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The Effects of Inflation and its Risk on Interest Rate: An Empirical Evidence from Nigeria

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Abstract

The paper examines the effects of inflation and its risk on interest rate in Nigeria. The data sets cover the period of 1995:M1 to 2014:M12. ARCH (1) and GARCH (1, 1) were used to measure inflation risk and the result indicates that GARCH(1, 1) measures inflation risk better than ARCH(1) model based on Schwarz Information Criterion (SIC), and adopting multiple regression method, the result reveals that inflation and inflation risk exact negative and positive impacts on interest rate respectively, but none is significant. This result implies that the direction of this interest rate by monetary policy rate (MPR) is not proactive enough to curb the rising inflationary pressure in Nigeria. Hence, there is a need for more proactive monetary policy rate that can cut back the rising inflationary pressure.

Keywords: ARCH (1), GARCH (1, 1), Multiple regression, SIC, Inflation and interest rate.

Contents

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1. Introduction

Inflation is considered to be one of the key economic targets and keeping inflation evenly low means a stable economic environment for investment, and therefore, creates the benign atmosphere for the best possible level of economic growth for a long period of time. Prior to 1986 in Nigeria, there was administrative fixing of interest rates, which failed to achieve the desired policy objective of promoting among other things, investment and growth in the real sector as a result of rising inflationary pressure necessitated by real low interest rates, thus discouraging savings and as such, the financial sector remained grossly underdeveloped. But with the deregulation of the financial sector in 1986 and the introduction of market determined interest rate and implementation of full deregulation of interest rate in 1996, banks were allowed to set their deposit and lending rates according to market condition.

The Monetary Policy Rate (MPR) was the principal instrument used to control the direction of interest rates and anchor inflation expectations in the economy. Most measures of inflation moderated throughout the period in response to the policy measures implemented by the Bank. Year-on-year headline inflation decreased to 8.0 per cent in December 2013, from 8.4 per cent in June 2013 and 12.0 per cent in December 2012. Food inflation also declined marginally to 9.3 per cent from 9.6 per cent over the same period. However, core inflation rose from 5.5 per cent to 7.9 per cent between June and December 2013 continued to contribute significantly to the robust performance of the economy after the shock of the global financial crisis in 2008 (on the one hand and the domestic banking crisis of 2009 on the other). In spite of these developments, output remained relatively high while inflation decelerated in 2013 (Central Bank of Nigeria, 2014).

In the recent years, interest rate has been raised to curtail the growing rate of inflation. The effect of inflation risk on interest rate has not been given much attention resulting to scanty literature on the subject matter. However, this paper differs from previous papers in the following dimensions; firstly, it investigates whether direct relationship exist between interest rate relative to inflation and inflation risk in Nigeria as found in other countries. Secondly, it measures inflation risk via the framework of autoregressive conditional heteroscedasticity models and selects the subclass of ARCH models that best describe inflation uncertainty.

The rest of the paper is organized as follows; section 2 deals with the literature review, section 3 presents the materials and method, section 4 presents the data analysis and results and section 5 deals with the conclusion and policy implications.

2. Literature Review

Earlier studies have shown that inflation uncertainty have positive relationship with interest rate. Many researchers like Fama and Schwert (1977); Mishkin (1981); Fama and Gibbons (1982) and Chan (1994) have provided empirical evidence for the positive relationship between expected inflation variation and the t-bill rates under different specifications such as asset pricing models.

Gul and Ekinci (2006) investigated the interaction between nominal interest rates and inflation for Turkey over the period of 1984-2003. Their result supports the idea that there is a long-run relationship between interest rates and inflation for Turkish markets. They also find that causality exists in only one direction from nominal interest rates to inflation. Kugler (1982) investigated the dynamic relationship between short term interest rates and inflation for the US, the UK, France, Germany, and Switzerland for the period 1974-1980. The result strongly suggests the variation of the nominal interest rate and inflation help to predict the ex ante real interest rate.

Umoru and Oseme (2013) examined the *rel*ationship between inflationary expectations and the variations in interest rate in Nigeria using the Generalized Method of Moment (GMM) estimator and their result indicated that the effect of interest rate variation on expected inflation in Nigeria is negative and significant. Berument (1999) studied the effect of inflation and uncertainty on interest rates in the UK with quarterly data from 1958:4 to 1994:4 and the result showed that both expected inflation and conditional variability of inflation positively affect the UK three-month treasury- bill rate.

Herwartz and Reimers (2006) employed a VEC model to examine the relationship between inflation and interest rates for 114 economies over a 45 year period using monthly data.

Interest rates and inflation are found to exhibit a long-run equilibrium relationship for numerous economic states. However, in states with large positive changes of inflation, high inflation risk or high interest rates, a long-run equilibrium relationship may not exist.

3. Materials and Method

This section provides information on source of data collection, variable measurement and definition, model specification and method of unit root test.

