Asymmetry Effects of Monetary Policy shocks on Output in Nigeria: A Non-Linear Autoregressive Distributed Lag (NARDL) Approach.

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Abstract

The study examines the long- run asymmetry effects of monetary policy shocks on output in Nigeria between 1986 and 2015. The monetary policy is proxied by broad money supply (M2) and output is proxied by gross domestic product (GDP). The monetary policy shocks are obtained by decomposing monetary policy variable into positive and negative components in order to examine their long run effects on output and to also confirm whether the long- run effects of positive and negative components of monetary policy variable are the same (non-asymmetric) or not the same (asymmetric). To achieve this, the study adopts a two – stage non-linear error correction model under the Non- Linear Auto Regressive Distributed Lag and Wald test to confirm the long- run relationship and the asymmetry effect. Results show that both the positive and the negative component of money supply have positive long-run effect on output in Nigeria. However, while the positive component is statistically significant at 5 percent level of significant, the negative effect is not statistically significant. Wald test result also indicates that the long run relationship between output and money supply in Nigeria are not asymmetry because their coefficients are the same.

Keywords: Asymmetry Monetary policy ARDL Wald Test Cointegration

JEL Codes : C13 E52 C22 C18 C20

1. 0 Introduction

The goal of every macroeconomic management is to achieve price stability, economic growth and other macroeconomic objectives. Over the past decade, monetary policy has increasingly become a frequently used tool in both the developed and developing economies to achieve these objectives due to the changes of international and domestic economic environment (Guo, Hu and Jiang, 2013). Monetary policy has been heavily used to adjust money supply, interest rate, exchange rate and reserve requirement to achieve the desired policy goals. There has been a growing surge of interest in analyzing monetary policy in developing countries. Studies in this area have differentiated between accommodative and stabilizing policies. Accommodative policy is said to provide a regular supply of credit for an expanding economy while stabilizing policy is used to dampen, or offset, undesired changes that are affecting the economy (Kandil, 2014). Under accommodative monetary policy, monetary growth accommodates output growth and price level, however, monetary authority varies monetary growth under stabilizing policy in order to counter the effects of other shocks. The variability of monetary growth, under stabilizing policy, depends on the objectives of monetary policy. If the monetary policy objective is to target output growth, the central bank will increase liquidity in order to increase credit expansion and stimulate the economy. This is otherwise refer to as expansionary monetary policy. If, on the other hand, the monetary policy objective is to achieve price stability, the central bank will reduce monetary growth. This monetary authority concept is referred to as contractionary monetary policy.

Ample literature exists on the effectiveness of monetary policy in the real economy. It is well established that monetary policy affects output over the short horizons (Zakir and Malik, 2013). However the pertinent question is whether or not monetary policy effect is symmetric in the short run and in the long run periods. This issue is important in the monetary policy analysis because policy action that is assumed to be balanced may not provide the required results as expected by the policymakers. The first distinction about the effect of monetary policy action was in the effect of anticipated and unanticipated changes in monetary policy on output, as explain by the rational expectation theory and put forward by Lucas (1972) and Sargent and Wallace (1975). The theory expounds that policy actions differ in their quantitative effects, based on whether these actions are anticipated or unanticipated. According to them, in an economy where agents have rational expectation, anticipated monetary policy would have no effect on macroeconomic variables since such changes would simply translate into price level changes. Unanticipated changes on the other hand, would have real effect because agents cannot distinguish between current, relative and absolute demand shifts. The empirical evidence of this distinction was first carried out by Barro in 1977, followed by Mishkin (1982)and Frydman and Rappoport (1987).

