Output Uncertainty, Monetary Uncertainty and the Nigerian Demand for Money

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Abstract: The study examines the stability of money demand in Nigeria for the period 1960-2015 by including two GARCH-based measures of output uncertainty and monetary uncertainty. These two measures of uncertainty were included in the money demand function for Nigeria because they could affect public's holding of money. Prior studies: Previous only examined the stability of money in Nigeria without examining the possiblity of uncertainties in monetary and output aggregates, a gap which this study fills. Approach: The study used the nonlinear autoregressive distributed lag (NARDL) to examine the short and long-run relationship. Results: It was discovered that only monetary volatility exert significant impact on the demand for money in Nigeria both in the short run and in the long run. However, output volatility is not significant both in short-run and the long run. In addition, including the two uncertainty measures yield a stable demand for money in Nigeria. Implication: Monetary uncertainty has strong substitution effects as compared to precautionary effects and that Nigerians substitute cash by shifting to alternative assets. Value: The study contributed to the literature by examining the non-linearity and uncertainties in the stability for demand for money in Nigeria.

Keywords: stability of money demand in Nigeria; monetary uncertainty; output aggregates

JEL Classification: O23

1. Introduction

Friedman (1959) among others emphasized the need for stability of money demand function as a condition for a credible monetary policy; this is because the stability of money governs largely the macroeconomic management and performance of an economy. In addition, the stability of money establishes a direct link between monetary aggregates and determines the effectiveness of fiscal policy in changing the level of income. Changes in fiscal variables, such as tax rates or government spending, affect the level of income if the demand for money changes when the interest rate changes.

Stability of money is equally important because it is the object of monetary policy which influences the demand for money and also serves as a key function in all models of the economy, be it closed or open economy. It is in this regard that the

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stability of money has a significant effect on the fundamental on problems of price instability, unemployment, declining economic growth, unequal distribution of income and balance of payment disequilibrium. It is against this backdrop that this study examine the impact of monetary and economic uncertainty on the demand for money in Nigeria and find out if the inclusion of the two uncertainty variables will yield a stable demand for money in Nigeria.

The study contributes to the extant literature of demand for money by analyzing the various policy changes that has taken place in Nigeria over the years which may affect the demand for money. A major policy shift is the introduction of the Structural Adjustment Programmes (SAPs) of 1986 where government changed his economic policy from a direct to an indirect approach by reducing the involvement of government activities. Among other several reforms initiated and implemented is the capital account liberalization as well as the financial sector reforms. The financial sector reforms of the 1980s witnessed a drastic turn in the foreign exchange controls and the deregulation of the financial markets. During this period, government bonds were expanded and interest rates were determined by the joint forces of demand and supply. One major happening during this period is the changes in the price level. At the onset of the reforms, the price level moves from single digit to a double digit, however, with the withdrawal of government funds from the money deposit banks the price level nosedived to a single digit.

During the 1990s, the country was hit with the banking and financial crises and there was an upsurge in the price level by the middle of 1990s. However, during the late 1990s, specifically 1999 there was a change in government from military government to a democratically elected government and this ushered in sound economic policies which helped to reduce the level of inflation to a single digit. From the foregoing, one can attest to the fact that the demand for money function could have been disrupted by the series of financial and economic changes. Thus, output and monetary policy uncertainties should be accounted for in the estimation of demand for money in Nigeria and this represents the major kernel of the study. The remainder of the paper is organized as follows. Section 2 provides the theoretical linkages and the empirical evidence on demand for money. Section 3 provides the methodology of the study. Section 4 is devoted to empirical results. Section 5 concludes.

2. Theory and Evidence

The theoretical literature on the demand for money can be classified into three and they are; the Fisher's quantity theory or the transactions approach, the Cambridge equation or the cash balances approach, the liquidity preference theory. Asides from

these theories, there are other theories who made substantial and robust addition by criticizing earlier theories on demand for money. The theories are discussed below.

The first theoretical relationship explaining the demand for money is the Fisher's quantity theory. Fisher (1911) explained his theory based on the following assumptions, first, nominal quantity of money is determined exogenously by the Central bank. Second, the amount of transactions carried out depends on the level of income. Third, there is full employment of resources. Given the above assumptions, the quantity theory of money is given as MV=PY; where M is the money stock, V is velocity, P is the price level and Y is the real income. Thus, the demand for money depends on the price level and the real income given that the velocity of money is constant.

