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Does Inflation Targeting Effectively Combat Exchange Rate Volatility in Ghana and South Africa?

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Abstract

Since after its implementation in New Zealand in 1990, the Inflation Targeting (IT) framework has been adopted by other countries around the world to ensure macroeconomic stability. However, the policy is yet to be massively embraced among the Sub-Saharan African economies. So far only Ghana and South Africa have successfully adopted the IT framework in the region. This study therefore, investigates whether the IT framework has effectively combat the ruin of foreign exchange rate in the two Sub-Saharan African IT economies. The paper employs Threshold Generalized Autoregressive Conditional Heteroscedasticity (TGARCH) to account for asymmetric effect in the model. The finding of the paper shows that there is evidence of exchange rate volatility reduction in both Ghana and South Africa after the adoption of IT framework. The leverage effect coefficient reveals that the menace of exchange rate volatility is higher during bad periods than good periods at least for the sample timeframe. This implies that exchange rate depreciation leads to higher uncertainty compared to exchange rate appreciation in the sampled countries. However, the policy transition leads to increased exchange rate volatility in the economies. The paper recommends more accountability and transparency of the monetary authorities to further minimize the prevailing exchange rate volatility in the economies.

Keywords: Exchange rate volatility, Ghana, Hedging strategy, Inflation targeting, TGARCH, South Africa.
JEL Classification: E42, E52, E58.

Contribution of Study

This study is one of very few studies which have investigated whether Inflation Targeting (IT) framework has effectively combat the ruin of foreign exchange rate in the two Sub-Saharan African IT economies. The study further uses new estimation methodology, TGARCH model to account for asymmetric effect in exchange rate volatility.

1. Introduction

Despite the increasing trend in the adoption of inflation targeting framework among the world economies to ensure price stability the policy has not been widely adopted in the Sub-Saharan Africa. Presently, the policy has only been implemented in Ghana and South Africa despite the persistent price instability and exchange rate volatility in the region. This leads to a question of whether the framework is an appropriate monetary policy for African economies or not (Heintz and Ndikumana, 2011). The probable explanation of why some countries did not adopt the policy is due to their practice of fixed exchange rate regime. Ghana practice flexible exchange rate regime since 1986 after the Structural Adjustment Programme (SAP) and South Africa practice managed floating era in the late 1970 down to 1990. The flexible exchange rate regime is said to have caused persistent volatility of exchange rate (Edwards, 2007). From the preliminary analysis of Epstein, 2008 and Heintz and Ndikumana, 2011 the adoption of IT framework leads to *rand* appreciation in real term at least for the immediate IT period roughly 2003 up to sometime in 2007. However, the exchange rate appreciation was curbed by the Reserve Bank of South Africa (RBSA) through a liberalization control measures to encourage export oriented-strategy in the economy (Heintz and Ndikumana, 2011).

The structural realities of Sub-Saharan African economies differ from the developed and emerging economies of the world that frequently adopted the framework of inflation targeting. For instance, even in Ghana where the policy is adopted, the Bank of Ghana does not report any deviation of inflation from its target, although publishes and maintain routine of information in newsletters and website (Amoah and

Mumuni, 2008). Therefore, this study attempts to investigate the effectiveness of IT framework in combating the ruin of foreign exchange in the only two targeting economies in Sub-Saharan Africa; Ghana and South Africa. Moreover, the link between IT policy rule and exchange rate uncertainty has been a significant policy matter that has not been adequately addressed in the previous literature (Edwards, 2007). Furthermore, earlier attempt in the previous studies to compare IT framework and exchange rate stability under the managed and fixed exchange rate regimes was not appropriate due to the principle of holy trinity. Besides, the inconsistencies on the relationship between IT policy and exchange rate is still a debatable issue in the literature. Unlike previous studies such as Daboussi (2014) and Kurihara (2013) who study Ghana and South Africa in a panel of inflation targeting economies without controlling for the vast differences in economic background in terms of both exchange rate management and central bank independence among others, the present study investigates whether IT framework has effectively combat the ruin of exchange rate while taking account of exchange rate regime using data from the only two IT economies in the Sub-Saharan African region (Ghana and South Africa). Lastly, we accounted for asymmetric nature of exchange rate volatility by employing TGARCH model. This enabled us to analyze the influence of IT framework on exchange rate volatility in both good and bad times. To the best of our knowledge this will be the first study to use time series TGARCH model to examine the effectiveness of IT in combating exchange rate volatility in Ghana and South Africa.