The notion of asymmetry in the response of output to changes in monetary policy started with seminal work of Cover in 1992. His hypothesis was that monetary expansions and contractions have different effects on macroeconomic variables (sign asymmetry). Another strand of asymmetric effect in the literature was that of size asymmetry. It was also believed that large monetary shocks have smaller real effects than smaller monetary shock. This was first tested by Ravn and Sola in 1996. Moreover, the last type of asymmetry identified in the literature was that of phase asymmetry. Researchers were of the opinion that effect of monetary policy actions were different during diverse phases of business cycle (Weise(1999),Garcia and Schaller(2002),Lo

and Piger(2005)). A considerable amount of empirical research on these issues are emerging for developing countries e.g.,Aye and Gupta (2012) and others. The evidence for asymmetry related to the sign of policy action is mixed. Cover (1992) and some other researchers like DeLong and Summers (1988) and Morgan (1993), supported that positive and negative monetary shocks have asymmetric effects. On the other hand, Ravn and Sola (1996) find that positive and negative monetary shocks have symmetric effects.

The primary objectives of monetary policy in Nigeria is price stability and sustainable growth. To achieve these objectives, Central Bank of Nigeria (CBN) has employed monetary targeting approach in the conduct of monetary policy. This implies money supply is tinkered in line with the monetary policy stance. Therefore, understanding how monetary policy conduct influences macroeconomic variables is crucial to the achievement of policy objectives. To this end, this study attempts to investigate the asymmetric response of output to changes in monetary policy in Nigeria. The focus of this work is on testing whether effects of positive and negative monetary policy shocks on output are asymmetric. In addition, the study exams whether effects of positive and negative monetary shocks on prices and investment are asymmetric in Nigeria between 1986 and 2015.

The rest of the study is organized as follows. The next section provides the literature review on Asymmetric effects of monetary policy on macroeconomic variables. Section 3 deals with Methodology, variable measurement and sources of data. Section 4 reports the results with their detailed analysis. Finally, Section 5 attempts to bring together the main findings for concluding remarks.

2 .0 Literature Review

Recent empirical literature explains two theoretical grounds for asymmetric effects of monetary policy actions on macroeconomic variables. First, the convexity of the aggregate supply curve. A convex aggregate supply curve could be as a result of production bottlenecks as output arises above the potential output. If monetary policy action has the same magnitude effects on aggregate demand at any given output level, a convex aggregate supply curve implies that expansionary monetary policy will increase output less than its potential. In the same vein, contractionary monetary policy will cause larger decreases in output. Therefore, a convex aggregate supply curve implies that monetary policy changes of similar magnitudes, depending on the initial position on the aggregate supply curve, will have different or asymmetric magnitude effects on output. This idea is consistent with an old fashion "L" shaped Keynesian aggregate supply curve that is horizontal for output below full employment and vertical at full employment. It is also consistent with modern representations of aggregate supply.

The second reason asymmetric monetary policy effects on output is that monetary policy may have different magnitude effects on aggregate demand, depending on the initial economic conditions. For instance, Keynes' argued that monetary policy may be ineffective in a recession due to insensitivity of investment to interest rates. Lamont (1995) gives Keynes' idea a formal foundation in a model of "debt overhang". In Lamont's model, more recent creditors of firms are behind the older creditors in receiving partial debt repayment if a firm declares bankruptcy. Bankruptcies are more likely if the economy is in a recession. Hence in a recession, a higher

initial debt (debt overhang), makes it more difficult for firms to borrow. Hence debt overhang combined with recession makes investment less sensitive to interest rates.

