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Monetary Policy Shocks and Economic Growth: New Evidence from Nigeria

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ABSTRACT

This study examined the impact of monetary policy shocks on economic growth in Nigeria for the period 1991 to 2020. This was with a view to providing further insight into how expansionary and contractionary monetary policies influence the growth of the economy. Secondary annual data on real gross domestic product, real exchange rate, real interest rate and external income from oil were used for the study. The data were sourced from Statistical Bulletin of the Central Bank of Nigeria. Structural vector auto-regression (SVAR) was used to examine the growth effects of monetary policy shocks. The study revealed that output responded positively to the expansionary money policy shocks but negatively to a contractionary interest rate shocks, while domestic output tend to reduce in the first four years and this continues in subsequent periods. Findings also showed that the contraction of monetary policy shocks does not directly affect foreign income and that much of the variation in economic growth in both the short-run and long-run is explained by its own shocks, closely followed by the shocks to foreign income, exchange rate and interest rate with 0.76%, 0.42% and 0.21%, respectively. The study concluded that expansionary monetary policy positively influence economic growth in Nigeria.

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INTRODUCTION

The Central Bank of Nigeria (CBN) has been mandated to promote and maintain monetary stability and a sound financial system in Nigeria. The bank has the objectives of achieving price stability and sustainable economic growth through the "means" of monetary policy. The objectives were anchored on the aim of achieving full employment, maintaining stability in the long-term interest rates and pursuing optimal exchange rate targets. In order to achieve these objectives, the CBN operates through a system of targets called operational targets, the intermediate targets and the ultimate target (Ibeabuchi, 2007). However, there is a growing debate among monetary economists; whether the exchange rate is still significant as a relevant transmission channel for monetary policy in the current medium-term orientation of monetary policy. In some periods, economic indicators move as expected in response to the use of monetary policy tools, while in other periods they move in directions that run counter to those suggested by standard theory. This emphasises the need to investigate the impulse responses of key macroeconomic variables especially output in response to monetary policy shock, using exchange rate channel. It has been confirmed that exchange rate tends to be sensitive to the interest rate in developing countries (Boivin et al, 2010). But can this be the case in Nigeria, with high oil-to-GDP ratio and given her over reliance on international trade, with less emphasis on non-export? Ukoha (2007) has also drawn attention to the importance of this issue through his view on the degree of responsiveness of exchange rate channel as regards the openness of economy.

The literature on the role of monetary policy in open economies has grown significantly in the last two and half decades with special emphasis on the exchange rate channel of monetary transmission mechanism (Ball, 1999; Batini et al., 2000; Corsetti & Pesenti, 2000; Galí, & Tommaso, 2002; Leitemo, 1999; McCallum & Nelson, 1999; Monacelli, 1999; Obstfeld and Rogoff, 1995; Svensson, 2000; Taylor, 2000a). This renewed interest notwithstanding, movements in the exchange rate are not very well understood in practice due to the interaction with various external shocks. There is widespread agreement that changes to monetary variables can affect the real economy in both short and long term (Corsetti & Pesenti, 2000). However, there is less agreement on the precise channels of exchange rate through which monetary policy affect output.

Conventional theoretical arguments suggest several key ways in which a change in the cash rate will induce output fluctuations through exchange rate channel but failed to consider the effect of external shocks (Dennis, 2000). Despite the existence of abundant literature on monetary transmission mechanism, there is limited empirical evidence concerning the importance of this channel, especially in Nigeria given the country's dependence on external demand of oil. Although majority of the studies outside Nigeria have shown that the exchange rate channel is weak in transmitting monetary policy to output, such evidence may not be applicable to Nigeria. This is because of the peculiar characteristics of the country's economy such as volatility and measurement error in the data, short samples dues to nonexistence of data or structural changes, and long supply shocks which may lead to a different outcome.

The fact that the monetary policy transmission mechanism remains a grey area in the empirical literature is somewhat surprising and problematic since that it is currently the primary policy instrument used to influence macroeconomic outcomes in the country. In addition, Woodford

(2007) argued that the increase in globalisation and liberalisation of the financial sector, which had reshaped the transmission channels of monetary policy, tend to strengthen the exchange rate channel of monetary transmission mechanism. However, the author pointed out that there was little reason to expect that globalization should eliminate or even substantially weaken the influence of domestic monetary policy over domestic inflation through output. Another point worthy of note is that series of global crisis has reshaped the channels of transmission of monetary policy especially in the developing countries which are resources dependent (Felices et al., 2009; Juks, 2004). This may also be the reason why the exchange rate channel has not been effective in most countries because of their inability to control the foreign demand through monetary policy. Besides most of the developing economies are commodities exporters.

Most of the empirical studies that have captured the exchange rate channel have concentrated on the advanced economies using different methodologies such as the vector autoregressive (VAR) model, vector error correction model (VECM), Structural VAR (SVAR), and Dynamic Stochastic General Equilibrium (DSGE). Most of the studies on Nigeria have concentrated on credit, exchange rate and interest rate channels using VAR framework (e.g., Adebiyi & Lawanson, 2006; Adeoye, Ojapinwa & Odekunle, 2014; Nnanna, 2001; Nwosa & Saibu, 2012; Uchendu, 1996). The general consensus among these studies is that monetary policy is effective through the interest and exchange rate channels. However, failure to account for the exogenous shocks of foreign demand is a serious limitation of the studies.

LITERATURE REVIEW

Monetary policy transmission mechanism refers to how a change in the money supply is channeled through particular models to influence real and nominal variables. Traditionally, the classical school of thought used the quantity theory to give a direct and mechanical link between money and prices, while Keynes emphasised the indirect mechanism whereby money affects the price level through interest rate (Dennis, 2000). The interest rate channel operates by altering the marginal cost of lending as well as borrowing and thereby produces changes in investment, saving, and aggregate demand (Horvath & Maino, 2006). An expansionary monetary policy leads to a fall in real interest rates, which in turn stimulates investment due to a decline in the cost of borrowing. An increase in investment leads to an increase in aggregate demand and output, which may in turn result in increased inflationary pressures in the economy. While changes in the central bank's policy rate are expected to be immediately transmitted to short-term money market rates, several factors influence the effectiveness of the interest rate channel. These include the structure and competiveness of the banking sector, the size of the shadow informal sector, and the speed with which the policy rate is transmitted to commercial lending rates (Dabla-Norris & Gunduz, 2012; Horvath & Maino, 2006; Tahir, 2012).