The remaining part of the paper is structured into 5 sections. The subsequent section presents the literature review. Section 3 offers methodology and data. Section 4 presents and discusses the results and section 5 gives the conclusion and drew policy recommendation.

2. Review of Literature

Due to scarcity of ample literature on the present phenomenon, we did not limit the review of literature on African economies but covered as wide existing literature as possible. Furthermore, most previous studies consider the effect of inflation targeting and general concept of central bank intervention on the reduction of inflation and instability of other macroeconomic variables. However, the few available studies focusing on inflation targeting and volatility of exchange rate are inconsistent and inconclusive. According to Allsopp *et al.* (2006); Edwards (2007); Josifidis *et al.* (2011); Khodeir (2012); Rose (2007) and Yamada (2013) inflation targeting framework evidently reduces the menace of exchange rate uncertainty in the inflation targeting countries. Furthermore, Siregar and Goo (2010) reveal that IT framework in Indonesia and Thailand leads to some success in combating inflation and output volatility. However, the impact differs during the aftermath of the collapse of 2008 Lehman Brothers. Lin (2010) also claims that IT adoption decreases volatility of exchange rate and foreign reserve of developing economies. The result however shows that the policy reduces the foreign reserve of the industrial countries. According to Pontines (2011) nominal and real exchange rate volatility tend to reduce in developing countries that implement IT framework compared to non-IT countries. However, the result on developed countries shows that volatility increases in IT countries. According to Kurihara (2013) IT policy enhances economic growth and leads to reduction in the exchange rate instability in the panel of targeting and non-targeting economies.

Contrarily, some other studies reveal that inflation targeting is ineffective in eliminating exchange rate volatility. This is reported in the studies of Batini *et al.* (2003); Berganza and Broto (2012); Dennis (2003); Gregorio *et al.* (2005); Kollmann (2002); Pavasuthipaisit (2010) and Petreski (2012). Furthermore, another study sees lack of independence of monetary policy framework as the main cause of the menace of exchange rate volatility especially in the developing economies (Pavasuthipaisit, 2010). He examines the optimality of central bank in response to movement in exchange rate under the regime of inflation targeting in the United States. The study reveals that exchange rate and inflation are determined by the state of the economy not inflation targeting.

A review of a panel study involving Ghana and South Africa as treatment group conducted by Daboussi (2014) and a similar study by Kurihara (2013) discover that exchange rate volatility reduces with adoption of IT framework in the emerging and developing economies. Furthermore, exchange rate pass through in emerging economies also tend to decrease due to implementation of IT framework compared to non-IT economies (Coulibaly and Kempf, 2010). However, Heintz and Ndikumana (2011) argue that a strict rule-based IT policy is not an appropriate monetary rule for Sub-Saharan African economies to achieve their goals of economic stability, development, rising living standard and poverty reduction. Their argument is in support of Epstein (2008) who argues that instead of maintaining price stability, the central banks should aim at pursuing a monetary policy that brings development in the real economic performance through central banks. They however, recommend that more research need to be done to fully evaluate the appropriateness or otherwise of the IT policy in the Sub-Saharan African region. Furthermore, Berganza and Broto (2012) empirically discover that exchange rate became more volatile under IT policy compared to alternative policy regimes and non-IT countries. Pourroy (2013) also argues that adoption of IT framework as usually applied under flexible exchange rate regime in developed countries would not be a solution in the developing and emerging economies.

