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Monetary Policy and Macroeconomic Instability in Nigeria : A Rational Expectation Approach

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ABSTRACT Generally, both fiscal and monetary policies seek at achieving relative macroeconomic stability. Based on countries' experience on the role of monetary policy in controlling economics instability, this study examines the efficacy of monetary policy in controlling inflation rate and exchange rate instability. The analysis performed is based on a rational expectation framework that incorporates the fiscal role of exchange rate. Using quarterly data spanning over 1980: 1 to 2000: 4, and applying time series test on the data used, the paper shows that the effort 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 the real exchange rate, thereby causing volatility in their rates. The paper reveals that inflation affects volatility of its own rate, as well as the rate of real exchange. The policy import of the paper is that monetary policy should be set in such a way that the objective it is to achieve is well defined.

Generally, both fiscal and monetary policies seek at achieving relative macroeconomic stability. Over the year, two issues have been subjects of debate in this regard. First is the superiority of each of these policies in the achievement of macroeconomic stability. While the Keynesians argued that fiscal policy is more potent than monetary policy, the monetarists led by Milton Friedman on the other hand believed the other way round. Although the focus of this paper is neither to join in nor extend the debate, based on countries' experience and the fact that monetary policy is often free from political interference, the study analyses how effective monetary policy has been in tackling macroeconomic instability in Nigeria. The second issue concerns the definition of macroeconomic instability. Macroeconomic instability can be regarded as a situation of economic malaise, where the economy does not seem to have settled in a steady equilibrium position (Azam, 2001), thereby making it difficulty to make predictions and good planning.

The definition of macroeconomic instability above suffers from lack of precision. The monetary policy focuses precisely on the achievement of price stability, with respect to both domestic and external prices. While inflation rate is often used to track movement in domestic price level, exchange rate is used as policy tool in ensuring external stability and enhancing export performance (Caballero and Corbo, 1989). In addition, exchange rate policy impacts on the outcome of stabilisation measures and debt management strategies (Busari and Olayiwola, 1999), especially in developing countries. Thus, this study examines the efficacy of monetary policy in controlling inflation rate and exchange rate instability. As a means of achieving this, a simple monetary model with rational expectation that emphasizes the fiscal role of the real exchange rate is used. The fiscal role of real exchange rate is particularly relevant to Nigeria since the bulk of government revenue is derived from foreign exchange earnings. In the theoretical model, the links between high inflation and the joint volatility of the real exchange rate and inflation rate, and some aspects of government's fiscal and exchange rate policies are illustrated in a rational expectation equilibrium framework. Consequently, inflation rate and the real exchange rates are jointly determined by the equilibrium of the model. This is derived from the sunspot equilibria theory in which Woodford (1986), Shigoka (1994) and Drugeon and Wignolle (1996) have demonstrated that macroeconomic instability is related to multiple rational expectation equilibria. This study therefore examines how inflation, through monetary policy target, impacts on relative prices and their instability, thereby impairing market signals.

The rest of the study is divided into four sections. Section II provides an overview of monetary policy and macroeconomic instability. Section III presents the theoretical framework of the rational expectation model. Section IV presents the empirical results and section V concludes the study.

OVERVIEW OF MONETARY POLICY AND MACROECONOMIC INSTABILITY, 1980 - 2000

Since its establishment in 1959 the Central Bank of Nigeria (CBN) has continued to play the traditional role expected of a central bank, which is the regulation of the stock of money in such a way as to promote the social welfare (Ajayi, 1999). This role is anchored on the use of monetary policy that is usually targeted towards the achievement of full-employment equilibrium, rapid economic growth, price stability, and external balance. Over the years, the major goals of monetary policy have often been the two later objectives. Thus, inflation targeting and exchange rate policy have dominated CBN's monetary policy focus based on assumption that these are essential tools of achieving macroeconomic stability.