The exchange rate indicates the value of domestic currency relative to foreign currencies and can be influenced by foreign as well as domestic interest rates. The size and the direction of the impact of a change in the policy rate on the exchange rate is difficult to predict, as it will depend on expectations about domestic and foreign interest rates as well as inflation. The normal reaction to a rise (fall) in the policy rate would be an appreciation (depreciation) of the domestic currency, as assets denominated in domestic currency would become more attractive for foreign investors. A depreciation of the domestic currency would make imports more expensive and exports cheaper, so net exports and, consequently, aggregate demand would decrease. In addition

to the effect on net exports and aggregate demand, the exchange rate has a direct effect on domestic inflation because it determines the price of imported goods expressed in domestic currency. This is known as the pass-through effect in the literature.

The exchange rate channel can also work through the wealth and balance sheet channels, which are generally included in the discussion about the asset prices channel. The exchange rate affects the balance sheets of firms with large foreign currency denominated debt. When foreign currency is appreciated (domestic currency appreciates), the debt burden of these firms increases, and with no corresponding assets denomination to match this increase, the net worth of firms goes down. The same happens with consumers holding large amounts of foreign currency assets; their wealth decreases and so does their consumption. In this framework, the exchange rate working through the balance sheet and the wealth channel, affects aggregate demand in an opposite direction compared to the traditional net exports channel. The exchange rate channel has received special attention in research works on transition economies, as it is believed to be particularly important in high inflation environments and in countries with poor financial markets (Chinn & Meredith, 2005). Kamin et al. (1998) stated that for developing countries, the exchange rate channel, in contrast to the other channels, affects not only aggregate demand, but also aggregate supply.

However, for the exchange rate channel to work within the monetary transmission framework, two relationships must hold. First, there must be a link between monetary policy and the exchange rate, and second, the exchange rate must influence output and inflation. Peeters (2004) examined details of the monetary policy transmission mechanism in Albania and tested the hypothesis that the exchange rate was the most important channel in the monetary policy process. The author analysed the relative importance of the exchange rate channel, the deposit and credit channel and the wage channel. He argued that the exchange rate channel is likely to be weak due to the sizable trade openness of the country and that movements in the exchange rate are likely to be influenced by foreign factors rather than by domestic monetary policy rate, i.e. a weakening of domestic currency after monetary tightening. His results that exchange rate shocks explain up to 25% of the consumer price variance suggested the presence of an asymmetry in the pass-through. The pass-through is higher in the case of domestic currency depreciation but lower in the case of depreciation. Beside interest rates and asset prices, both nominal and real exchange rates play a prominent role in the monetary transmission mechanism. Monetary policy is able to bring about changes in the level of the exchange rate and thus provoke changes in (a) prices, (b) trade volumes and (c) investment. The first stage of the transmission mechanism is how short-term interest rates impact on exchange rates. The second stage is then the pass-through from exchange rates to import and domestic prices, followed by an adjustment in real variables such as imports, exports and investment

Monetary policy influences the exchange rate through interest rates via the uncovered interest rate parity (UIP) condition, through direct intervention in foreign exchange markets, or through inflationary expectations (Dabla-Norris & Gunduz, 2006). The link between monetary policy and exchange rate under the UIP condition was popularised by the open macroeconomic models developed by Dornbusch (1976), Fleming (1962) and Mundell (1968). Under the UIP, the difference between the domestic and foreign interest rate is equal to the expected exchange rate change. Accordingly, monetary policy induced changes in domestic interest rates, therefore, change exchange rate expectations and hence the relative price of imports and exports, which in turn affects aggregate demand and supply (Dabla-Norris & Gunduz, 2012),. The exchange rate

channel affects aggregate spending via two sub-channels. First, through the balance-sheet effect, in that, if households and enterprises have debts denominated in foreign currency, movements in the exchange rate will change their net worth and debt-to-asset ratio, which in turn affects their spending and investment decisions. Second, the relative price effect, in which an appreciation of the domestic currency increases the demand for foreign goods relative to domestic goods (Mishkin, 1996) The effectiveness of the exchange rate channel in the transmission mechanism depends on the extent of the pass-through to domestic prices, which in turn depends on the import share and other characteristics of the economy. In general, the larger the import share or the more the economy is dollarised, the larger the exchange rate pass-through (Horvath & Maino, 2006).

The credit channel, which has assumed greater importance in contemporary research, emphasises the role of asymmetric information and how the costly enforcement of contracts creates agency problems in financial markets (Bernanke & Gertler, 1995). The fundamental of this channel is that monetary policy can have price and output effects through credit rationing that arises from information asymmetries between financial institutions and the firms and consumers to which they lend (Loayza & Schmidt-Hebbel, 2002). It is argued that monetary expansion reduces adverse selection and moral hazard problems by increasing firm's net worth, reducing perceived loan risks, improving firms' cash flow, and decreasing the burden of nominal debt contracts (Loayza & Schmidt-Hebbel, 2002). The channel has two sub-channels the bank lending and the balance sheet channels. The bank lending sub-channel works by influencing banks' ability to make loans following changes in the monetary base (Huang, 2003; Kashyap & Stein, 2000; Kishan & Opiela, 2000; Sichei, 2005). In the channel, a contractionary monetary policy decreases bank reserves and bank deposits thus leading to a decline in funds available for lending and investment spending.

Here, a policy induced expansion of the monetary base increases the amount of reserves (deposits) available to banks, which they can use to advance loans. An expanded monetary base is thus likely to increase lending for investment and consumption purposes, leading to a rise in investment and consumption spending. The increase in domestic demand raises aggregate demand and, if aggregate demand exceeds aggregate supply, also inflationary pressures in the economy. Bernanke and Blinder (1988) argue that there are three conditions for the existence of the bank lending channel, that is: imperfect substitution between bank loans and bonds for borrowers, the central bank should be able to affect the supply of bank loans by changing the quantity of reserves, and the existence of imperfect price adjustment that prevents any monetary shocks from being neutral. Using the traditional IS-LM model, where IS curve was replaced by the credit-commodity curve (CC), Bernanke and Blinder (1988) formulated the CC-LM model, in which monetary policy is deemed to affect economic activity via the credit channel or bank loan channel.