Despite the existence of a few literature on the subject especially in the developing inflation targeting countries, most of the previous analysis are conducted under fixed or pegged exchange rate regimes which has less basis for measuring the effectiveness of IT framework. Inflation targeting should be best examined under a floating exchange rate regime due to the principle of "impossibility of the holy trinity" (Mishkin and Savastano, 2001; Carare and Stone, 2006; Edwards, 2007). Furthermore, most previous studies generally examine the performance of IT on price stability and output volatility. Furthermore, the findings of the previous studies are sensitive to various control variables and are usually

stronger when IT economies are compared to non-IT economies. Comparison between targeting and non-targeting is weaker and usually influenced by the control group (Heintz and Ndikumana, 2011).

3. Methodology and Data

3.1. Data

In this study, we employ quarterly time series data spanning from 1990:Q1 to 2014:Q4 for both Ghana and South Africa. We collected the data from International Financial Statistics (IFS) on nominal exchange rate, inflation, interest rate and money supply. To get the differentials of the variables mentioned above their foreign counterpart are considered. This entails collecting data on the US inflation, interest rate and money supply. We use dummy variable to represents inflation targeting.

3.2. Unit Root

This paper uses Lee and Strazicich (2013) minimum LM test with one structural break to check the stationarity property of the series. According to Lee and Strazicich (2013) the present unit root test differs from the traditional test in that the test is break point nuisance invariant under null and alternative hypothesis, unaffected by neither size nor location distortion. Furthermore, the test is free from spurious rejection and unaffected by the size and incorrect estimation whether there exist any break or not.

3.3. Model Specification

Following Chinn (2012) we specify the model considering the new strand of macroeconomics by introducing the monetary policy rule otherwise known as inflation targeting into the estimation of the monetary model of exchange rate determination. The Taylor rule has been employed in the analysis of exchange rate modeling to assess the impact of the rule in determining the rate of changes in the exchange rate equilibrium (Engel and West, 2005; Engel and West, 2006; Chinn, 2008). The modified model is presented in Equation 1:

$$EX_t = +\gamma_0 + \gamma_1(m_t - m_t^*) + \gamma_2(i_t - i_t^*) + \gamma_3(\pi_t - \pi_t^*) + \gamma_4 IT_t + IT_{t-1} \quad (1)$$

where EX_t is the nominal exchange rate, m_t i_t and π_t represent domestic money supply, interest rate and inflation rate respectively whereas, m_t^* i_t^* and π^* denote foreign money supply, interest rate and inflation rate respectively and *IT* stands for inflation targeting that is, the central bank reaction function. For the IT framework to combat exchange rate uncertainty in the economies, the coefficient of *IT* is expected to be negatively related to the volatility of exchange rate. This implies that implementation of inflation targeting should cut the inflation rate to its target level which will reduce the volatility of exchange rate, strengthen the value of the domestic currencies and restore the unstable foreign exchange to its equilibrium level.

3.4. TGARCH Model

Most of previous related studies such as Edwards (2007) reported the standard GARCH model and Kurihara (2013) used GMM estimators to examine the effect of IT policy on the stability of exchange rate in targeting and non-targeting economies. Here we use TGARCH model to estimate the equation specified above. According to Zakoian (1994) the TGARCH model enables forecasting of the conditional variance taking asymmetric effect into account. Secondly, the model is not constrained by positivity condition. And finally, It further employs a more flexible lag lengths in the model of volatility considering both negative and positive aspects of the stochastic process keeping the tractability of GARCH process.