Monetary policy in Nigeria has been carried out through the portfolio behaviour of the CBN in terms of the control of its credit and management of reserves. Credit control is being used to check movement in domestic price level, while the exchange rate policy serves as measure for determining the competitiveness and current account performance as well foreign reserves. Figure 1 indicates that during the first half of 1980s, CBN's reserves relative to domestic credit witnessed continual decline it however started to increase from 1986 up till 1990. Around the last quarter of 1990 the reserves nose-dived again until 1991 when it picked up again. This trend in reserves coincides with the three different exchange rate regimes. The period 1980 to 1986 was marked by overvaluation of domestic currency, Naira vis-à-vis other trading partners currencies (especially US dollars), during this period the monetary authority adopted fixed exchange rate regime. The first substantial increase in reserves fell within the devaluation year, the third quarters of 1986 and first quarter of 1992, however the devaluation was characterised by manage or pegged exchange rate regime. In March 1992 when the floating exchange rate was adopted by the merging of official exchange rate with the parallel market rate there was an initial shock in the system and this affected the reserves negatively. The initial shock was later absorbed as evident by the subsequent increase in the reserves. Although it can be deduced that the upward trend experienced in reserves from 1994 was due to reduction in importation, the increase was as a result of great cut back in CBN's credit to the Federal Government. Figure 1 presents the trend in credit to the government over the period of 1980 to year 2000, the figure shows that there was a huge decrease in the allocation of credit to government as an aftermath of floating exchange rate before it rose again to its pre-devaluation level in 2000.

The different exchange rate policies couple with the inflationary targeting of monetary policy has affected domestic price level and stopped

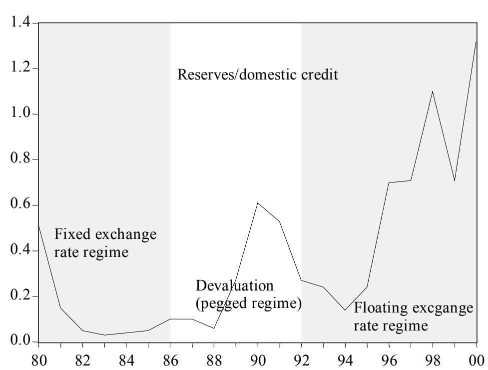


Fig. 1. Central Bank's reserves and domestic credit, 1980-2000

Fig. 2. Central Bank's credit to the Federal Government, 1980-2000

competitiveness in several ways. First, as evident from Figure 2, there was an appreciation in nominal effective exchange rate (NEER) between the Period 1980 and 1986. The NEER however appreciated with the devaluation of 1986 until 1992 when it started depreciating again with the adoption of the floating exchange regime. On the other hand, the general price level, as depicted by consumer price index (CPI) has fluctuated, leading to high level of instability in domestic prices. In fact, the different monetary policies have led to galloping inflation, with inflation rate hovering around two-digit in most of the period under review. The trend in inflation is presented in Figure 3, which reflects a picture of high level of instability in the inflation rate. During the fixed exchange rate regime inflation rate was mild averaging about 19 percent, during the first devaluation (1986: 3 to 1992: 1) the average rate of inflation was 25 percent. The floating exchange rate regime initially brought about increase in the rate of inflation with inflation reaching a peak of about 72 percent in 1996 before going down back to the pre-devaluation level. Similarly, there has been a continuous real depreciation in the value of Naira against the value of major trading partners' currencies the situation, which is depicted by the downward trend in the real effective exchange rate (REER) (Fig. 4).

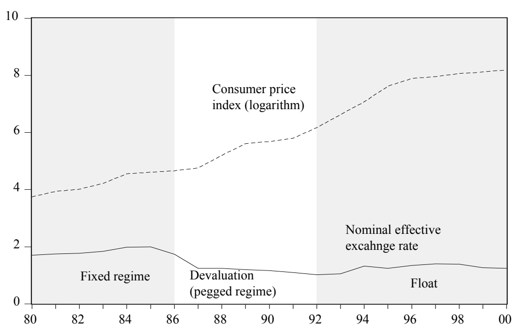


Fig. 3. Consumer price index and nominal effective exchange rate

The REER is calculated as a trade-weighted index of the price level of the main trading partners, relative to the domestic price level. Although the REER may be influenced by the behaviour of the trading partners' currencies, it indicates the competitiveness of a country.