The balance sheet sub-channel is premised on the prediction that the external finance premium that a borrower faces depends on the borrower's net worth. In this regard, monetary policy can have direct and indirect effects on borrowers' balance sheets. A direct effect arises when an increase in interest rates works to raise the payments a borrower must make to service debts, while an indirect effect arises when interest rates reduce the capitalized value of the borrower's assets (Ireland, 2010). As a result, an increase in interest rates arising from tight monetary policy depresses spending through the traditional interest rate channel, but also raises the borrowers'

cost of capital through the balance sheet channel. This reduces investment, consumption, employment, and output, and puts downward pressure on prices. Factors that strengthen the credit channel include the magnitude of bank capitalization, the degree of development of the securities markets, and the size of firms in the economy (Putkuri, 2003; Tahir, 2012).

As noted by Horvath and Maino (2006), the asset price channel operates through changes in the market value of firms and the wealth of households. Here, changes in monetary policy alter the relative price of new equipment, thereby affecting firms' investment spending and their market value. Changes in monetary policy also affect households' collateral for borrowing, thereby affecting consumption spending. According to the theory of the asset price channel, expansionary monetary policy results in higher equity prices because the expected future returns are discounted by a lower factor, thereby raising the present value of any given future income stream. Higher equity prices make investment more attractive (e.g., through Tobin's q), which raises aggregate demand. Higher equity prices also entail increased household wealth, which raises consumption and aggregate demand (Loayza & Schmidt-Hebbel, 2006).

Over the last three decades, there has been a surge in empirical research on the role of asset prices as a channel of monetary policy transmission. For example, Lin (2004) assessed the impact of housing wealth on consumption using German data and found the existence of a significant link between consumption and housing wealth. Belke and Leo (2004) also confirmed the link between fluctuations in asset prices and changes in monetary policy regimes. Similarly, Kannan (2007) tested the predictive power of equity prices for inflation rate and economic activity in India and discovered that stock prices seemed to be a leading indicator of inflation, though they appeared to lack predictive power for the output gap. Sonia (2000) noted that asset prices could mirror price bubbles since such movements influenced and help to predict general price inflation. In this regard, if equity prices fall, the incentive to buy stock or use it as a source of financing investment weakens. For real estate, price affects aggregate demand through its direct effect on housing expenditure and increase in housing wealth. This would in turn lower the cost of financing housing investment, while increasing the prices of real estate. He, therefore, concluded that asset prices should be included in a broader and more comprehensive measure of the general price level which could be factored into the formulation of monetary policy by central banks.

Study by Al-Mashat and Billmeier (2007) on asset price channel in Egypt concluded that the rapid development in the Egyptian stock market index between March 2003 and February 2006 could have contributed to the impact that the monetary policy stance had on real activities and prices. McCarthy and Peach (2002), in a study of residential investment, focused on the effects of securitization on the monetary policy transmission mechanism by examining how regulatory changes and other innovations in housing finance had impacted on the transmission of policy shocks to housing investment. They discovered that interest rates as opposed to quantity constraints have taken on a larger role, since the dismantling of regulation and the shift from thrift-based intermediation to a more market–oriented system of housing finance. Perhaps as a consequence of these changes, mortgage interest rates responded swiftly to monetary policy than they did prior to 1986. However, residential houses responded more slowly and fluctuated more or less concurrently with the overall level of economic activity. Thygesen (2002) noted that the transmission mechanism through changes in asset price to the real economy was well understood though difficult to quantify empirically.

Thus, the three main transmission channels through which this could occur are the wealth effect, the Tobin‘s Q effect and changes in credit through the balance sheet of financial intermediaries. Ehrmann and Fratzscher (2004) examined the reaction of equity markets to the US monetary policy in the period 1994 to 2003. They explained that a high degree of market volatility, changes in the direction of monetary policy, and unanticipated changes in the federal funds rate cause stronger effect on stock prices. The effect is stronger in industries that are cyclical and capital-intensive. Thorbecke (1997) found that an expansionary monetary policy increased ex-post stock returns. With a low interest rate, firms' economic activity increased, leading to larger cash flows and higher returns. Similarly, Cooley and Quadrini (1999) developed a value-weighted index and employed a general equilibrium model with heterogeneous, old firms where financial factors played an important role in production and investment decisions, to examine the response of stock market index to monetary policy shocks. They found that small firms responded more to monetary shocks than big firms and as a result of the financial decisions of firms, monetary shocks had impact on output. Furthermore, monetary shocks led to considerable volatility in the stock market.

Two types of effects have been identified under the other asset price channel of transmission: Tobin‘s q-Theory and Wealth effects. Tobin‘s q-theory (Tobin, 1969) provides an important mechanism for how movements in stock prices can affect the economy. It explains how monetary policy can affect the economy through its effects on the valuation of equities. Tobin‘s q is defined as the market value of firms divided by the replacement cost of capital. If q is high, the market price of firms is high relative to the replacement cost of capital, and new plant and equipment capital is cheap relative to market value of firms. Companies can then issue stock and get a high price for it relative to the cost of the facilities and equipment they are buying. Investment spending will rise, because firms can buy a lot of new investment goods with only a small issue of stock. Conversely, when q is low, firms will not purchase new investment goods because the market value of firms is low relative to the cost of capital. The crux of the Tobin q-model is that a link exists between stock prices and investment spending.

The literature also identifies a fifth channel, which is based on the private sector's expectations about the future stance of monetary policy and related variables (Loayza & Schmidt-Hebbel, 2002). This reflects the notion that monetary policy changes can influence expectations about the future course of real activity and the confidence with which those expectations are held. Changes in perception will then affect the behaviour of participants in financial markets and other sectors of the economy through, for instance, changes in expected future labour income, unemployment, sales, and profits (Tahir, 2012). The increase in the policy rate may lead economic agents to think that the monetary authorities believe that the economy is likely to be growing faster than previously thought, giving expectation of future growth and confidence in general. There is, however, also the possibility that economic agents interpret a rate hike as signaling a perceived need by the monetary authority to slow growth to achieve the inflation target, which would impact negatively on growth expectations and confidence. Hence, depending on how expectations are formed, the impact of monetary policy change could be very different.

Mohanty and Turner (2008) observed that most central banks agree that the growing role of the expectation channel has implications for the magnitude of their interest rate response. For example, in Colombia, the volatility of the policy rate had fallen since 2000 following improved credibility of monetary policy. Similarly, in Israel, more stable nominal wage expectations had

allowed the central bank to moderate interest rate movements. Mayes (2004), in his study on the monetary policy transmission mechanism in the Baltic States, found that monetary policy actions exerted effects on the economy through their impact on the confidence and expectations of economic agents about the future outlook of the economy. In particular, expectation effects might improve monetary policy transmission through the other channels by shortening reaction lags. He underscores how commitment to future expansionary monetary policy can raise expected price level and, hence, expected inflation.