3.1. Source of Data Collection

The data sets on monthly consumer price index (CPI) and deposit rate were obtained from published Central Bank of Nigeria (CBN) statistical bulletin of 2013 and March 2015. The data sets cover the period of 1995:M1 to 2014:M12.

3.2. Variable Measurement and Definition

One of the most commonly used surrogate to inflation is the CPI hence, this paper used CPI to measure inflation and monthly deposit rate (DR) is used to measure interest rate. And the variables are defined using first difference of natural logarithm of present and previous values of each variable multiplied by 100 and are presented as follows;

Inflation rate is defined as $ifr_t = \log\left(\frac{CPI_t}{CPI_{t-1}}\right)\times 100$, interest rate is defined as $itr_t = \log\left(\frac{DR_t}{DR_{t-1}}\right)\times 100$.

Moreover, since inflation risk is not directly observable, the better describing Conditional Heteroscedasticity model between Autoregressive Conditional Heteroscedasticity (ARCH (1)) Model and Generalized ARCH (1, 1) model were adopted to measure inflation risk. In other words, inflation risk is measured using inflation volatility (conditional variance).

According to Engle (1982) given the mean equation of inflation as $\inf_t = \mu + \varepsilon_t$ the ARCH(1) is of the form;

$$\sigma_t^2 = \omega + \alpha\varepsilon_{t-1}^2 \quad (1)$$

were the nonnegativeness and stationarity of σ_t^2 are guaranteed for ω > 0, $\alpha \geq 0$ for and $\alpha < 1$. Hence, σ_t^2 becomes a function of the previous squared shock, large shocks of either sign tend to be preceded by large shock and vice versa. Though the ARCH (1) model can capture the stylized facts of volatility clustering and excess kurtosis, its short coming is that, it is unlikely that the model accommodates for the features related to the autocorrelation function of squared disturbances ε_t^2. And according Bollerslev (1986) GARCH(1, 1) is of the form;

$$\sigma_t^2 = \omega + \alpha\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 \quad (2)$$

Where $\varepsilon_t \to t(0, \sigma^2, v)$, the tail parameter v > 2 and t-distribution approaches normal distribution if $v \to \infty$. According to the property of GARCH model, $0 \leq \alpha, \beta \leq 1$ and $(\alpha + \beta) < 1$ show that the model is covariance stationary. Again, a large ε_{t-1}^2 or σ_{t-1}^2 gives rise to a large σ_t^2. This means that a large ε_{t-1}^2 tends to be followed by another large ε_t^2, generating again, the well-known behavior of volatility clustering in financial time series.

3.3. ERS Unit Root Test

Elliot Rothenberg, and Stock Point Optimal (Elliott *et al.*, 1996) Test is a unit root test that is based on the quasi-differencing regression

$$d(y_t / a) = d(x_t / a)' \delta(a) + \eta_t \quad (3)$$

where,

$$d(y_t / a) = \begin{cases} y_t & \text{if } t = 1 \\ y_t - a y_{t-1} & \text{if } t > 1 \end{cases} \quad (4)$$

and x_t contains either a constant, or a constant and trend, $\delta(a)$ is the OLS estimates from this regression and η_t is the residual. Let $SSR(a) = \sum \hat{\eta}_t^2(a)$ be the sum squared residuals function. The ERS (feasible) point optimal test statistics of the null that α = 1 against the alternative that α = ā, is then defined as:

$$P_T = (SSR(\bar{a}) - \bar{a}SSR(1)) / f_0 \quad (5)$$

where,

$$\bar{a} = \begin{cases} 1 - 7/T & \text{if } x_t = \{1\} \\ 1 - 13.5/7 & \text{if } x_t = \{1, t\} \end{cases} \quad (6)$$

and f_0 is an estimator of the residual spectrum at frequency zero. The estimator f_0 can be estimated using autoregressive spectral density estimator at frequency zero based upon the residual variance and estimated coefficients from the auxiliary regression.

$$\Delta\bar{y}_t = \alpha\bar{y}_{t-1} + \varphi.\bar{x}_t'\delta + \beta_1\Delta\bar{y}_{t-1} + \cdots + \beta_p\Delta\bar{y}_{t-p} + u_t \quad (7)$$

The AR spectral estimator of the frequency zero spectrums is defined as

$$f_0 = \hat{\sigma}_u^2 / (1 - \hat{\beta}_1 - \hat{\beta}_2 - \cdots - \hat{\beta}_p) \quad (8)$$

and $\hat{\sigma}_u^2 = \sum \bar{u}_t^2 / T$ is the residual variance and $\hat{\beta}$'s are estimates from the auxiliary regression.

3.4. Model Specification

The model specification for the effects of inflation and its risk on interest rate is based on multiple regression and it is given as follows

$$itr_t = \lambda_0 + \lambda_1 ifr_t + \lambda_2\sigma_{ifr.t}^2 + e_t \quad (9)$$

Where $\lambda_i (i = 0,1,2)$ are parameter coefficients, $\sigma_{ifr.t}^2$ is the conditional variance of inflation (inflation risk) and e_t is the disturbance term and $e_t \sim N(0, \sigma^2)$.