The above shows that despite the effort of monetary authority in ensuring macroeconomic stability, the different monetary policy measures put in place so far have not succeeded in wiping off instability in the economy. Thus, the inflation targeting of monetary policy has only created volatility of both inflation rate and the REER. Consequently, in what follows we analyse the relationship between inflation and REER volatility, and also the relationship between inflation and the volatility of its rate. However, in the next section we first set out the rational expectation framework within which the dynamic relationships between inflation and REER are examined.

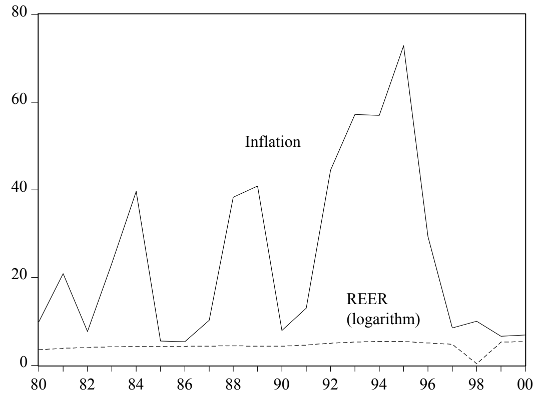


Fig. 4. Inflation rate and real effective exchange rate

RATIONAL EXPECTATION MODEL OF INFLATION AND EXCHANGE RATE INSTABILITY

The theoretical framework for linking the relationship between inflation, the instability of REER and inflation rate adopted here draws heavily from Azam (1999, 2001). In the model, international price of tradable goods in terms of foreign currency is equal to one, so that their nominal price in domestic currency is e. Further, let us assume that quantity of money in the economy is M while the price level is P, and that the price level is an increasing (and linearly homogenous) function of e and of the price of non-tradable, assumed implicit in the model. If we also define $q = e/P$ as the real exchange rate, which is an increasing function of real exchange rate defined as the ratio of the price of tradable goods to the price of non-tradable goods.

In order to effectively incorporate the fiscal role of the real exchange rate, government expenditures and revenues are spilt into two different categories, subject to how they are affected by the exchange rate. It is assumed that government expenditures are indexed on price level P, while its revenues (including foreign aid) are indexed on exchange rate. Therefore, let *D* represent the excess of expenditures over revenues indexed on *P* and *F* the excess of revenues over expenditures indexed on *e*. Since the government budgetary policy is usually exogenous of stability objective of monetary policy, this implies that *D* and *F* can be held constant. Consequently, the monetary financing of the overall deficit is given by:

$$dM/dt = pD - eF \quad (1)$$

Equation (1) implies that change in money stock is used to finance fiscal deficits. If we denote the rate of inflation by p = *d* log *p*/*dt* and the rate of change in the local currency chosen by government as *d* = *d* log *e/dt*. In Nigeria the exchange rate regime chosen by government determines the rate of crawl, therefore it is assumed that *d* is control by government. Since the rational expectation hypothesis assumes private agents to have perfect knowledge about the market, this then indicates that they know *d*.

The real rate of depreciation of the domestic currency is determined by the difference between the rate of change chosen by the government and the inflation rate, that is;

$$dq/dt = (\delta - \pi)q \quad (2)$$

If we denote real money balances by *m*, then equation (1) can be re-written as:

Assume that the demand for real money balances is determined *à la* Cagan (1996) as a function of the expected rate of inflation p^e by the function:

Equation (4) holds under the assumption of ration expectation equilibria in which case $p^e = p$ and I p^e I << μ, "t > 0, where 0 is the present time period or the initial period.