The second strand of theoretical relationship on the demand for money is the Cambridge equation or the cash balance approach. Pigou (1917) and Marshall (1923) place emphasis on the function of money as a store of value or wealth. They further opines that the current rate of interest, individuals wealth, future rates of interest and future prices determines the demand for money and that changes in the above mentioned factors remain constant or they are relative to changes in individual's income.

The third strand of theoretical literature on demand for money is the Keynesian theory of money. Keynes (1936) stated that the demand for money arises for three motive; transactions motive, precautionary and speculative motive. According to Keynes the total demand for money means total cash balances which may be of two types: active and idle balances. The former comprises transactions and precautionary demand and the later comprise speculative demand. Both the transaction and precautionary demand are positively related with the changes in money income, while the speculative demand for money is negatively related with the changes in the rate of interest. Finally, Keynes held that the total demand for money is determined by the interest and income.

The fourth strand on the theoretical relationship is the theories of demand for money put forward by Baumol (1952), Tobin (1956), Mundell (1963), Friedman (1984) and Choi and Oh (2003). Baumol's based his analysis on the holding of an optimum inventory of money for transactions purposes by a firm or an individual. In his model he opined that the relation between transactions demand for money and income is neither linear nor proportional as stated by Keynes. Tobin's (1956) contributes to the theoretical literature on demand for money by identifying the two major defects of the Keynesian theory of liquidity preference; first, the expectations of future interest rates and second, an individual hold either money or bonds. Thus, Tobin argued that individuals are uncertain about the future rate of interest, and that an individual's portfolio holds money and bonds rather than only one at a time.

Mundell (1963) argued that exchange rate is another determinant of demand for money owing to substitution of the currency. He further argues that an appreciation of the domestic currency or depreciation of foreign currency results in a decrease in domestic currency value of the assets held abroad by domestic residents. A perceived decrease in wealth, public will tend to reduce spending by demanding lesser money. On the other hand, when foreign currency depreciates, if there is expectation of further depreciation, people may hold less of foreign currency and more of domestic currency.

Friedman (1984) identified the volatility of nominal money supply as a significant factor influencing the level of money demand. He emphasized that increase in the degree of volatility of monetary growth tends to raise the degree of an apparent uncertainty and thus raise cash holding. In addition, Choi and Oh (2003) also contributes to the theoretical literature on demand for money by introducing output volatility as a determinant of demand for money. They argued that due to output volatility the public are faced with uncertainty in the job market in the future, thereby increasing the cash holding capacity of the public.

There is plethora of empirical literature of demand for money in Nigeria, but they have different results owing to different methodology and techniques, different sample size as well as inability to account for economic and monetary uncertainties. Some of these empirical literatures are but not limited to the followings; Teriba (1974) examined the determinants of demand for money in Nigeria for the period 1958 to 1972. Using the Ordinary Least Squares (OLS), there is evidence of significant income elasticity of demand deposits in Nigeria, but interest rates were not statistically significant. Ojo (1974) also examined the demand for money in the Nigerian economy, employing OLS and partial adjustment model they found that demand for money is inelastic with respect to income and price change expectations. In addition, the study of Oresotu and Mordi (1992) differs from earlier studies. They examined the determinants of demand for money in Nigeria by accounting for the effect of structural adjustment programme. Their result suggests that current income, foreign interest rate, domestic interest rate, inflationary expectations and exchange rate matter for money demand in Nigeria,

Anoruo (2002) and Nwafor et al (2007) examined the stability of demand for money in Nigeria using the Johansen and Juselius cointegration test and results suggest that there is evidence of a long run relationship and that the CUSUM and CUSUMSQ suggest stability of money demand in Nigeria. Kumar et al (2010) also examined the stability of demand for money in Nigeria by accounting for structural breaks. Their results show that demand for money was stable in Nigeria after accounting for a break in 1986. Equally, Doguwa et al (2014) contributes to the empirical literature by examining the stability of demand for money in Nigeria by accounting for the effect of structural breaks occasioned from the recent global and financial crisis.

Using the Gregory-Hansen residual based test for cointegration, the determined exogenous break dates coincides with the financial crisis of 2007. In addition, the CUSUMSQ test provides evidence of a stable money demand function before and after the crisis. From the foregoing studies, it was discovered that none of the studies included a measure of economic and monetary uncertainty in their specifications, and this remains a major gap to be filled in this study.