Various studies have been carried out to in Nigeria to examine the monetary transmission mechanism, using different methodologies with a view to identifying the path of monetary shocks transmission. For instance, Folawewo and Osinubi (2006) used quarterly data spanning over the period 1980:1 to 2000:4 based on times series test. The study showed that the effects of monetary policy at influencing the finance of government fiscal deficit through the determination of the inflation-tax rate affects both the rate of inflation and exchange rate, thereby causing volatility in their rates. Moreover, Chuku (2009) investigated the effects of monetary policy shocks on output and prices using a SVAR model and three alternative policy instruments i.e. broad money (M2), Minimum Rediscount Rate (MRR) and the real effective exchange rate (REER). He found that monetary policy innovations carried out on the quantity-based nominal anchor (M2) has modest effects on output and prices with a very fast speed of adjustment. His conclusion showed that the manipulation of the quantity of money (M2) in the economy is the most influential instrument for monetary policy implementation. Ogun and Akinlo (2010) tested the effectiveness of the bank credit channel of monetary transmission with the adoption of deregulatory measures over the period 1986:1 to 2006:4. Using the SVAR model, their results showed that bank deposits, securities holdings and total loans and advances responded slowly to monetary policy shock during the simulation period. Monetary policy shock also contributed very little to the forecast errors of these bank balance sheet variables, which led to the conclusion of ineffectiveness of bank credit channel in Nigeria.

Furthermore, Amassoma and Nwosa (2011) adopted a simplified Ordinary Least Square (OLS) technique in examining the effect of monetary policy on macroeconomic variables for the period 1986 to 2009. They found that monetary policy had a significant effect on exchange rate and money supply while monetary policy was observed to have an insignificant influence on price instability. Moreover, despite the significant relationship highlighted in this study, their failure to take into consideration the likelihood of spurious regression, when time series data are used to serve as a weak point of this research. In a study that focused on sectoral impacts, Nwosa and Saibu (2012) investigated the transmission channels of monetary policy impulses on sectoral output growth over the period 1986-2009 using both the VAR granger causality techniques. Their results showed that while the interest rate channel was the most effective in transmitting monetary policy to agriculture and manufacturing, the exchange rate channel was the most effective for transmitting monetary policy to building/construction, mining, service and wholesale/retail.

Agbonkhese and Asekome (2013) also attempted ploughing the working mechanism of monetary policy through bank credit creation from 1980 to 2010 using the OLS method. They found the existence of positive linear relationship between total credit creation and the explanatory variables consisting of total deposits and treasury bills rate while the reserve requirement ratio and interest rate had a negative relationship with total credit creation. This showed that the

reserve requirement as a monetary policy on credit creation is not reliable much. But rather emphasis should be on the monetary policy rate (MPR) that could affect the lending rate as well as the open market operations while commercial banks could increase credit creation by reducing lending rates through more cost effective strategies for sourcing of deposits to fund their credit creation as high lending rates would appear to reduce the demand for credit in Nigeria. Moreover, Adeoye et al. (2014) expounded the main models of the credit channels of monetary transmission using quarterly time series data from 1986:1 to 2010:4 within a VAR framework. They found a potential connection between credit conditions through investment to aggregate demand and further submitted the existence of a close relationship between the bank credit and the aggregate demand, which suggests a stronger monetary transmission system via credit channels and investment multiplier in Nigeria.

In addition, Adeoye and Saibu (2014) analysed the effects of monetary policy shocks using changes in various monetary policy instruments on exchange rate volatility and the classical OLS to examine the short-run monetary policy determinants of exchange rate volatility in Nigeria coupled with the technique of error correction mechanism. They submitted that both real and nominal exchange rates in Nigeria have been unstable during the period under review. In short, the variation in the monetary policy variable explains the movement/behaviour of exchange rate through a self-correcting mechanism process with little or no intervention from the monetary authority (CBN). In addition, they also asserted the existence of causality between the exchange rate volatility and monetary policy. Oyadeyi and Akinbobola (2020) assessed how the different monetary policy channels respond to several macroeconomic variables from the period of 1986 to 2017 using quarterly data as well as the structural break and SVAR methods. Their results showed a significant standard deviation real effect on each monetary policy channel in the short term, while it also found that innovations arising from a channel itself caused the greatest shock on its future values. The authors also found that each monetary policy channel had a weak influence on output, with interest rate channel being the dominant channel of monetary policy on output.

Some important concerns can be drawn from the empirical literature on Nigeria reviewed above. One, consensus among economists have not been achieved, especially in estimating the effect of monetary policy on domestic price, output, domestic credit, wages, money and exchange rate using different monetary policy instruments. Two, some of the empirical studies adopted the OLS technique which has been faulted on the ground of not been able to capture the effect of monetary policy on the real sector in particular and the economy in general. Also, Gujarati (2004) faulted the sole application of the technique to the estimation of econometric models on the ground that it can only establish a linear relationship but not capture the interaction of variables. Three, studies that adopted other approaches such as the VAR and SVAR models in their estimation concentrated on the credit channel but neglected the channel of exchange rate which is not less important. Finally, the studies failed to capture foreign shocks in their modelling of monetary transmission in Nigeria. Therefore, this study was conducted to address these concerns and contribute to the empirical literature on Nigeria.

METHODOLOGY

The theoretical framework widely accepted for analysing monetary policy effects is the Keynesian IS-LM framework with a Philips curve superimposed on it to determine inflation. The

mechanism is such that changes in monetary policy (usually specified as exogenous shifts in monetary aggregates) affect the money supply, which changes interest rate to balance the demand with supply. The changes in interest rates then affect investment and consumption which latter cause changes in output and eventually prices.

The demand for money is rooted in the classical quantity theory of money, as articulated in the work of Fisher (1911b). Following the argument of Mundell-Fleming-Dornbush model which asserts a priori, that expansionary monetary policy reduces interest rates, depreciates the real exchange rate and increase prices, money supply and the level of real output (Rafiq & Mallick, 2008). The basis for estimating the relationship between the monetary policy and economic growth through the exchange rate channel is expressed as follows:

$$y_t = \mu_0 - \mu_1 r_t + \mu_2 y_t^* + \mu_3 q_t + \varepsilon_t \quad (1)$$

where y denotes Gross Domestic Product (GDP), r denotes interest rate, y^* denotes external income from oil, q is real exchange rate, ε is the error term, t captures time.