The recent empirical literature begins with Clover (1992). Extending the seminal empirical work by Barro (1977, 1978) and Mishkin (1982) on the effects of unanticipated money supply shocks, Cover, estimates a money supply function to obtain measures of positive and negative money supply shocks. Then he estimates a real GDP growth equation with the estimated negative and positive supply shocks as independent variables. Clover finds that real GDP growth declines in response to negative money supply shocks while positive money supply shocks have no effect on real GDP growth. Some of the subsequent research has followed Clover in using the money supply as a measure of monetary policy. Rhee and Rich (1996) estimate a Cover type model and find little evidence of an asymmetric effect of money supply shocks on real GDP growth. Using Ball and Mankiw (1994) as a theoretical framework, they then estimate a Markov switching model for inflation where inflation switches between low and high inflation regimes. Rich and Rhee find that negative money supply shocks have larger effects on output when inflation is high. Weise (1999) uses a logistic smooth transition vector auto regression model to estimate whether monetary policy has asymmetric effects on output and prices. Weise finds no evidence that positive and negative money supply shocks have different effects on real GDP growth. He does find that money supply shocks have a larger impact if the economy is starting from a period of slow real GDP growth. Zakir and Malik (2013) investigate whether the response of output to monetary policy actions is symmetric or not. The study test all the three main forms of asymmetries in the impact of monetary policy discussed in the literature so far. Also, the study make some hybrid cases to go further in the detail of the tested asymmetries. While mainly following the methodology given by Cover (1992), some necessary variations are made to the procedure. Results favor asymmetry in the effects of monetary policy actions on output. Results indicate that monetary policy actions seem ineffective in periods of high growth while having strong effects on output during low growth periods. Further, output responds strongly to tight monetary policy actions when the economy is in low growth phase. It also find some support for the argument that negative money supply changes affect output whereas positive changes do not. The findings also suggest that output responds only to small monetary policy shocks and big shocks do not significantly explain the variations in the transitory component of output. The results of hybrid case give further insight that output strongly responds to small negative monetary policy shocks. Wald test rejects the hypothesis of symmetry in the favor of asymmetry in the response of output to monetary policy actions in all the cases.

Other researchers have used the Federal funds rate as the measure of monetary policy. Morgan (1993) tests for asymmetric effects of monetary policy by first estimating a reaction function for the Federal funds rate where the funds rate is regressed on lags of itself and lagged real GDP growth and inflation. Morgan finds that increases in the funds rate have large and statistically significant negative impact on real GDP growth, while the effect of decreases in the funds rate on real GDP growth are small and statistically insignificant. Garcia and Schaller (2002) ask if monetary policy has the same effect on output in expansions and recessions. They use changes in the Federal funds rate as their measure of monetary policy and use the Markov switching model developed by Hamilton (1989) to estimate if the state of the economy influences the effectiveness of monetary policy. The authors find that changes in the funds rate have larger

absolute magnitude effect on real GDP growth in recessions than in expansions. Hayford(2006) uses standard econometric models of monetary policy to derive measures of policy shocks to the Federal funds rate. The measures of funds rate shocks are used to test if positive and negative funds rate shocks have an asymmetric effect on real GDP growth and if the effectiveness of monetary policy depends on whether or not the economy is in a recession. The results suggest that monetary policy is equally effective in a recession or expansion and that positive funds rate shocks have a larger absolute value impact on real GDP growth than negative funds rate shocks. Sznajderska (2014) investigates whether the reaction function of the National Bank of Poland (NBP) is asymmetric according to the level of inflation gap and the level of output gap. Moreover, the stud test whether these asymmetries might possibly stem from nonlinearities in the Phillips curve. Threshold models are applied and two cases of unknown and known threshold values are investigated. Our results show that the Polish central bank responds more strongly to the level inflation when the level of inflation is relatively high. The study finds a weak evidence that the level of inflation reacts more strongly to the output gap when the output gap is relatively high. Thus, the asymmetries in the monetary policy rule seem to indicate asymmetric preferences of the central bank. Ülkea and Berument (2016) investigate the asymmetric effects of monetary policy shocks on the macroeconomic variables of exchange rate, output and inflation for Turkey, using monthly data between 1990 and 2014. The study employs the innovative nonlinear vector autoregressive model of Kilian and Vigfusson (2011), which allows for the observation of the effect of different stances (tight or loose) and different sizes (small or large) of monetary policy actions. Empirical evidence reveals that tight monetary policy, which, in this case, is captured with a positive shock to interest rate, decreases exchange rate, output and prices, as economic theory suggests. Loose monetary policy, which is captured with a negative shock to interest rate, has the opposite effect on these variables. However, the effects of loose monetary policy are weaker than the effects of tight monetary policy because loose monetary policy shocks are less effective than tight monetary policy shocks. Moreover, as the magnitude of a shock increases, the difference between the effects of tight and loose monetary policies also increases.