The TGARCH model is specified in Equation 2. The symbol ε is the residuals of the mean equation. In the TGARCH model unlike the traditional GARCH model, the residuals ε_t in the model can be either negative or positive with ε_t^+ being the maximum and ε_t^- the minimum. In other words, the threshold value $\varepsilon_t = 0$ and that negative shocks are associated with different effect compared to positive shocks. Negative shock on ε_t^- indicates a more severe leverage effect than the ε_t^+ shocks. The statistically non-zero value of α_i^+ or α_t^- confirms the existence of threshold effect in a given set of data.

$$\sigma_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i^+ \varepsilon_{t-i}^+ - \alpha_i^- \varepsilon_{t-i}^- + \sum_{j-1}^{p} \beta_j \sigma_{t-j} + \sum_{k=1}^{m} \xi_k X_k + \rho_1 IT_t + \rho_2 IT_{t-1} \quad (2)$$

here σ_t represents exchange rate volatility and σ_{t-j} denotes exchange rate volatility at time $t-j$; X_k denotes other explanatory variables specified by the monetary theory of exchange rate determination which also contributes to instability in exchange rate. For the purpose of this study, X_k represents the differential domestic money supply, interest rate and inflation rate. The dummy variable *IT* takes zero for the sample period before the adoption of inflation targeting and one for the period after the adoption. If the coefficient of inflation targeting is found statistically significant, we conclude that inflation targeting has an effect on exchange rate uncertainty. If the coefficient ρ_1 in Equation 2 is negatively related to the dependent variable $(\rho_1 < 0)$ the conclusion is that inflation targeting combats the average of the volatility of exchange rate and reverse hold if the coefficient is positive and significantly different from zero. Furthermore, we follow Edwards (2007) to use lag dummy variable IT_{t-1} to account for the policy transition effect. The study will also control for floating exchange rate regime for South Africa and take

account of the structural breaks found in the data generating process using LS test to see whether they affect the stability of exchange rate in the economies.

4. Empirical Results

4.1. Unit Root Test

The study uses LS minimum LM test with one structural break to check the stationarity properties of the data. This is one of the requirements of estimating ARCH type models. The test helps to indicate whether the variables in the model are stationary or otherwise. The test result is presented in Table 1

Table-1. Lee and Strazicich One-Break Minimum Lagrange Multiplier (LM) Unit Root Test

	Model A					**Model C**				
Variables	k	$\hat{T}_B$	$\hat{t}_{\gamma j}$	***Test Statistic***	***Critical Value Break Points*** λ	k	$\hat{T}_B$	$\hat{t}_{\gamma j}$	***Test Statistic***	***Critical Value Break Points*** λ
GHANA *LEXC*	4	2001:02	-.646	-1.610	-.01	4	2000:03	.617	-3.408	.01
$L(m_t - m_t^*)$	4	1996:04	1.824**	-1.972	.02	4	1999:03	-.077	-3.095	.01
$L(\pi_t - \pi_t^*)$	4	1994:01	-.727	-2.029	.01	4	1998:01	.001	-4.249[c]	.01
$L(i_t - i_t^*)$	4	1999:02	-1.525	-3.252[c]	-.02	4	2004:04	-2.139**	-4.351[c]	-.02
$L(y_t - y_t^*)$	4	2005:04	3.610***	-1.971	.04	4	2006:01	2.161**	-3.617	.02
S/AFRICA *LEXC*	4	1996:01	-2.297**	-2.957	-.02	4	2002:04	1.378	-3.705	.01
$L(m_t - m_t^*)$	4	1999:03	2.065**	-1.497	.02	4	1997:01	.966	-2.500	.01
$L(\pi_t - \pi_t^*)$	4	1999:02	-.352	-1.285	-.01	4	1998:03	-5.459***	-2.952	-.06
$L(i_t - i_t^*)$	4	2008:01	1.695*	-4.897[a]	.02	4	2008:01	-954	-4.842[b]	.01
$L(y_t - y_t^*)$	4	1997:02	.043	-2.113	.01	4	2010:04	2.036**	-3.865	.02
Critical values		1%	5%	10%						
Model A		-4.239	-3.566	-3.211						
Model C		-5.110	-4.500	-4.210						

Note: k is the optimal number of lagged first-difference terms included in the unit root test to correct for serial correlation. $\hat{T}_B$ denotes the estimated break points. $\hat{t}_{\gamma j}$ is the *t* value of DT_{jt}, for j=1. See Lee and Strazicich (2013) page 2488, for the critical values. a, b and c indicates significance of the LM test statistics at 99%, 95% and 90% critical level, respectively. While ***, ** and * indicates the two-tailed significance level of the break date at 99%, 95% and 90% respectively.

