policy rate. However, the individual impact of monetary policy cyclicality is countercyclical on economic growth; when the economy is booming, there is the high-

interest rate to curb excessive inflation of prices but when the economy is in a recession there is low Monetary Policy Rate to engender economic activities.

The individual impact of industry output and inflation on economic growth is negative and they are both not significant at any level. The joint explanation of the changes in economic growth by the independent variables is 99.8% and a significant level of the f-statistics indicates that there is linear relation relationship among the variables.

Table 2: Dependent Variable: Economic Growth

	Equation 7	**Equation 8**
Monetary cyclicality (y_{gapt})	-0.157 (0.166)	-16.4177 (0.000)*
Industrial output (ind)	1.039 (0.0000)*	-0.48706 (0.119)
Inflation (π_t)	-0.0034 (0.018)*	-0.00091 (0.431)
Interactive term (y_{gapt}*ind)		0.611708 (0.000)*
Constant	0.766(0.000)*	41.22 (0.000)*
R-squared	0.996	0.998
F-statistic	2971.94	3978.185
Prob(F-statistic)	0.000	0.0000

Source: Authors' Computation.
Note: the p-values are indicated in the parenthesis and*signifies significant at 5%

The result is consistent with the findings of Aghion and Kharroubi (2013) that macroeconomic policy has a countercyclical effect on economic growth. Though the findings of this study are in contrast with Duncan (2013) that monetary policy is mostly procyclical for developing the economy. However, the findings follow Duncan idea that monetary policy is less prone to the political influence unlike fiscal policy, thus there is strong possibility that even in the presence of high level of corruption, monetary policy can still be effective as it is less subject to political influence as the case with fiscal policy in developing country. Therefore, the acyclical and countercyclical evidence reported in this case might be an indication that monetary policy in Nigeria is less prone to political influence and its effectiveness may not be affected by institutional quality.

In furtherance of the regression estimate of the study, the

directional causal effects among monetary policy cyclicality, industry output and economic growth in Nigeria were estimated using equation 9. From the table 3, the causality between monetary policy cyclicality and economic growth are bi-directional; the two variables cause each other. More so, industry output does not Granger-cause economic growth but economic growth causes industrial output to increase; thus, increase in economic performance causes industrial output to increase. Lastly, the interaction between monetary policy cyclicality & industry output causes economic growth and economic growth as well causes the interaction. The implication of the causality test among the variables is that monetary policy cyclicality, the interaction between monetary policy cyclicality & industry output are potent to cause changes in economic growth in Nigeria.

Table 3: Pairwise Granger Causality Tests

null hypothesis	obs	f-stat	prob.
mprcyclicality_gdpgap does not granger cause log(gdp)	33	14.82	0.005
log(gdp) does not granger cause mprcyclicality_gdpgap		3.14	0.058
log(ind) does not granger cause log(gdp)	33	0.65	0.528
log(gdp) does not granger cause log(ind)		3.022	0.064
mprcyclicality_gdpgap*log(ind) does not granger log(gdp)	33	14.09	0.005
Log (gdp) does not granger cause mprcyclicality_gdpgap*log(ind)		7.094	0.003

Source: Authors' Computation

5. Summary and Conclusion

The paper has examined the time variability impact of monetary policy cyclicality and industry output on economic growth in Nigeria including the causal relationship between monetary policy cyclicality,

the relationship between monetary policy cyclicality & industry output and economic growth. The findings of the study are summarized as follows: first, the monetary policy cyclicality in Nigeria is countercyclical and impact economic growth negatively. Second, the impact of the interaction between monetary policy cyclicality & industry output on economic growth is significant and negative meaning that the linkage between monetary policy cyclicality and industry output play a significant role in revamping the economy during the recession and stabilize price level during boom. Third, the industry output had significant impact economic growth and monetary policy cyclicality and economic growth cause each other. However, economic growth causes industry output only while there is a bidirectional relationship between the interaction of monetary policy cyclicality & industry output and economic growth.

The policy implication of the findings is that the significant countercyclical effect of monetary policy on economic growth suggests that monetary authority in the country could revamp the economy from recession by lowering monetary policy rate and stabilize price level by increasing monetary policy rate during boom. As industry output impact economic growth significantly, the focus should be given to industrial development as the development in the sector will engender economic growth in the country. Furthermore, the findings of this study showed that monetary policy can still be an effective instrument of stabilization and stimulation of economic activities in Nigeria.

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Appendix

Figure A1: Output Gap Measurement
Hodrick-Prescott Filter (lambda=25)