The Impact of Exchange Rate and Interest Rate Volatility on Stock Market Returns

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This paper sought to examine the impacts of the exchange rate and interest rate volatility on stock market returns within the economies of three major African countries namely, Ghana, Nigeria and South Africa using Exponential General Autoregressive Conditional Heteroscedasticity (EGARCH) and Threshold GARCH (TGARCH) also known as GJR-GARCH estimation methods. We find a positive shock to interest rate and exchange rate lead to persistence rise in the price levels over the 60-month horizon. We find the majority of coefficients are positive compared to negative coefficients. Our results indicate that response asymmetries of positive and negative impact interest rate and exchange rate changes on all stock market returns. Overall, country-analysis suggests that coefficients of interest rate and exchange rate for Ghana are typically negative. Both GJR-GARCH and EGARCH methods show that good news has an impact on volatility more than bad news under different assumptions.

Keywords: GJR-GARCH, EGARCH, stock market return, exchange rate, interest rate

INTRODUCTION

It has been empirically established that exchange rate and interest rate are important features of financial markets that could have a significant impact on the economies of countries. It is suggested that although the exchange rate and interest rate volatility could affect financial firms, the magnitude and direction of the effect could significantly differ. Joseph and Vezos (2006) indicate that the foreign exchange rate and interest rate risks are essential financial and economic factors that impact the value of stocks. Many studies have theoretically justified the existence of a relationship between the volatility of the financial market and its impact on the exchange rate and interest rate changes on bank stock returns. It is argued theoretically that, an increase in the exchange rate and interest rate is connected to a rise in aggregate demand and subsequently to increases in stock market prices. Under the lens of the EGARCH and TGARCH, also known as GJR-GARCH models, this paper sought to determine the impact of exchange rate and interest rate volatility on stock market returns in Ghana, Nigeria and South Africa. It is undeniable that Nigeria and South Africa are the two largest economies in Africa however; the inclusion of Ghana, a smaller country comparison exposes some very important revelations in this study. Besides, not many studies have been conducted on exchange rate and interest rate volatility on stock market returns in Africa, and most of all, studies comparing three countries using these variables are non-

existence. The above are some of the reasons that motivate us to undertake this study. Both EGARCH and GJR-GARCH are our favourite methods relative to symmetric GARCH since the symmetric GARCH presupposes that the conditional variance is symmetric. This may be an important factor in model selection in favour of asymmetry shocks to volatility models. We used both GJR-GARCH and EGARCH methods to explain the exchange rate and interest rate volatility of the stock market returns. In these models, the good news is associated with lower volatilities, while bad news of the same magnitude is related to higher volatilities. Verma (2016) find volatility spillover on the exchange rate and interest rate on bank stock returns. The study also shows that banks' stock is sensitive to bad news than positive news due to changes in the exchange rate and interest rate. This suggests that banks portfolio reacts more strongly to negative shocks volatility than the positive shocks. Perera (2016) find a feeble effect of exchange rate volatility on stock market return volatility. The study also indicates that the volatility of Euro exchange rate has a positive and significant impact on the volatility of stock market returns but volatilities of US dollar and British pound were negative and insignificant on the stock market returns. Christie (1982) and Papadamou and Siriopoulou (2014) find a positive relationship between interest rates volatilities and market stock returns. Flannery and James (1984) also find a positive correlation between stock return and interest rate changes. The co-movement between stock returns and interest rate sensitivity is linked to maturity mismatch of the bank asset and liabilities.

Another set of empirical studies support the negative relationship between the exchange rate and interest rate volatility on stock market returns. Dinenis and Staikouras (1998) find a significant negative relationship between common stock returns and changes in the interest rate in their UK studies and that changeability of interest rate is correlated with a significant positive coefficient. In the same vein, Suriani et al. (2015) argue that there is no relationship between exchange rate and stock market returns. Kasman et al. (2011) find interest rate and exchange rate have a significant negative effect on the conditional bank stock returns. They indicate that the sensitivity of the bank stock returns mostly depend on the market return relative to both interest rate and exchange rate. And that interest rate and exchange rate volatilities are key determining factors of bank stock return volatility. The study also finds that banks were exposed to interest rate and exchange rate risk as a result of a lack of mitigation techniques within an emerging economy like Turkey. Faff et al, (2005) investigate the impact of interest rate and interest rate volatility on Australia financial sector return distributions. They find financial firms are highly sensitive to interest rate shocks and deregulation increased the risk confronted by financial firms and small banks.