Another group of researchers used panel data in estimating asymmetric effects of monetary policy on output. Prominent among them is Karras (1996). He uses annual data from 1960 to 1990 on a panel of 38 countries to estimate the impact of positive and negative money supply shocks on real GDP growth and inflation. Karras finds strong evidence that negative money supply shocks have a larger magnitude impact on real GDP growth than positive money supply shocks. He also finds that money supply shocks do not have an asymmetric effect on inflation. Karras interprets his results as consistent with both a convex aggregate supply curve and aggregate demand being more responsive to negative money supply shocks than positive money supply shocks. Kandil (2014) uses annual data for a sample of 105 developing countries, including oil-producing Gulf developing countries such as Qatar, Saudi Arabia, and the U.A.E., former Eastern Bloc countries, middle income countries like Argentina, Indonesia, and Mexico, and low income countries. The time-series evidence indicates the allocation of monetary policy shocks, both expansionary and contractionary, between price inflation and output growth. Subsequently, cross-country regressions evaluate factors that underlie the difference in these allocations and their implications. The real effects of monetary shocks increase as the elasticity of aggregate demand increases with respect to monetary shocks. Nonetheless, capacity constraints hamper the output adjustment to monetary shocks and

increase price inflation. Across countries, trend output growth increases with the output response to monetary shocks. Consistent with the stabilizing function of monetary policy, the variability of output growth decreases in the face of monetary fluctuations across countries. In contrast, monetary fluctuations increase the trend and variability of price inflation across countries.

It can be deduced from the review above that there is dearth of literature on the asymmetric effect of monetary policy action on output in Nigeria. However, understanding how monetary policy conduct influences macroeconomic variables is crucial to the achievement of policy objectives. Therefore, the study attempts to investigate output response to effects of positive and negative monetary policy shocks in Nigeria. Furthermore, different methods have been used in the literature, however, this study employs nonlinear Autoregressive Distributed Lag approach.

3.0 Methodology, variable Measurement and Data Sources

3.1 Model

The study employs an empirical methodology similar to that of Cover(1992). The empirical methodology implements a modification of the approach of Cover (1992) and Karras (1996a, 1996b) and Zakir and Malik (2013). The estimated system consists of two equations. The first equation describes the money supply process as follows:

$$m_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} m_{t-i} + \sum_{i=1}^{q} \alpha_{2i}\, x_{t-i} + u_t \qquad (1)$$

where m_t is the growth rate of money at time t, α_{1i} are the coefficients of lagged values of dependent variable while α_{2i} is the vector of coefficients of other variables, m_{t-i} are the lagged values of the dependent variable, and x_{t-i} is a vector of other relevant variables. To test whether output's response to expansionary and contractionary monetary policies are asymmetric, two additional series of monetary shocks are generated. $\varepsilon_t^+ = \max(\varepsilon_t, 0)\,, \varepsilon_t^- = \max(\varepsilon_t, 0)$ where the series ε_t^-equals the money-supply shocks if the shock is negative, otherwise it equals zero. The series ε_t^+ equals the money-supply shocks if the shock is positive, otherwise it equals zero. The second equation is formulated by combining the two shocks and other macroeconomic variables as follows:

$$x_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i}\, x_{t-i} + \sum_{i=1}^{k} \beta_{2i} \varepsilon_{t-i}^+ + \sum_{i=1}^{l} \beta_{3i} \varepsilon_{t-i}^- + \epsilon_t \qquad (2)$$

where x stands for output growth (y), the growth rate of inflation, and the growth rate of investment. The βs are coefficients to be estimated. If $\beta_i^+ = \beta_i^-\,, \forall_i$, the effects of money-supply shocks are symmetric. Using the sum of these coefficients as a measure of effectiveness, the "traditional" kind of asymmetry requires

$$\sum_i \beta_i^- > \sum_i \beta_i^+ \geq 0,$$

So that monetary contractions have larger effects than monetary expansions.