Conventionally, the estimation of demand for money is often expressed as a scale variable represented by real income, a measure of opportunity cost of holding money and these are proxy by the interest rate and the rate of inflation, exchange rate to account for effect of currency substitution. Given Nigeria's market-oriented economy, which introduces the possibility of business cycles, could the demand for money be affected by economic uncertainty? Indeed, the recent decline in the Nigeria growth rate because of the global recession and the oil price fluctuations may trigger this effect. To the best of our knowledge, studies on demand for money assessing the impact of monetary and economic uncertainty includes; Brüggemann and Nautz (1997) for Germany, Choi and Oh (2003) for the US, Bahmani-Oskooee and Xi (2011) for Australia, Bahmani-Oskooee, Xi, and Wang (2012) for China, Bahmani-Oskooee, Kutan, and Xi (2013) for ten emerging countries,Bahmani-Oskooee and Xi (2013) for India, Indonesia, Malaysia, Pakistan, the Philippines, and Singapore, and by Bahmani-Oskooee et al. (2015) for Thailand and Bahmani-Oskooee and Baek (2016) for Korea. Therefore, the kernel of this paper is to investigate the possible impact of output and monetary uncertainties on the Nigerian demand for money.

3. Methodology

Following the review of the theoretical literature, the specification of the demand for money in any country includes monetary aggregates, a measure of opportunity cost of holding money and these are proxy by the interest rateand the rate of inflation, level of economic activity used as a scale variable to account for transaction demand for money, exchange rate to account for effect of currency substitution, output volatility and monetary volatility.

In specifying the demand for money in Nigeria, the study adopts the specification from a recent study of Bahmani-Oskooee and Baek (2016) for Korea who included the two uncertainty measures. The long-run specification of the demand for money in log-linear form in Nigeria is given as:

$$LnM_t = a + bLnY_t + cLnr_t + dLn(P_t/P_{t-1}) + eLnEX_t + fLnVY_t + gLnVM_t + \varepsilon_t \quad (1)$$

Equation (1) is the long-run determinants of the demand for money in Nigeria. The scale variable Y measured by Nigerian real GDP is included to account for the

transaction demand for money. The long-term interest rate, r, is included to account for opportunity cost of holding money against other financial assets and inflation rate in Nigeria proxied by Ln(Pt/Pt−1) is included to account for opportunity cost holding money against real assets. The exchange rate is also included to account for currency substitution, the exchange rate (EX) measured by nominal effective value of the Nigerian naira. In addition, a measure of output volatility (VY) and a measure of monetary volatility (VM) are included to account for output and monetary uncertainty. These two volatility measures are constructed using GARCH (generalized autoregressive conditional heteroskedasticity) approach as discussed in detail in the Appendix. Based on theoretical a-priori, we expect the estimated coefficient of ***b*** to be positive and estimated coefficients of ***c*** and ***d*** to be negative. In addition, the estimated coefficients of ***e, f,*** and ***g*** could either be negative or positive.

To distinguish the short-run effects of uncertainty measures from their long-run effects, Equation (2) is specified in an error–correction modeling form. Following Bahmani-Oskooee and Baek (2016) and Pesaran et al.'s (2001) bounds testing approach and rewrite (1) as follows:

$$\begin{aligned}\Delta LnM_t = \alpha + \sum_{i=1}^{n1} \beta_i \Delta LnM_{t-1} + \sum_{i=0}^{n2} \delta_i \Delta LnY_{t-1} + \sum_{i=0}^{n3} \varphi_i \Delta Lnr_{t-1} \\ + \sum_{i=0}^{n4} \gamma_i \Delta Ln(P_t/P_{t-1})_{t-1} + \sum_{i=0}^{n5} \omega_i \Delta LnEX_{t-1} + \sum_{i=0}^{n6} \eta_i \Delta LnVY_{t-1} \\ + \sum_{i=0}^{n7} \lambda_i \Delta LnVM_{t-1} + \rho_0 LnM_{t-1} + \rho_1 LnY_{t-1} + \rho_2 Lnr_{t-1} \\ + \rho_3 Ln(P_t/P_{t-1})_{t-1} + \rho_4 LnEX_{t-1} + \rho_5 LnVY_{t-1} + \rho_6 LnVM_{t-1} \\ + \varepsilon_t \qquad (2)\end{aligned}$$

Without lagged level variables equation (2) will be a standard VAR model. The linear combination of lagged level variables have replaced the lagged error term from equation (1), resulting in error–correction model expressed in equation (2). To test for cointegration, the Pesaran et al. (2001) F-test for joint significance of the lagged level variables was used. Once cointegration is established, estimates of $\rho_1 - \rho_6$normalized on $\rho_0$will yield the long-run effects of all exogenous variables. The short-run effects are reflected by the estimates of coefficients attached to first-differenced variables.