Nevertheless, little studies have been conducted in Ghana, Nigeria and South Africa of these emerging economies and low-income countries. Indeed, there exists a huge gap in the empirical studies on how exchange rate and interest rate volatility affect stock market returns in these emerging economies and records of empirical studies that have been conducted normally focused on advanced market economies (see e.g. Christie, 1981; Dinenis and Staikouras, 1998; Faff et al., 2005; Joseph and Vezos, 2006). This empirical study attempts to bridge the gap by investigating the exchange rate and interest rate volatility on the performance of stock market returns volatility in Ghana, Nigeria and South Africa. Over a decade, the exchange rate and interest rate volatility on stock market returns have been extensively high in these countries. Given the significant impact of these economic variables have on a country's economy, exchange rate and interest rate play a vibrant role in a country's level of trade, this is grave to the governments of these emerging economies. For that matter, governments normally watch, analyze and manipulate exchange rate and interest rate risk.

This study presents an analysis of the exchange rate and the interest rate on the stock markets' returns and the possible effect of currency fluctuations between the US dollars and currencies in these countries. Again, the study also aims to identify changes in the exchange rate and interest rate volatilities on stock market returns and the possible effects of these currencies on the various economies. The sensitivities of stock market return to exchange rate and interest rate volatilities are due to the high-interest rate within these economies. Higher interest rates are characterized by higher borrowing by the governments of these countries. If you have a government that keeps on borrowing, it will push the interest rate high. We investigate the relationships between exchange rate, interest rate volatilities and stock market return in these emerging economies since these have received little attention in the literature. We are interested in

the asymmetry and volatility effects on exchange rate and interest rate appreciation or depreciation and whether such changes will lead to upward or downward bias in response to changes in the exchange rate and interest rate (see e.g. Lai and Joseph, 2010).

This paper makes several important contributes to the emerging market literature on the exchange rate, interest rate and volatility. First, we focus on the exchange rate, interest rate and volatility that have received little attention in the literature from these emerging economies perspective. These emerging markets economic variables received little attention compared to the advanced economies. Second, we investigate whether the exchange rate and interest rate volatilities in Ghana, Nigeria and South Africa behaviour like those reported in the advanced economies. Third, investigate response asymmetry of the exchange rate and interest rate on the stock market returns and the effect of both positive and negative changes. Fourth, two models that allow for asymmetry shocks to volatility, EGARCH and TGARCH are employed. We estimate the model using both the Exponential GARCH (EGARCH) method due to Nelson (1991) and Threshold GARCH (TGARCH) of Glosten, Jagannathan and Runkle (1993) estimation method (also known as GJR-GARCH estimation method). The two estimation methods enable us to capture the time variation and asymmetric impact of positive and negative exchange rate and interest rate changes on the stock returns volatility. The asymmetric GARCH method leads to greater estimation efficiency relative to the OLS method. Indeed, Corhay and Rad (1996) show that the conditional variance in the data causes the standard OLS method to overestimate (underestimate) the regression parameters following positive (negative) shocks relative to GARCH approach. Finally, we are not aware of any study on exchange rate and interest rate volatility on stock market returns in some emerging economies and compared them.

The remaining structure of the paper is as follows: Section 2 presents the empirical review of prior studies while Section 3 discusses the data set and the methodology used in the study. In section 4, we present the empirical results and final section 5 concludes this paper.

LITERATURE REVIEW

The demand for and supply of the currency is the important determining factors of the exchange rate. The Interest Rate Parity Theory (IRPT) states that the difference between the spot and forward exchange rates is equal to the differential between interest rates available in the two countries. This theory states that the country with the higher interest rate will see the forward rate for its currency subject to depreciation. Thus, home currency depreciation will give rise to significant import price adjustment and this means that importers will need more of the Ghanaian Cedis, Nigerian Naira and South African Rand to buy the foreign exchange of the US dollars. On the other hand, an increase in the interest rate will lead to a demand for domestic currency assets, which will cause an upward shift in exchange rates. This may occur because a higher Ghanaian, Nigerian and South African interest rate will attract capital inflow to these economies, increasing the demand for various countries' currencies. According to stock oriented model, an increase in stock price will lead to an increase in demand for domestic asset and thus the domestic currency, and consequently higher exchange rate. The model suggests that an upward shift (downward shift) in stock price would generate colossal capital inflow (outflow), as a result, exchange rates would appreciate (depreciate) in consequence of an upward shift (downward shift) in demand for the home currency (Frenkel, 1983). However, because none of these countries' currency is a hard currency (reserve currency), the high-interest rate has a catastrophic or detrimental effect on the various economies.