The study adopted the SVAR approach in estimating equation (1) in line with some of the extant studies in the literature. This framework provides a systematic way to capture the dynamics in multiple time series, and the statistical toolkit that came with SVARs was easy to use and to interpret. An important feature that makes SVAR popular is the fact that it is built on the hypothesis that the variables are contemporaneously related and, therefore, using single equation framework will not be appropriate because of the problem of endogeneity (Sims, 1980).

From equation (1), the following endogenous relationship can be specified as regards the behavior of output:

$$G_t = \left[r_t, y_t, y_t^*, x_t \right]$$

where G_t is a 4×1 vector of the macroeconomic variables, y_t is an $n\times1$ vector of endogenous variable; and x_t is an $n\times1$ vector of structural is a k in terms of its moving average as follows:

$$G_t = B(L)v_t \quad (3)$$

where $B(L)$ is the 4×4 convergent matrix polynomial in the lag operator L, $B(L) = \sum_{i=0}^{\infty} B_i L^i B_j L^j$. v_t is a 4×1 vector of reduced form residuals assumed to be identically and independently distributed, $v_t \sim iid(0,\Omega)$, with positive definite covariance matrix Ω. Following the existing literature, the underlying orthogonal structural disturbances (ε_t) are assumed to be written as linear combinations of the innovations (v_t). Hence, the VAR model can be written in terms of the structural shocks as:

$$G_t = C(L)\varepsilon_t \tag{4}$$

where $B(L)S = C(L)$. Clearly, if S is identified, one can derive the MA representation in equation (4) since $B(L)$ can be calculated from a reduced form estimation. Hence, to go from the reduced form VAR to the structural interpretation, one needs to apply restrictions on the S matrix. Only then can one recover the relevant structural parameters from the covariance matrix of the reduced form residuals.

With a four-variable VAR, one can identify four structural shocks, namely, monetary policy shocks, real exchange rate shocks, output shocks and foreign income shocks. By ordering the vector of structural shocks, the following obtains:

$$\varepsilon_t = \left[\varepsilon_t^{i^*}, \varepsilon_t^{ex}, \varepsilon_t^{y^*}, \varepsilon_t^{x}\right]$$

The recursive order between monetary policy shocks and the (domestic) macroeconomic variables implies the following restriction on the S matrix:

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 \\ 1 & 1 & 1 & 0 \\ 1 & 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_t^{i^*} \\ \varepsilon_t^{ex} \\ \varepsilon_t^{y^*} \\ \varepsilon_t^{x} \end{bmatrix} \tag{5}$$

Foreign income is placed on the top of the ordering, assuming it will only be affected by exogenous foreign monetary policy contemporaneously. Furthermore, the recursive restriction commonly used in the closed economy literature (namely that domestic variables such as output and inflation react with a lag to the policy variables, while there is a simultaneous reaction from the economic environment to policy variables), is taken care of by placing the domestic variables above the interest rate in the ordering, and assuming zero restrictions on the relevant coefficients in the S matrix as shown in equation (5). The matrix is still one restriction short of identification. The standard practice in the VAR literature, namely to place the exchange rate last in the ordering and assuming $S_{45} = 0$, so that monetary variables are restricted from reacting simultaneously to the exchange rate shock, while the exchange rate is allowed to react simultaneously to all shocks, would have provided enough restriction to identify the system, thereby allowing for the use of the standard Cholesky recursive decomposition. However, by replacing one contemporaneous restriction with a long run neutrality restriction, the model is now uniquely identified. The restrictions allows for contemporaneous interaction between monetary policy and exchange rate dynamics, without having to resort to methods that deviate extensively from the established view of how one identifies monetary policy shocks in the closed economy literature. Furthermore, the long run neutrality assumption used is theoretically appealing, being consistent with the underlying assumptions in the Dornbusch's overshooting model. Yet, introducing a new restriction does not come without any type of costs. In particular, using an infinite (long run) restriction on finite dimension VAR may provide unreliable estimates, unless the economy satisfies some type of strong restrictions on the finite horizon.

The study employed secondary data on Nigeria covering the period 1991-2020 on real GDP, interest rate, exchange rate and foreign income from oil. All the data were obtained from CBN's Statistical Bulletin.

RESULTS AND DISCUSSION

This section presents the resulted obtained from the statistical and econometric analysis carried out by the study.

Unit Root Test Results

It has been well established in literature that OLS regression estimate produces spurious results while using data with unit root. Inadequately accounting for unit roots can lead to estimates which may appear to be significant and meaningful but in reality were meaningless and insignificant. Therefore in an attempt to test for the stationarity of the variables, the unit root test was carried out using the Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) tests with constant/intercept. The results of the two tests, which are presented in Table 1, show that all the variables are integrated of the first order, that is, they are I(1) series. In view of this, the cointegration test was conducted to know whether a long run relationship exists among the variables.

Table 1: *Unit Root Test Results*

Series	**Augmented Dickey-Fuller Test**			**Phillip Perron Test**		
	Level	1st Difference	Remarks	Level	1st Difference	Remarks
RGDP	2.8637	-3.7871*	I (1)	2.7836	-3.7626*	I (1)
RINTR	-2.2866	-6.2230*	I (1)	-2.2939	--22.160*	I (1)
REXR	-2.6423	-6.0597*	I (1)	-2.7443	-6.04508	I (1)
FINC	1.2593	-4.7318*	I (1)	-2.0209	-4.7270*	I (1)

Note: *RGDP denotes real GDP, INTR denotes interest rate, EXR denotes exchange rate, and FINC denotes foreign income. * denotes significance at 5% significant level.*

Source: Authors' computation (2021)

4.2 Johansen Cointegration Test

Given that each variable under study is integrated of order (1), it is possible that they are cointegrated, that is, they have a linear combination. In order to test the possible existence of cointegration among the variables, the study employed the test proposed by Johansen (1991) as well as Johansen and Juselius (1990). The results of the Johansen cointegration test were

influenced by the order of the VAR model. The order of the VAR model was chosen with the help of three information criteria, namely, the Likelihood Ratio Criterion (LR), Akaike Information Criterion (AIC), and Final Prediction Error (FPE).