4. Results

A battery of unit root tests was conducted to determine the order of integration of the variables. The unit root tests used for the study are; the Augmented Dickey Fuller (ADF), Phillips and Perron (PP) and the Ng and Perron (NP) which test the null hypothesis of a unit root. Results from the ADF, PP and NP unit root tests are shown in Table 1 and indicate that all the series are non-stationary in levels, but stationary in first differences. The exception to this finding is for the inflation rate which is significant at level for the three unit root tests.

Table 1. Unit Root Test, 1960Q1-2015Q04

Series	ADF	PP	NG-PERRON
LnEX	-1.920	-1.908	-1.002
ΔlnEXR	-12.549***	-12.546***	-7.314***
LnM	-1.613	-1.783	-1.542
ΔlnM	-14.203***	-14.232***	-7.431***
$\ln(P_t/P_{t-1})$	-6.304***	-10.049***	-5.369***
$\Delta\ln(P_t/P_{t-1})$	-16.039***	-50.115***	-8.360***
LnY	-1.519	-1.519	-1.780
ΔlnY	-14.661***	-14.661***	-7.448***
Lnr	-1.706	-2.159	-1.824
Δlnr	-9.341***	-9.986***	-16.734***
lnVM	-1.486	-1.599	-1.410
ΔlnVM	-15.497***	-15.498***	-7.`443***
LnVY	-0.157	-0.293	-0.985
ΔlnVY	-5.726***	-14.601***	-4.056***

Notes: In this paper for the NP test we use the test statistic MZt. Proper lag length for each test was chosen by AIC. ***, ** and * indicates significance at 1, 5 and 10 per cent

The above results show that the variables are of different order of integration, thus the need for adopting the Pesaran et al.'s (2001) approach to estimate error–correction model in equation (2). Since data are quarterly, we follow the literature and impose a maximum of four lags on each first-differenced variable. We then use Akaike's information criterion (AIC) to select optimum lags. The results are reported in Table 2.

Panel A reports in Table 2 reports the short-run estimates, Panel B reports the long-run estimates. Finally, Panel C reports diagnostic statistics. From the short-run coefficient estimates in Panel A, it is clear that there is at least one short-run significant coefficient obtained for every first-differenced variable except the interest rate. Concentrating on the two uncertainty variables, only monetary uncertainty have short-run significant effects on the demand for money in Nigeria. In addition, both output and monetary uncertainty have negative effects on the demand for money in Nigeria.

Panel B, examine whether or not the short-run effect is permanent on transitory. It was discovered that output and monetary uncertainty have negative long-run effects on the demand for money in Nigeria, with monetary uncertainty having a significant impact. This implies that public in Nigeria seems to strong support substitution effects as compared to precautionary effect. Income elasticity is also negative and it implies that a 1 per cent economic growth requires about 0.32 per cent decrease in money supply growth. The interest rate elasticity and inflation rate elasticity are both positive and statistically insignificant for interest rate, implying that in Nigeria both financial assets and real assets are not alternative to holding money. The exchange rate is a significant determinant in the long run reflects that there are no obstacles for Nigeria in reshuffling their portfolio between domestic and foreign assets. The result shows that if exchange rate depreciates by 1 per cent, money supply growth will decline by 0.53 per cent. However, for these long-run coefficients to be meaningful, we must establish that the variables are cointegrated. To this end, we proceed to Panel C.

The results of the F-test along with other diagnostic statistics are reported in Panel C of Table 2. Given the 5% upper bound critical value of the F-test at 4.0, our calculated statistic of 8.37 is significant, supporting cointegration. Another sign of cointegration could stem from the fact that variables are adjusting toward their long-run equilibrium values. To test this hypothesis, we use the normalized long-run coefficient estimates from Panel B, generate the error term, and call it ECM. We then replace the linear combination of lagged level variables in Equation (2) by ECM_{t-1} and estimate this new specification after imposing the same optimum lags reported in Panel A. If variables are to adjust toward their long-run equilibrium values, ECM_{t-1} must carry a significantly negative coefficient. This is indeed the case from Panel C. The estimated coefficient itself reflects the adjustment speed. In Nigeria, for example, 5% of the adjustment takes place within one quarter.