Equation (2) is estimated using a nonlinear Autoregressive Distributed lag (ARDL) approach. The Non-linear ARDL model recently developed by Shin, Yu, and Greenwood-Nimmo (2014),

uses positive and negative partial sum decompositions in detecting the asymmetric effects in the long-run and the short-run periods. Compared to the classical cointegration models, NARDL models present some other advantages. Firstly, it performs better for determining cointegration relations in small samples (Romilly, Song, & Liu, 2001). Secondly, it can be applied irrespective of whether the regressors are stationary at level or at the first difference (i.e. I(0) or I(1)). It cannot be applied however if the regressors are I(2).The other advantages of NARDL are; it helps not only to gauge the short- and long-run asymmetries, but also to detect hidden cointegration. For example, a positive shock of oil prices may have a larger absolute effect in the short-run while a negative shock has a larger absolute effect in the long-run (or vice-versa).

3.2 Data: Sources and Measurement

Annual secondary data are used and they are obtained from the World Development Indicators (Online Version). GDP is used to construct the variable y, M2 is used for money supply (m), consumer price index for inflation and gross fixed capital formation for investment. The time period is 1986 to 2015.

4.0 Results: Estimation and Discussion

Following the proposed methodology for this study, the first step is to test the stationarity properties of all the series used. The conventional augmented Dickey–Fuller and Philip Perron unit root tests are employed. Results are presented in Table 1. The result shows that all the variables under consideration, except inflation are integrated of order one, while inflation is integrated of order zero.

Table 1: Unit Root Test Results

Variables	ADF	Remarks	PP	Remarks
GDP	-3.5435**	I(1)	-3.6282**	I(1)
M2	-3.8513**	I(1)	-3.5476**	I(1)
INFLATION	-2.8346***	I(0)	-2.9169***	I(0)
INVESTMENT	-2.6864***	I(1)	-7.0132*	I(1)

Next step is to test whether monetary policy effect is asymmetry and also to investigate the long run output, inflation and investment response to monetary policy actions. Results are presented in table 2 below. Results show that both expansionary and contractionary policies have positive effects on output, inflation and investment. It can be deduce that expansionary policy has greater effect (19 per cent) than contractionary policy (1 per cent). In addition, expansionary policy effect on investment (8 per cent) is greater than contractionary policy effect on investment (7 per cent). The reverse is the case for inflation. Results show that contractionary policy effect (68 per cent) rather than expansionary policy effect (14 per cent) has greater effect on inflation. Wald test cointegration results, presented in the last row of table 2, show that all the variables have long run relationships. This implies that effects of expansionary and contractionary policy shocks are long run effects on macroeconomic variables.

Table 2: Long-run sign Asymmetry Effects (4 Lags)

Shocks	y	π	I
ε_t^+	0.19 (0.00)*	0.14 (0.00)*	0.08 (0.02)**
ε_t^-	0.01 (0.92)	0.68 (0.03)**	0.07 (0.01)**
$\varepsilon_t^+ = \varepsilon_t^- = 0$	0.10	0.71	0.98
$Wald\ Test\ (\chi^2)$	0.00*	0.00*	0.00*

5.0 Conclusion

The study examines the long- run asymmetry effects of monetary policy shocks on output, inflation and investment in Nigeria between 1986 and 2015. The monetary policy is proxied by broad money supply (M2), output is proxied by gross domestic product (GDP), inflation is proxied by consumer price index and investment is proxied by gross fixed capital formation. The monetary policy shocks are obtained by decomposing monetary policy variable into positive and negative components in order to examine their long run effects on output and to also confirm whether the long- run effects of positive and negative components of monetary policy variable are the same (symmetric) or not the same (asymmetric). The study adopts a two – stage Non-Linear Auto Regressive Distributed Lag developed Shin, Yu, and Greenwood-Nimmo (2014) and Wald test to confirm the long- run relationship and the asymmetry effect. Results show that both the positive and the negative component of money supply have positive long-run effect on output in Nigeria. However, while the positive component is statistically significant at 5 percent level of significant, the negative effect is not statistically significant. Wald test result also indicates that the long run relationship between output and money supply in Nigeria are not asymmetry because their coefficients are the same.

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