Substituting equation (4) into (3) yields

$$d\pi/dt = (1/\lambda^{'})dm/dt = (1/\lambda^{'})(D - qF - \pi\lambda(\pi)) \quad (5)$$

$$D - qF = \pi\lambda(\pi) \quad (6)$$

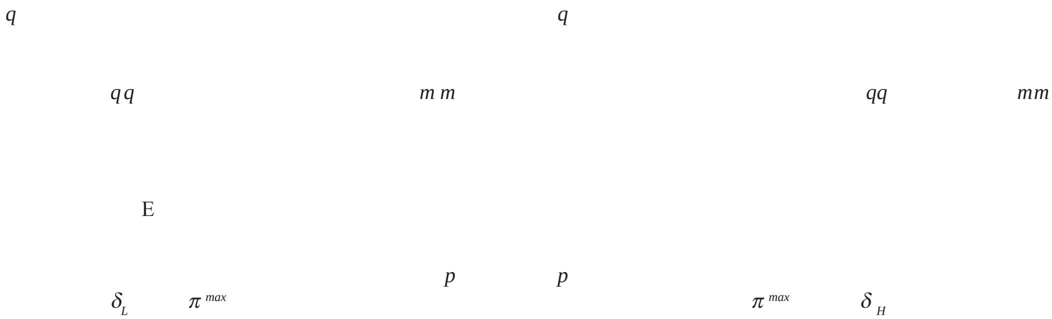
This implies that inflation is stabilised as (*dπ / dt = 0*) for all pairs {q, *p*} such that:

From equation (6), it can be seen that the inflation finance, the real seignorage represented by the left hand side of the equation, is a linear decreasing function of *q*. The negative slope of the function is reinforced by assuming that *D* and *F* to be function of *q*, in which case it would be assumed that $D^{/} < 0$ and $F^{/} > 0$. This is based on the fact that real depreciation will raise the real value of foreign trade, on which a lot of taxes are based, therefore raising the level of *F*, while it will reduce the real value of public expenditures on non-traded goods, which determines *D*. The proceeds of the inflation tax, represented by the right hand side of equation (6) is a non-monotonic concave function of *p*, according to the inflation-tax Laffer-curve mechanism (see Bruno and Fischer, 1990; Dornbusch and Fischer, 1993). The inflation-tax is maximised as the aggregate maximum of the product of expected and actual inflation rate. This gives the inflation-tax maximising rate as:

$$\pi \max = \arg\max(\pi\lambda(\pi)) \quad (7)$$

Figures 5a and 5b show that equation (6) is a non-monotonic convex curve labelled as *mm*. This implies that any level of the real exchange rate that is consistent with the existence of a stationary equilibrium – that is located on *mm*- can correspond equally to a low or a high rate of inflation, depending on the side of the curve on which the equilibrium is located. Any movement of the {*q, p*} pairs above the mm locus causes inflation rate to increase overtime, as indicated by equation (5), while movement of the pairs below the locus decreases inflation. Consequently, a depreciation in the real exchange rate *q* leads to increase in fiscal deficit since this will imply an increase in the real value of aid and trade-related taxes. The situation will cause private agents to reduce their real money balances. It is however important to note that this condition only holds with the rational expectation equilibrium if there is acceleration in inflation.

Figures 5a and 5b analyse the combined effect of the exchange rate dynamics contained in equation (2) using phase diagrams. In the phase diagrams, the locus of point such that *dq/dt = 0* is denoted *qq*. Diagram 5a represents the case where the chosen rate of crawl lies below the inflation-tax maximising inflation rate, which connotes a saddle point with a zero-dimensional convergent sub-space. Then as there is no pre-determined variable in the system, the economy jumps instantly at point *E*, and stays there as long as the chosen rate of crawl δ_L is credible.