Table 2 reports the results of the Johansen cointegration test conducted by the study. The results show the eigenvalue of 0.92061 with trace statistics of 34.23 and critical value of 69.81, which suggest the likelihood of no cointegrating equation among the variables. This is a clear indication that the stochastic behavior of the variables must be taken into consideration while estimating the variables relationship. Consequently, the study conclude that there is no cointegrating relationship among the variables, which implied that variables do not establish long run relationship. Thus, for the rest of the analysis the SVAR model is carried out in first differences and no error-correction terms were included. According to VAR literature, when there are cointegrating relationships among the variables, that is, when the series are I(1) and cointegrated, one can estimate a VECM or structural vector error correction (SVEC) model in levels. However, if the variables involved are not found to be cointegrated, a VAR/SVAR model is specified in first differences. Therefore, the study specified a SVAR model in first differences.

Table 2: *Johansen Cointegration Results*

Hypothesis No of CE(s)	Maximum Eigenvalue	Trace Statistics	Critical Value
None *	0.92061	34.23	69.81
At most 1	0.82918	20.89	47.85
At most 2	0.51511	13.71	29.79
At most 3	0.28250	8.62	15.49
At most 4	0.01285	0.32	3.84

Source: *Authors' computation (2021)*

Lag Selection Criteria

In selecting the appropriate lag for the model, the study compared the values of the Schwarz and Akaike information criteria at different lags of the variables. In addition, the performance of some diagnostic statistics were used to examine the best lag of the model. However, in achieving a robust model, the same lags was selected for the variables. In using the two criteria, the study selected the model with the least information criteria, that is, the one that has the lowest SC. The results of the selection test in Table 3 reveal that 147.7301 was the least SC value and, therefore, lag of 2 is considered as the most appropriate lag length in the model.

Table 3: *Lag Selection Table*

Lag	LogL	LR	FPE	AIC	SC	HQ
1	-1797.059	NA	1.43e+57	145.7647	146.9836	146.1028
2	-1766.154	37.08575	1.10e+57*	145.2923*	147.7301*	145.9684*
3	-1722.385	35.01527	4.89e+56	143.7908	147.4474	144.8050

Source: *Authors' computation (2021)*

SVAR Estimation Results

The SVAR model consists of four variables with selection of the lag length based on the three criteria pointed out earlier. The model fulfills the stability condition, indicating that all roots of the characteristic polynomial lie within the unit circle, and hence pointing to stationarity. Diagnostic tests were conducted to further assess the nature of the residual errors. The Lagrange multiplier (LM) and Breusch-Godfrey test results reported in Table 4 support the acceptance of the hypothesis of no serial autocorrelation at 2 lags ($p > 0.05$).

Table 4: *Serial Correlation and Heteroskedasticity Test Results*

Test	**Chi-square**	**P-value**
Serial Correlation LM test	11.8245	0.7560
Heteroskedasticity Test	85.5763	0.3144

The results of the Jarque-Bera normality test in Table 5 provide evidence in support of the acceptance of the null hypothesis of normality. The likelihood ratio test (LR-test) was conducted for the SVAR model in order to establish whether the covariance matrix of the residual for SVAR model is diagonal or not. The decision rule is that if the covariance of the matrix residuals are zero, there is no point using contemporaneous restrictions to identify the SVAR system (Mackinnon, 2011). Since the LR statistic was found to be greater than the critical value, the study rejected the null hypothesis that the restrictions are not valid and accepted the imposed identification restrictions within matrix. This implies that shocks in the entire model have contemporaneous correlation in the system and thus, the contemporaneous correlation among the variables would have been neglected by the unrestricted VAR model.

Table 5: *Normality Test for SVAR Model*

Component	Jarque-Bera	Df	Prob.
1	7.540221	2	0.2604
2	1.690533	2	0.4294
3	1.706002	2	0.4261
4	2.880693	2	0.3981
Joint	13.81744	8	0.2952

Source: *Authors' computation (2021)*

The estimated system of the shocks from the SVAR can be seen from the matrix in Table 6. The coefficients of the structural shocks (impulse response coefficients) represented the given standard deviations of the variables in the system. The respective *p–values* are given in the last column. It can be seen that all the coefficients carry the correct signs. Worthy of note is the fact that the contemporaneous relationship among our variables holds implicitly in the system.

Table 6: *Structural VAR Estimates*

$$\begin{bmatrix} 1.00 & 0.00 & 0.00 & 0.00 \\ 0.57 & 1.00 & 0.00 & 0.00 \\ 0.67 & 0.05 & 1.00 & 0.00 \\ 0.62 & 0.24 & 0.66 & 1.00 \end{bmatrix} \begin{bmatrix} \varepsilon_t^{i^*} \\ \varepsilon_t^{ex} \\ \varepsilon_t^{y^*} \\ \varepsilon_t^{x} \end{bmatrix}$$

Source: *Authors' computation (2021)*

Monetary Policy Shocks and Economic Growth in Nigeria

Figure 1 presents estimates of the effects of monetary policy rate on economic growth through interest rate and exchange rate taking into consideration the foreign income shocks. However, in order to explore this interaction among the macroeconomic variables, the study carried out the analysis of the structural one standard deviation of the corresponding shock on the economic growth. Foreign income in Nigeria is highly redundant to monetary policy shocks in the short run. However, it tends to respond significantly to interest rate, which reacts to the monetary shocks. The foreign income responds negatively to the shocks in exchange rate, which might have accumulated the international pressure on the country's sources of income. It is of note that Nigeria's income depends on the oil revenue, given its high volatility, and both long and short run effect on exchange rate. The response of income from abroad may likely nosedive at a slight shock in monetary policy. This is obvious in Figure q, given the sudden sparks in foreign income

in the second period, which later rebound, but failed to converge at the baseline. This reveal the fact that foreign is highly exogenous and failed dissipates shocks. It is also pointer to the scenario of Nigeria's failure to control her external income due to the observation of international trade. The foreign income of most oil dependent economies like Nigeria depends on the economic outlook in most of the developed economies.

The effect of monetary policy shocks on the economic growth looked low in the beginning, but tended to increase as the period increase. Foreign income induced positive response in economic growth, thus shocks to foreign income through monetary policy adjustment contributed significantly to Nigeria economic growth. The inflow of foreign investors and capital, necessitated by a favourable monetary environment, could be the reason why foreign income in the light of monetary shocks causes positive growth in the economic output. Comparing exchange rate and monetary variable shocks suggest that the economic growth was susceptible to variability of the macroeconomic components. The reaction of the economic growth to the interest rate and foreign income shocks was relatively high. However, it is vital to note that each shock has its directional impact in causing the economic growth to co move, which in turn affect exchange rate. The strength of an economy will determines it exchange rate, owing to the fact that more output enhances the capability to export and therefore, leads to robust foreign income.