Table 1 indicates that except for South African interest rate differentials none of the variables is stationary at level in both countries under both intercept and trend models. The test reveals that all the variables in the study are found stationary with structural break after taking the first difference. The LS test result for the first difference are available from the authors upon request. In this study the break point λ is computed as T_B/T and found not beyond λ = 0.1 in all cases. Therefore, the critical values displayed in Table 1 can be appropriately employed for testing the null hypotheses of unit root with structural break. The break points in Ghana and South Africa are found less statistically significant under both intercept and trend models. This implies that the break points may not have effect on the data generating process of the series.

4.2. TGARCH Estimations

We estimated TGARCH model in this study based on the existence of ARCH effect presented in Table 2 and clustering volatility depicted in Figure 1 (a) and (b) for Ghana and South Africa respectively. We employ TGARCH model in order to investigate the effectiveness of IT framework in combating exchange rate uncertainty and account for the impact of volatility in good and bad times.

Table-2. Test of ARCH effect

Country	**F-statistic**	**Obs*R-squared**
Ghana	4.4533** (.0374)	4.3445** (.0371)
South Africa	39.9053*** (.0000)	28.7753*** (.0000)

*** and ** represent rejection of the null hypothesis at 1% and 5% significance level respectively. The probability values corresponding to each test is reported in parenthesis.
Source: *Author's Computation*