4. Data Analysis and Results

This section presents the Unit root test as shown in Table 1 below. Table 2 presents the analysis of conditional variance of inflation as a measure of inflation risk via ARCH(1) and GARCH(1, 1) models and selects the appropriate model that describes inflation risk using SIC and Table 3 gives the estimates of the effects of inflation and inflation risk on interest rate as specified in Equation (7).

Table-1. ERS Unit Root Test Analysis

Variable	Test	Deterministic Terms	Lags	Test value	critical values		Remarks
					1%	5%	
ifr_t	ERS	C	0	0.935938	1.925600	3.187550	I(0)
		C, t	0	1.297306	4.032450	5.652200	I(0)
itr_t	ERS	C	1	0.281204	1.925600	3.187550	I(0)
		C, t	1	1.039423	4.032450	5.652200	I(0)

Source: Computed by the author

Table 1 shows the result of ERS unit root test of inflation and interest rate. The lag orders used were suggested by Schwarz information criterion. The result indicates that inflation and interest rate are both integrated order zero, that is I(0), which shows that both variables are stationary.

Table-2. Estimates of inflation volatility (risk) and Diagnostic test using ARCH(1) and GARCH(1, 1)

Statistics	Coefficient	z-Statistic	Prob.	Remarks
ARCH(1) Conditional Variance Equation				
C	0.000167	9.805471	0.0000	Significant at 1%
ε^2_{t-1}	0.409637	3.119283	0.0018	Significant at 1%
Diagnostic test				
ARCH(LM 15lag)	0.280289		0.9966	No ARCH in the squared residuals up to 15th lag
Ljung-Box Q-statistics	4.6614		0.995	No serial correlation in the squared residuals up to 15th lag
SIC	-5.306162			
GARCH(1, 1) Conditional Variance Equation				
C	1.27E-08	0.044802	0.9643	
ε^2_{t-1}	0.226103	5.137666	0.0000	Significant at 1%
σ^2_{t-1}	0.780375	29.56277	0.0000	Significant at 1%
ARCH(LM 15lag)	0.211851		0.9993	No ARCH in the squared residuals up to 15th lag
Ljung-Box Q-statistics	3.5950		0.999	No serial correlation in the squared residuals up to 15th lag
SIC	-5.534332			

Source: Computed by the author

The comparison of the conditional variance of inflation as estimated using ARCH(1) and GARCH(1, 1) indicate that there is neither ARCH nor serial correlation in the squared residuals up to lag 15. However, comparing the two models using SIC precludes that the GARCH(1,1) measure of inflation risk is preferable.

4.1. Results and Discussion

The result of model specification of Equation (9) is presented below. The values in brackets are the p-values. Estimation is via OLS

$$itr_t = -0.0008 - 0.1718 ifr_t + 2.5905 \sigma^2_{ifr.t} + e_t$$

$$t - Statistic \quad [-0.1114] \quad [-0.5928] \quad [0.2301]$$

$$\text{p - value} \quad (0.9114) \quad (0.5539) \quad (0.8182)$$

$$\text{Durbin - Watson stat} = 2.059763 , R^2 = 0.0016$$

The estimated regression model above shows that inflation has an insignificant negative effect on interest rate. This result differs from the findings of Berument (1999); Fama and Schwert (1977); Mishkin (1981); Fama and Gibbons (1982) and Chan (1994) who find positive relation between inflation and interest rate. And inflation risk (measured using conditional variance of inflation) has positive influence on interest rate, but is not significant. This finding agrees with that of Berument (1999) in the UK, though the effect of inflation risk in Nigeria is not statistically significant. The Durbin-Watson Statistic is approximately 2 suggesting absence of serial correlation in the model.

The R^2 value of 0.0016 is very low; indicating about 0.2% variation in interest rate is explained by inflation and inflation risk. This result shows that other macroeconomic factors rather than inflation and inflation risk explained about 99.8% variation in interest rate.

5. Conclusion and Policy Implications

This paper examines the effects of inflation and inflation risk on interest rate in Nigeria. The result reveals that inflation and inflation risk exact negative and positive impacts on interest rate respectively, but none is significant. The negative effect of inflation rate on interest rate is an indication of indirect relationship between the two variables. Inflation risk although not significant, has a direct relation with interest rate.

The insignificant effects of inflation and inflation risk on interest rate and a very low R^2 value imply that interest rate variation is influence by other macroeconomic factors rather than changes in inflation and inflation risk. However, the result also implies that building a measure to curb inflationary pressure based on monthly deposit rate may not be realistic. Hence, a more practical direction of interest rate that can cut back the rising inflation by our MPR becomes a necessity.

The findings of this paper also provide a lead way for further investigation on which measure of interest rate has strong relationship with inflation in Nigeria. This is essential for the purpose of practical monetary policy that can control inflationary pleasure.

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