Thus, the real exchange rate and the inflation rate are uniquely determined by the chosen rate of crawl.

However, in case 5b there exists a distinct result with the chosen rate of crawl d_H which is greater than the inflation-tax maximising rate p^{max}. In this case, the steady-state is stable at point *S*, with a two-dimensional convergent sub-space. According to the phase diagram, steady-state S is reachable only through either the north-east, or the south-west, which are positive slope trajectory along the space.

Linearising the system around the stationary point $\{\pi^*, \theta^*\}$, where $\pi^* = \delta$ yields;

$$\begin{bmatrix} d\pi/dt \\ dq/dt \end{bmatrix} = \begin{bmatrix} (-1/\lambda'(\lambda+\pi\lambda') & (-1/\lambda')F \\ -q & 0 \end{bmatrix} \begin{bmatrix} \pi-\pi^* \\ q-q^* \end{bmatrix} \ldots\ldots(8)$$

The determinant of the Jacobian matrix in equation (8) is always positive, while its trace has the same sign as $l + p\, l'$, which in turn is the same as the sign of the $p^{max} - d$, because of the assumed inflation-tax Laffer curve. Consequently, the eigenvalues of the matrix are both positive, if the chosen rate of crawl is smaller than the inflation-tax maximising rate of inflation, or they are both negative if the reverse is the case.

From the above, when the chosen rate of crawl is below the inflation-tax maximising rate of inflation, there will exist a unique rational expectation equilibrium that determines jointly the rate of inflation and the real exchange rate. Any point other than the stationary point E will cause the explosion of the trajectory, and hence violates the convergence condition for rational expectations equilibrium. Therefore, monetary authority embarks on policy that controls the rate of inflation and the real exchange rate through the chosen rate of crawl dictated by the given parameters of the system. On the other hand when the stationary point is *S*, any point inside the phase space belongs to a trajectory that converges eventually to *S*, and therefore conforms to the rational expectations equilibria. This leads to a continuum of rational expectations equilibria. It is essential to note that the difference between the two situations comes from the elasticity of the demand for money with respect to the expected rate of inflation.

In the practical sense, the continuum of the rational expectations equilibria predicts a high volatility for the variables in the system. Since the system has no anchor, the variable of the system becomes extremely unstable and jump from one trajectory to the other based on the response of private agents to information relevant to their expectations. Blanchard and Fischer (1989) provide an elaborate theoretical exposition in the sunspot model that tries to capture this behaviour. Adam, Ndulu and Sowa (1996) in their effort at finding the parameters of the demand for money function that determines the inflation-tax maximising rate of inflation, apply the theory to Kenya, Ghana and Tanzania and find that the average inflation-tax maximising rate of inflation is about 15 or 20 percent, while the estimate by Randa (1999) for Tanzania is about 44 percent.

Given the above, monetary policy aimed at minimising or maximising inflation-tax may lead to instability in the rate of inflation, as well as the real exchange rate subject to the inflation tax rate chosen by the monetary authority and the response of private agents to the market information. The policy import of the theory therefore is that inflation causes volatility in its own rate and in the real exchange rate. Further it shows that both inflation and the real exchange are jointly determined. In the next section, we present empirical result of how inflation affects the instability of these variables.

EMPIRICAL RESULTS

In the application of the theoretical framework, a search procedure method, a la Hendry, which allows us to move from general to specific, is employed (see Banerjee et al., 1993). This enables us to arrive at a dynamic relationship between variables of the theoretical system as applied by Azam (2001). In the empirical analysis, the data used span over 1980:1 and 2000:4, this implies that quarterly data is used. First, an investigation of the time series properties of the variables is carried out. Using the Augmented Dickey-Fuller (ADF) test, Table 1 shows the unit root test results which indicates that three of the variables in the empirical model are integrated of order zero, I (0), implying that they are stationary at their actual level. These variables are inflation rate, real value of credit to government (RCRDTGOV) and the ratio of Central Bank's reserves to aggregate domestic credit (RESCRDT). On the other hand, consumer price index (CPI) and both nominal effective exchange rate (NEER) and real effective exchange rate (NEER) are integrated of order one, I (1), which means that they are only stationary at their first difference. The variable RESCRDT is used to capture what dictates the type of exchange rate policy measure adopted by government. Second, a test of the existence of long-run relationship among the series of the model equations is performed. The Johansen test shows that comparing the Likelihood Ratio at 136.87 to the 5 percent critical value of 68.52 there exists cointegrating vectors of up to 4 in the model (see Table 2), thereby suggesting that the relationship of the model can be used for long-run predictions.