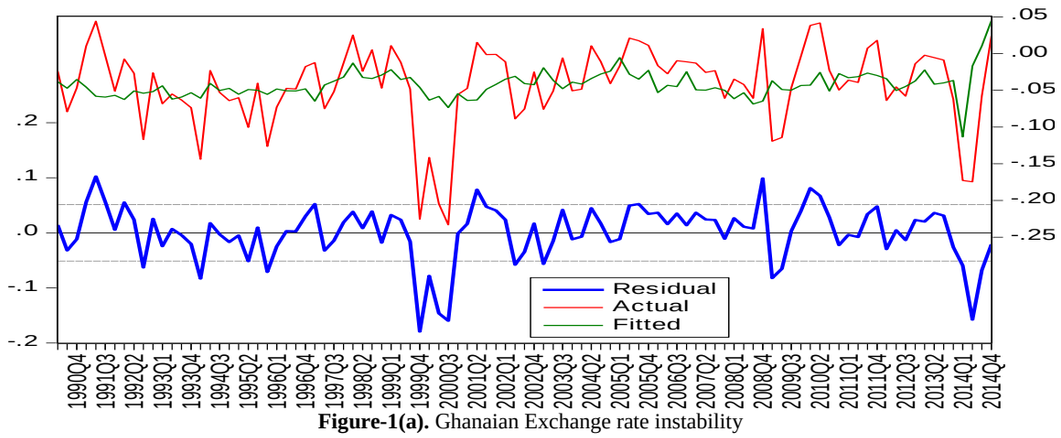

Figure-1(a). Ghanaian Exchange rate instability

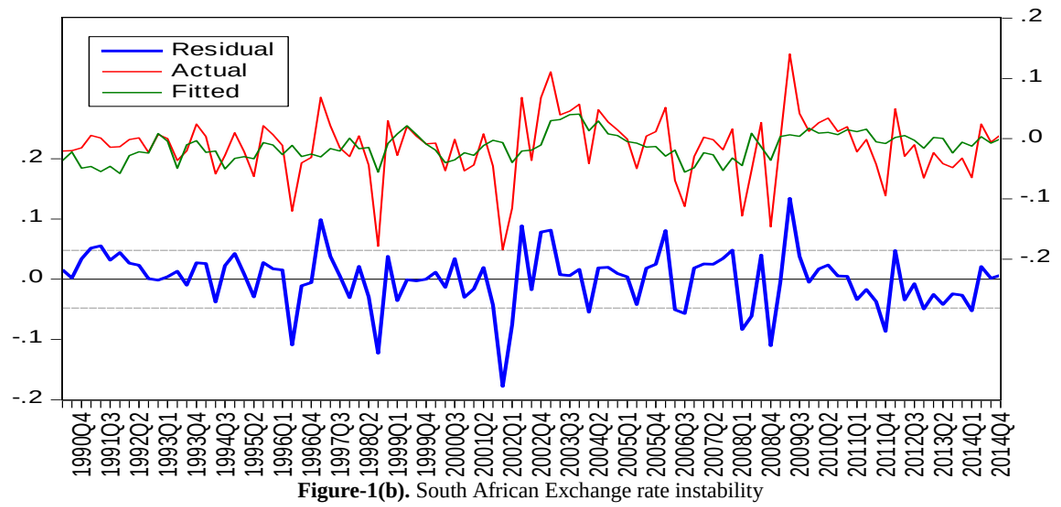

Figure-1(b). South African Exchange rate instability

The Table 2 above presents the test for ARCH effect in the normal regression model. The null hypothesis of no ARCH effect was rejected for both Ghana and South Africa which denotes the existence of ARCH effect in the residuals of the estimates. The prevalence of ARCH effect and clustering volatility necessitate the estimation of ARCH model. The effect of IT policy on exchange rate volatility is estimated based on Equations (1) and (2) for the two countries and the result is presented in Table 3. We display only the coefficients of leverage effect, Inflation targeting and lag of inflation targeting to capture the effect of policy transition in the economies. We controlled for exchange rate regime in South Africa due to the country's prolonged managed floating regime that lasted up to 1990s. We estimated different specifications of the TGARCH process and found the result in Table 3 to be the optimal orders of the models.

Table-3. TGARCH Result: IT Framework, Exchange rate regime and Exchange rate volatility

Variables **DV: Exchange Rate Volatility**	**Ghana** **TGARCH (1,1,2)**	**South Africa (1)** **TGARCH (1,1,1)**	**South Africa (2)** **TGARCH (1,1,1)**
LEV	.1340*** (2.7261)	.2618** (2.0431)	.2016*** (3.1461)
ITF	-.0012** (-2.3243)	-.0019*** (-2.7416)	-.0029** (-3.5872)
ITF(-1)	.0011** (2.0550)	.0020*** (3.2656)	.0027*** (3.4757)
FEX	-	-	.0001** (1.9524)
FEX(-1)	-	-	.0002 (.9084)
Diagnostics			
Ljung Box (4) & (36) Q stat- Level	.0851 (.7710) 34.1740 (.5080)	.5603 (.4540) 31.4960 (.6380)	2.4802 (.1150) 22.1950 (.9650)
Ljung Box (4) & (36) Q stat- Squares	.0254 (.8730) 24.4500 (.9280)	.0007 (.9790) 35.0660 (.5130)	.0143 (.9050) 34.9750 (.5170)
ARCH LM test Chi-square	.0245 (.8757)	.0006 (.9800)	.0139 (.9060)
Jarque-Bera statistic	14.0498 (.0009)	17.9127 (.0001)	2.8874 (.2360)

*** & ** represent 1% and 5% significance level respectively. The values in parenthesis are the z-statistic whereas, they represent probability values under the diagnostic test. LEV, ITF and FEX stand for Leverage Effect, dummies for Inflation Targeting Framework and Flexible Exchange rate respectively.