The interest rate in this case which had been described as the main channel of monetary policy in Nigeria, can be said to reflect the monetary policy shocks, because monetary policy rate have an instantaneous link with the bank lending rate, and shocks from CBN MPC can instantly bring about a ripple across the monetary targets such as interest and exchange rate. More so, it is of note that monetary policy can influence consumer prices indirectly through exchange rates or directly through monetary targeting and inflation targeting, which likely have link effect with the economic growth. As shown in Figure 1, a positive shock in monetary policy, results in a decrease in domestic interest rate. Interest rates decrease dramatically after the shock of monetary policy, and then decreases slightly after 2 years. So interest rates falls in response to monetary shocks.

However, when interest rates rise and this creates a burden to enterprises and households, the CBN puts some interest caps to reduce interest rates and set up special support for the real sector like agricultural sector. Currently, the CBN puts a cap of 15% for lending interest rates. The cyclical responses of interest rate appear, but are insignificant. A positive shock to interest rate is depicted as a tightening of CBN monetary policy. Positive shocks to Nigerian output lead to increase in inflation when the economy is overheating. Furthermore, a positive shock to output induces a tightening of monetary policy, resulting in an increase in domestic interest rates. This rise in interest rates seems to cause the money demand and the price level to decline. A positive shock to price level leads to an inflationary pressure in the economy. However, the variables' responses of exchange rate and output to interest rate shock is not in line with the consensus view that output and exchange rate react negatively, while interest rates react negatively to shocks. The foreign income induces a positive economic growth in the short term. They show the economy behavior in the supply side. When foreign income increases this stimulates more production and then demand for money also goes up. However, the domestic output fluctuates around the original level and tends to decrease after one year. The response of monetary policy is adjusted by increasing interest rates of naira. Thus, to deal with resulting inflation, the monetary policy is tightened and results in an increase in interest rates within about two periods. This is

consistent with the literatures. The shock in exchange rate is key indication in explaining the variance of the interest rate as well as monetary policy of Nigeria.

In the short term, a positive shock to money leads to an easing of monetary policy where the interest rate declines. It decreased in 3 periods and then went up. On the contrary, the increase in interest rates induced money demand to decline. Thus money supply also decreased. A similar positive money shock on exchange rates produces an expected result where the exchange rates depreciated in periods. Similarly, a positive shock to interest rates provided the expected contractionary effect on exchange rates whereby the money declined and the exchange rate appreciates. The exchange rate, however, fluctuated slightly and tends to depreciate in response to the positive change of interest rates. A positive shock to exchange rates, representing an appreciation of the naira, leads to a sharp fall in the interest rate. As expected, a positive shock to exchange rates causes the money demand to respond positively. In general, exchange rates reacted sensitively to interest rate changes. The output responded positively to the expansionary money. The output responded negatively to a contractionary interest rate shock. The domestic output tends to reduce in the first four year and this continues in subsequent period. The contraction of monetary policy shocks does not directly affect foreign income. Confronted with the increase in exchange rates, foreign income tended to decline while the output fluctuated, with a trend to a lower level. A positive shock to exchange rate (depreciation) caused output increase. In general, the results indicate that exchange rates have significant roles in transmitting the monetary shock to target variables of output in Nigeria.

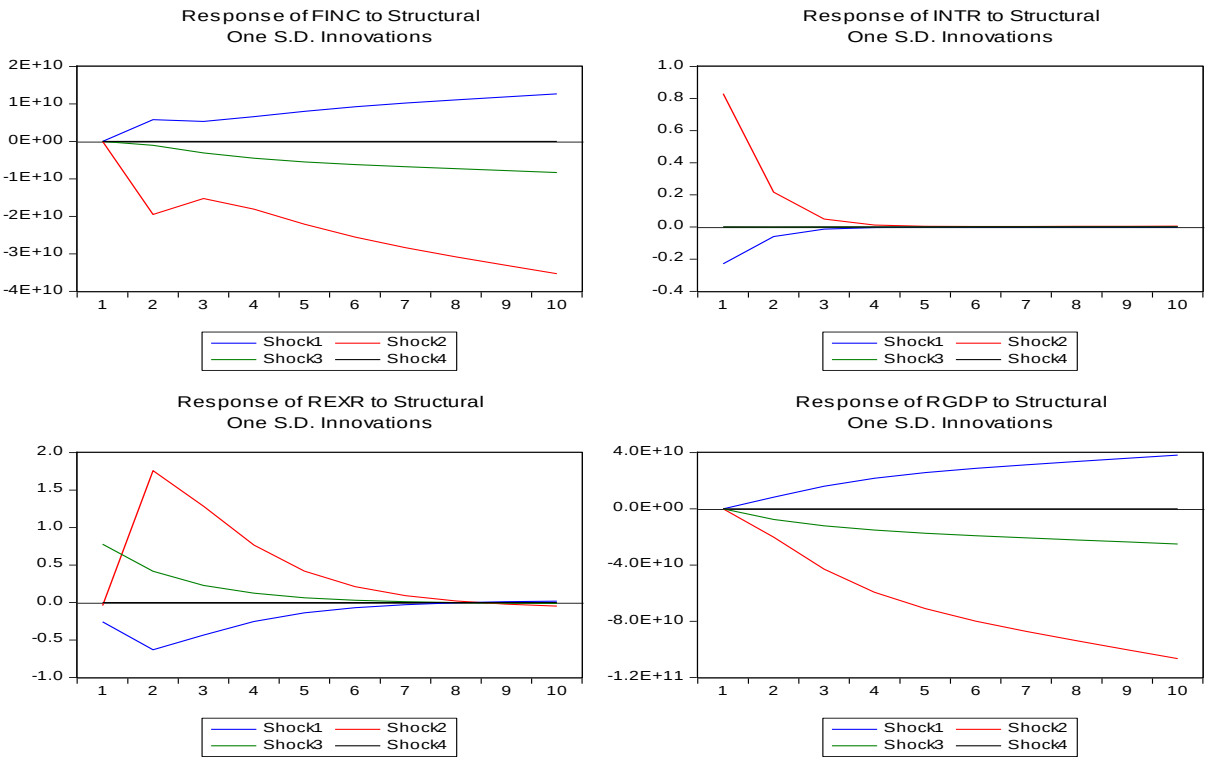

Figure 1: *Impulse Response of the Endogenous Variables*

The study used the forecast error variance decomposition to examine the interactions between variables over the impulse response horizon with the results presented. This allows evaluating the response of the economy as well as monetary policy to domestic and foreign shocks in the short and medium term. The variation proportion of the five domestic variables including, real output, interest rates and exchange rates is showed in the Table 7. It reflects interactions between the domestic and foreign variables. The variance decomposition is reported for forecast horizons of periods 1, 2, 4, 8 and 10. During the period 2000–2015, much of the variation in output in both the short and medium term was explained by its own shock followed by the shocks on foreign income, exchange rates and interest rates.