Table 1: Unit root test result

ADFVariable	*Level*	*First Difference*	*Order of Integration*
CPI	-1.2445	-3.3670	I (1)
Inflation	-2.9830	na	I (0)
Neer	-2.1310	-4.3082	I (1)
Rcrdtgov	-4.1451	na	I (0)
Reer	-1.3593	-3.9147	I (1)
Rescrdt	-3.0950	na	I (0)

Notes: 5 percent critical value = -2.8972, na = not applicable

In the empirical analysis the volatility of REER is examined through equation (9), the result shows that an appreciation in NEER leads to appreciation in REER and vice versa. Contrary to the prediction of theory, the result indicates that even with decrease in reserves real exchange rate still depreciates as reflected by the negative sign of the RESCRDT, the result, which is direct opposite to that obtained in Azam (2001). However, one year-lagged value of RESCRDT is positively related to REER, implying that it is actually the past value of the ratio of total reserves to aggregate credit that shows the willingness of government in Nigeria to depreciate domestic currency. Equation (9) further shows that inflation rate is very significant causal factor of instability in REER, with decrease (increase) in current period inflation rate corresponding to depreciation (appreciation) in REER, while increase in one-period lagged value of inflation leads to real depreciation of REER. In the equation Δ represents first difference operator, white heteroscedasticity-consistent *t* ratios (because of heteroscedasticity problem detected by various tests conducted) are in parentheses and lag operator is denoted as (-1). The result shows that there is no problem of serial correlation. The ARCH test indicates the presence of little auto-regressive conditional heteroscedasticity, but it is not enough to bias the estimates of the model.

Table 2: Johansen cointegration test

Likelihood	*5 Percent Eigenvalue*	*Ratio Critical Value*
0.570	136.868	68.52
0.354	70.228	47.21
0.169	35.759	29.68
0.149	21.100	15.41
0.101	8.388	9.01

$$\begin{aligned}\Delta \log REER = &-0.02 + 0.265\Delta \log NEER - 0.211 \log RESCRDT\\ &(-0.77) \qquad (5.55) \qquad (-3.76)\\ &+ 0.240 \log RESCRDT(-1) - 0.034 INF + 0.342 INF(-1)\\ &(4.26) \qquad (-4.71) \qquad (5.86)\\ &N=83,\ R^2 = 0.46,\ ARCH\ (2) = 14.9,\ F = 12.94,\ DW = 1.89 \quad \ldots\ldots \quad (9)\end{aligned}$$

In equation (10) we analyse the actual source of instability of REER by testing whether inflation is the main cause of volatility in the stochastic process of the relationship in equation (9) by using the GARCH process suggested by Enders (1995). Equation (10) shows that inflation is actually the major source of volatility of REER in equation (9), in (10) RES2 is the squared term of the residual from (9). Therefore, the result is indicative of the fact that the higher is the level of inflation the more will the real exchange rate depreciate.