The estimated coefficient of the Inflation Targeting Framework (ITF) dummy in Table 3 for both Ghana and South Africa 1 and 2 are found negative and significantly different from zero. This implies that the adoption of IT framework helps in combating the volatility of exchange rate in the economies. The result is not different in South Africa (see South Africa 2) even after controlling for exchange rate floating regime. Furthermore, the lag ITF was also found significant in both Ghana and South Africa 1

and 2 indicating that the policy has transition effect on the stability of exchange rate. However, the result indicates a positive transition effect meaning that the policy transition increased the volatility of exchange rate at least for the studied countries. This might be explained based on the immediate sudden shock in nominal interest rate in order to cut inflation to its target level which can cause sudden response of currency price in the exchange rate market. When we controlled for flexible exchange rate regime for South Africa because of the country's prolonged partly managed floating regime, the result shows that flexible exchange rate era influences the volatility of exchange rate in the economy. However, the lag floating exchange rate regime is not associated with transitional effect on the equilibrium of exchange rate.

The result reveals that adoption of ITF effectively help in combating the ruin of exchange rate in Ghana and South Africa. This result is in line with the findings of Edwards (2007) for Brazil, Chile and Israel; Pontines and Siregar (2012) and Kurihara (2013) in the panel of developing Sub-Saharan Africa and East Asian IT targeting and non-targeting economies among others. The possible explanation for such effectiveness is that ITF adoption tends to restore inflation deviation to its target and minimizes sudden shocks effect on the exchange rate due to transparency and predictability of the monetary policy framework of the IT principle.

The study found the existence of leverage effect in the model. This means that exchange rate react differently during good and bad times. The asymmetric response in the estimation indicates that negative shock leads to higher volatility compared to positive shock implying that exchange rate depreciation leads to higher volatility than exchange rate appreciation in both Ghana and South Africa.

The adequacy of the model is examined using the diagnostic checks reported at the lower part of Table 3. The tests indicate that there is no evidence of serial correlation for lag 1 to 36 in both the economies. Furthermore, the models do not suffer from ARCH LM effect. The normality of residuals was tested using Jarque-Bera statistic. The result shows non-normality of residuals in all cases except under South Africa 2 when exchange rate floating regime is controlled for. However, the parameter estimates are consistent and we further employ the Bollerslev-Wooldridge robust standard errors and covariance otherwise known as Quasi-maximum Likelihood (Bollerslev and Wooldridge, 1992) to take care of the problem of non-normality of residuals.

5. Conclusions and Policy Implication

This study investigates whether adoption of IT framework has combated the ruin of exchange rate in the only two IT economies in Sub-Saharan Africa, Ghana and South Africa. We controlled for flexible exchange rate regime only for South Africa due to the country's prolonged dual policy of managed floating exchange rate regime which lasted up to 1990s. The present research defers from the previous studies primarily conducted on the effectiveness of IT policy on developed inflation targeting and non-targeting countries with only a few studies on the emerging economies. We extend the literature considering the developing and emerging economies of Ghana and South Africa respectively in the Sub-Saharan African region using threshold autoregressive conditional heteroscedastic model. The finding of the study reveals that IT framework has effectively combat the ruin of exchange rate in both Ghana and South Africa. Furthermore, the policy transition has positive effect on the exchange rate stability of these economies. This might be as a result of immediate sudden shock in nominal interest rate in order to cut inflation to its target level which can cause sudden response of currency price in the exchange rate market. Moreover, the flexible exchange rate era causes exchange rate volatility in South Africa whereas, the exchange rate regime does not have transition effect. We did not controlled for floating exchange rate regime in Ghana due to the country's prolonged flexible exchange rate.

The leverage effect indicates that exchange rate responds differently to negative and positive shocks. Exchange rate volatility is found to be higher during bad periods for both Ghana and South Africa compared to good periods. The minimum LM test with break shows that none of the breaks date is significant thus, none is included in the estimation process. The paper recommends more accountability and transparency of the monetary authorities to further minimize the prevailing exchange rate volatility in the economies.

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