As for the exchange rate, in the shorter horizon, the variation is mostly explained by interest rate shocks and its own shocks, while in the longer horizon, much of the movements was caused by foreign income followed by output. The variation in the interest rate was mainly affected by its own shock and output while in the longer run. So interest rate appeared to be playing an important role in explaining much of the variation in domestic variables, especially in the longer horizon. Apart from the interest rates, foreign income also seemed to be affecting the movements in the Nigeria monetary aggregate, interest rates, and exchange rates in the short term. The result is consistent with what was observed in the impulse response function analysis whereby the variation in the domestic variables tend to be largely affected by the movement in the foreign variables. It is clear from the table that the monetary policy rate shock like the interests rate shock had a significant and continuous effect on domestic output. These findings are similar to the ones obtained by Domaç (1999) as well as Oyadeyi and Akinbobola (2020). A sudden and transitory rise in the short-term monetary policy rate was accompanied by a decrease in output, with the impact taking off between periods 2 and 10 after the shock. Then again, a sudden and transitory rise in the exchange rate (which implies an appreciation) is accompanied by a decrease in domestic output, with the impact taking off between periods 4 and 10.

Table 7: *Variance Decomposition*

Variance Decomposition of RGDP:					
Period	S.E.	RGDP	REXR	FINC	RINTR
1	2.06E+12	100.0000	0.000000	0.000000	0.000000
2	3.36E+12	98.84688	0.353290	0.608958	0.190871
3	4.57E+12	98.47492	0.595208	0.742921	0.186954
4	5.61E+12	98.11690	0.794055	0.804847	0.284202
5	6.54E+12	97.84830	0.943593	0.847704	0.360400
6	7.38E+12	97.66792	1.043793	0.885336	0.402951
7	8.14E+12	97.54116	1.116044	0.907205	0.435595
8	8.84E+12	97.44260	1.171096	0.923767	0.462538
9	9.50E+12	97.36808	1.212905	0.936854	0.482158
10	1.01E+13	97.31018	1.245484	0.946908	0.497432

Variance Decomposition of REXR:					
Period	S.E.	RGDP	REXR	FINC	RINTR
1	45.69304	0.472664	99.52734	0.000000	0.000000
2	68.06076	1.763253	94.63376	0.398135	3.204852
3	90.29791	1.645531	88.67517	0.872499	8.806796
4	107.0769	1.261096	88.23457	0.664639	9.839695
5	121.1901	0.984727	88.35416	0.590111	10.07100
6	134.4151	0.802638	88.02624	0.552601	10.61852
7	146.5006	0.675677	87.85513	0.512398	10.95679
8	157.5900	0.584923	87.78417	0.480835	11.15007
9	167.9992	0.515595	87.70133	0.459514	11.32356
10	177.8229	0.461044	87.63057	0.441617	11.46677
Variance Decomposition of FINC:					
Period	S.E.	RGDP	REXR	FINC	RINTR
1	8.55E+11	11.10604	1.998661	86.89529	0.000000
2	1.62E+12	45.88820	0.911573	46.31339	6.886835
3	2.04E+12	52.63477	1.209781	41.20016	4.955289
4	2.43E+12	56.55413	1.643179	38.11940	3.683290
5	2.81E+12	58.97410	1.814939	36.12716	3.083793
6	3.14E+12	60.81120	1.936490	34.57574	2.676570
7	3.45E+12	62.00009	2.049658	33.58870	2.361546
8	3.73E+12	62.87806	2.127853	32.84993	2.144160
9	4.00E+12	63.55641	2.185139	32.27624	1.982217
10	4.24E+12	64.08600	2.232576	31.82882	1.852602
Variance Decomposition of RINTR:					
Period	S.E.	RGDP	REXR	FINC	RINTR
1	20.52162	2.760409	1.032154	46.21994	49.98750
2	20.75209	2.768100	1.307307	45.23486	50.68973
3	22.44966	7.997020	3.457972	43.88941	44.65560

4	23.60233	7.278582	4.487643	46.43708	41.79669
5	24.41131	6.805314	5.430810	48.20295	39.56092
6	25.16094	6.422706	6.685851	49.59443	37.29701
7	25.99274	6.018617	7.711402	51.14121	35.12877
8	26.77507	5.682170	8.591454	52.41070	33.31568
9	27.52273	5.380762	9.429191	53.52531	31.66473
10	28.26277	5.107772	10.18268	54.54553	30.16401
Cholesky Ordering: RGDP REXR FINC RINTR					

CONCLUSION AND POLICY RECOMMENDATION

This study examined the impact of monetary policy shocks on economic growth in Nigeria for the period 1991 to 2020 using the SVAR model. The data were sourced from Statistical Bulletin of the CBN. Results revealed that monetary policy contraction causes a little downward response in the price level as well as an increase in the short and long run monetary policy rates. This further causes aggregate output to increase and exchange rate to depreciate. The results further suggested that monetary policy had a limited persistent influence on price level. Although, there was no outright evidence to underscore monetary policy credence, yet the results did not cast any doubts on whether monetary policy tightening is effective and useful in controlling the evolution of exchange rate movement in the Nigerian economy. Based on these findings, a long lasting and significant inflation reduction might require strong tightening of monetary policy, causing stability in price level and hence economic growth at least in the short run. In restoring fervent international competitiveness and to achieve financial integration in the global economy, Nigeria ought to put more effective monetary policy in place through conscious efforts by the monetary authorities than ever before. More particularly, the adoption of fully-fledged inflation targeting is required. This will bring inflation expectations down and thereby, the exchange rate channel will become credible and stronger, which will in turn make the effects of monetary policy more anticipated and will thereby require less aggressive monetary policy rate changes. Such credibility will help monetary policy to become more reliable in achieving both internal and external balance.

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