Reported in Panel C are also the Lagrange multiplier (LM) and Ramsey's RESET statistics. The LM statistic is used to test for first-order serial correlation and the RESET statistic is for model specification. Both are distributed as $\chi 2$ with one degree of freedom. Given its critical value of 9.48 at the usual 5% significance level, both statistics are insignificant supporting autocorrelation free residuals and correctly specified model.

Lastly, we examine whether all the coefficient estimates, that is, the short-run as well as the long-run estimates, are stable. We applied the well-known CUSUM test proposed by Brown, Durbin, and Evans (1975) to the residuals of the optimum error-correction model. For the stability of the model, the plot of the statistics should stay within a significance level of 5 percent. As shown in Figure 1, the estimated money demand function is stable.

Table 2. Demand for Money estimates of equation 2

Panel A: Short-run coefficients estimates						
ΔlnM(-1)		0.218(3.425)***				
Δln Y		0.064(3.944) ***				
ΔlnEX		-0.025(2.498) **				
$\Delta \ln P_t/P_{t-1}$		-0.397(3.639) ***				
$\Delta \ln P_t/P_{t-1}(-1)$		0.834(4.612) ***				
Δlnr		0.014 (0.671)				
ΔlnVM		-0.008 (1.971)*				
ΔlnVY		-0.002 (0.514)				
Panel B: Long-Run coefficients estimates						
Constant		-0.371 (0.372)				
lnY		-0.320 (1.568)				
lnEX		-0.526 (2.699)**				
$\ln P_t/P_{t-1}$		23.490 (2.354)**				
lnr		0.303 (0.675)				
lnVM		-0.178 (2.492)**				
lnVY		-0.033 (0.371)				
Panel C: Diagnostic Statistics						
F-Statistic		8.368				
ECM		0.047 (2.607)**				
LM		1.869				
RESET		2.153				
Adjusted R		0.7				

Notes: Numbers inside the parenthesis are absolute values of the t-ratios. The upper critical bound value of the F-statistic at the 5% significance level is 4.0. LM and RESET are the Lagrange multiplier test of first-order serial correlation and Ramsey's test for functional form, respectively. ***, ** and * denote significance at the 1, 5 and 10% levels, respectively.