Also, the causal factors of changes in the rate of inflation are examined using a similar approach to that adopted in equation (9). In arriving at equation (11) we embarked on variable deletion test by moving from an over-parameterised to a parsimonious equation. From equation (11) it is clear that variations in inflation rate are significantly determined by all the determinants used. The equation shows that current level of inflation is positively related to its past values, level of NEER and the past level of the ratio of reserves to aggregate credits, while it is negatively

$$\begin{array}{l} INF = -0.068 + 1.004\, INF(-1) + 2.820\Delta \log NEER - 6.667\Delta \log REER \\ \qquad\quad (-0.17) \qquad (24.74) \qquad (3.96) \qquad\qquad (-4.79) \\ \qquad\quad - 3.895\, LRESCRDT + 3.974\, LRESCRDT(-1) + 0.851\, RCRDTGOV \\ \qquad\qquad (-5.22) \qquad\qquad (5.26) \qquad\qquad (2.15) \quad \ldots\ldots\ldots\ldots (11) \\ N = 83,\ R^2 = 0.90,\ F = 117.12,\ DW = 1.19,\ LM(2) - F = 7.99,\ ARCH(1) = 6.10 \end{array}$$

related to REER and present level of RESCRDT. This implies that there is a transfer effect of inflation on its yearly rate, and that depreciation in NEER increases the rate of inflation, while appreciation in REER leads to increases in the rate of inflation, this result is consistent with Corrinne and McCauley (2003) findings. The various diagnostic tests suggest no estimation problem.

Lastly, we investigate how inflation impact on the volatility of its own rate through changes in periodic values of the CPI. Equation (12) shows that depreciations in both NEER and REER raise the level of CPI, just as increase in credit to government sector also induces high level of CPI. An important result in the equation is significant impact of the past value of CPI on its variation.

$$\begin{array}{l} \Delta \log CPI = -0.231 + 0.315\Delta \log NEER + 0.212\Delta \log REER(-1) \\ \qquad\qquad (0.42) \qquad (0.4.32) \qquad (2.78) \\ \qquad - 0.173 \log RESCRDT + 0.119\, RECRDTGOV + 0.330\Delta \log CPI(-1) \\ \qquad\qquad (2.35) \qquad\qquad (2.14) \qquad\qquad (5.65) \quad \ldots\ldots\ldots\ldots (12) \\ \quad 2 \end{array}$$

In order to isolate the actual impact of CPI on the instability of inflation, we perform a GARCH test similar to that of equation (10). The result of the volatility test shown in equation (13) changes in CPI is positively related to the volatility of the residual of the CPI equation (12).

$$\begin{array}{l} RES^2 = -0.044 + 0.450\Delta \log CPI(-1) - 0.069\, RES^2(-1) \\ \qquad\qquad (-0.82) \qquad (5.77) \qquad\qquad (1.94) \ldots\ldots (13) \\ \quad N = 82,\ R^2 = 0.35,\ F = 4.49,\ LM(2) - F = 2.32 \end{array}$$

Overall, the results of the different analyses have shown that inflation rate affect changes in real exchange rate and equally affects its own volatility. Also, the effort of monetary authority in Nigeria at using its credit and reserve as monetary tools in checking inflation and the rate of exchange has affected the volatility of the two variables over the years. Thus, monetary policy, if not well targeted could yield negative results. This is because private agents speculative activities may frustrate monetary effort (Berg and Pattillo, 1999), just as improper inflation targeting could affect real exchange rate volatility (Amato and Gerlach, 2002) and exchange rate intervention induce inflation (Galati, 2000). Thus, monetary policy should be set in such a way that the objective it is to achieve is well defined, and in way that efforts at stabilising exchange rate will not generate inflation and vice versa.

CONCLUSION

This paper has investigated how monetary policy objective of controlling inflation rate and intervention in the financing of fiscal deficits affect the variability of inflation and real exchange rate. The analysis is done using a rational expectation framework that incorporates the fiscal role of exchange rate. The paper has shown that the effort 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 the real exchange rate, thereby causing volatility in their rates. The paper revealed that inflation affects volatility of its own rate as well as the rate of real exchange. The policy import of the paper is that monetary policy should be set in such a way that the objective it is to achieve is well defined.

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