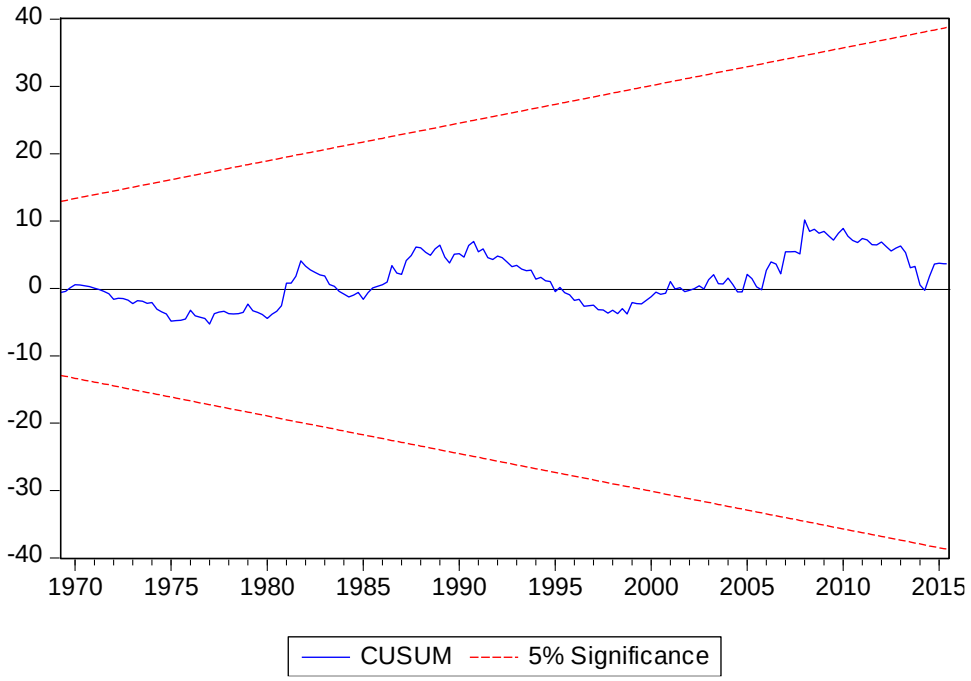

Figure 1. Plots of CUSUM

5. Summary and Conclusion

This study repose the assumption that demand for money in Nigeria depends on domestic economic activity, the opportunity cost of holding money, and the exchange rate. We contribute to the demand for money literature in Nigeria by including monetary and output uncertainty variables generated from GARCH model. The justification for the inclusion of these variables is premised on the fact that increased output or monetary uncertainty could induce people to substitute less volatile assets, such as real assets, for cash. On the other hand, the same increase in both economic and monetary uncertainty could make the public more cautious about the future by holding more cash today. Using the bounds-testing approach for cointegration and error-correction modeling, a standard demand for money that included GARCH-based measures of output and monetary uncertainty was estimated and results suggest that monetary uncertainty have short-run and long-run effects. The implication of this result is that monetary uncertainty has strong substitution effects as compared to precautionary effects and that Nigerians substitute cash by shifting to alternative assets.

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Appendix 1

Data Definition and Sources

Quarterly data over the period 1960:Q1-2015:Q4 were used to conduct the empirical analysis. The source of data is the Central Bank of Nigeria Statistical Bulletin.

Variables

M= Real money supply measured byM2. Nominal M2 is deflated by GDP deflator

Y= Real GDP

R = Interest rate defined as treasury bills rate

P = Consumer Price Index

EX = Nominal effective exchange rate

VY = GARCH-based volatility measure of real income, Y

VM = GARCH-based volatility measure of nominal M2.

We use GARCH method (generalized autoregressive conditional heteroskedasticity) to generate the two volatility measures. In doing so, we closely follow Bahmani-Oskooee and Baek (2016).

Let the variable of concern to be real income or output Y. GARCH allows the variance of Y change over time by assuming Y to be a random variable which is drawn from a conditional density function $f(Y_t|Y_{t-1})$.

A simple GARCH model assumes that Y follows a first-order autoregressive process, i.e. $Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \varepsilon_t$, where ε_t is white noise with $E(\varepsilon) = 0$and $V(\varepsilon) = h^2$. In order to forecast the variance of Y, we need to estimate the conditional variance of ε_t which is a time-varying variable.

The theoretical specification of a GARCH model which is being used is as follows:

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \varepsilon_t (1)$$

$$\varepsilon_t|I_{t-1} \sim N(0, h_t^2) (2)$$

$$V(Y|I_{t-1}) = V(\varepsilon_t|I_{t-1}) = h_t^2 (3)$$

$$h_t^2 = \beta_0 + \beta_1 \varepsilon_{t-1}^{2+} \beta_2 \varepsilon_{t-2}^2 + \cdots + \beta_q \varepsilon_{t-q}^2 \varphi_1 h_{t-1}^2 + \varphi_2 h_{t-2}^2 + \cdots + \varphi_p h_{t-p}^2 \ (4)$$

Where I_{t-1}includes all available information and h_t^2 is the conditional variance. The GARCH (p,q) model outlined by Equation (4) is used to generate predicted value of h_t^2 as a measure of volatility of Y.

Before estimating the GARCH model outlined by Equation (4) we must establish the ARCH effect in Y. The ARCH effect states that the variance of the current error term is a function of the variance of error term in the previous periods. The following ARCH(q) equation is usually estimated:

$$\varepsilon_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \varepsilon_{t-2}^2 + \cdots + \alpha_q \varepsilon_{t-q}^2 \qquad (5)$$

A few significant α's will support the ARCH effect. After establishing the ARCH effect, we estimate Equations (1)–(4) simultaneously. The order of GARCH is determined by significance of β's and φ'$s$in (4). In most instances, a GARCH(1,1) specification is sufficient. Following other studies, we also assume a GARCH (1,1) specification of the type: $h_t^2 = \beta_0 + \beta_1 \varepsilon_{t-1}^2 + \varphi_1 h_{t-1}^2$ which yielded significant coefficients.