The weak form efficiency hypothesis claims that share prices reflect all the information encompasses past prices record. Therefore share prices follow a random walk and will move up or down depending on what information that comes into the market. If really information is a factor that determines the value of the stocks' market returns volatility, the greater exposure of interest rate and foreign exchange rate risks will significantly decrease or increase the volatility of stock returns of banks (Joseph and Vezos, 2006). Kanas and Karkalalos (2017) find robust substantiation of volatility spillovers within equity returns, exchange rate returns and equity flows. Caporale et al. (2013) suggest that the financial turmoil, the high volatility of the stock market creates instability in the foreign exchange market. It is well known that

stock returns are characterized by volatility clustering, that is larger returns and small returns are followed by large returns and small returns respectively, leading to contiguous periods of volatility and stability.

Cho et al. (1992) investigate the sensitivity of US banks' stock returns to the variability of market, interest and exchange rate. They find that exchange rate changes significantly negatively correlated to bank stock returns. Evidence of market and interest rate is much weaker, which indicate that there is a significantly negative relationship between the stock market and interest rate and bank stock returns. Jareño et al. (2016) find the stock market performance of the financial firms is exposed to interest rate changes. Thus a change in interest rate will significantly increase or decrease the financial firms' stock market returns. The sensitivity of financial sector returns to real interest rate risk is statistically significantly negative. The effect of real interest rate risk is the most extreme market conditions and poor stock market performance. Again, changes in the expected inflation rate hurt the stock market performance (see e.g. Jareño et al., 2016). They hypothesized that both interest and inflation rates have an inverse relationship with financial sector returns of US stock prices.

In the literature, asymmetric responses of stock market returns have been studied in the UK and US. For example, the asymmetric response of future excess returns are related to unexpected monetary policy changes whilst strongest asymmetric response of stock returns to increase in policy interest rates had significant positive policy impact on stock returns relative to negative policy effect (Bredin et al., 2007; Chulin et al., 2010). It is well known that when real depreciation of the national currency will lead to capital movements and the spread of inflation. These countries and for that matter, most African countries have instituted exchange rate and inflation rate policies to combat against the widespread of exchange rate depreciation and domestic and foreign inflation rates that are characterized in the region. However, the level of economic instability in the region and inconsistencies in economic policies makes it very hard to achieve these policies.

DATA AND METHODOLOGY

Data

The study consists of monthly stock market price traded on the Ghana, Nigeria and South Africa Stock Exchange. The interest rates are the 3-month Treasury bill rate and exchange rate on the stock market returns and the effect of response asymmetries of both positive and negative changes. The exchange rate is defined as the amount of 1 US dollars to the home currency. That is 1 US dollar against Ghanaian Cedis, Nigerian Naira and South African Rand. The data sets used for the study are taken from the DataStream Database. The sample period or observation period spans from January 1, 2001, to December 31, 2018. We use monthly data relative to daily data because daily data generally suffer from the delinquent of non-synchronous trading (Jong et al., 2006). Before estimating the variables, all the series were transformed into natural logarithms.

Methodology

We investigate the exchange rate and interest rate volatilities to stock price return volatility. We use both the Exponential General Autoregressive Conditional Heteroscedasticity (EGARCH) of Nelson (1991) and Threshold GARCH (TGARCH) Glosten al et. (1993) estimation method that allows for asymmetry shocks to volatility to mitigate methodological problems in reporting our results. The EGARCH model of Nelson (1991) allows the asymmetric response of volatility to positive and negative returns. This model is frequently used due to certain common properties with GARCH model. Another asymmetric GARCH model due to Glosten al et. (1993) also known as Threshold GARCH or GJR-GARCH model, to curb some drawbacks associated with symmetric GARCH models. The asymmetric GARCH method leads to greater estimation efficiency relative to the OLS method. So the asymmetric GARCH method enables me to avoid some of the restrictive assumptions that underlie the standard OLS method. In general, GARCH estimation approaches lead to enhancements in estimation efficiency (see Engle, 2001). The mean and volatility between the portfolios of the stock market price are computed using the following equation:

$$R_{it} = \alpha_i + \lambda_i R_t + \delta_i INT_t + \varphi_i XR_t + \varepsilon_{i,t} \quad (1)$$

where, α_i λ_i, δ_i and ϕ_i are parameters to be estimated. R_{it} is the price of the stock market price at a time $t-1$. R_t is the price of the stock market price for all countries at time t. INT_t denotes a risk-free interest rate for all countries at time *t*, XR_t is the exchange rate between the US dollar and all countries currency at the time t. $\varepsilon_{i,t}$ an error term conditioned on the past information $\Omega_{t-1.}$

Engle and Ng (1993) show that the conditional variance of the GJR-GARCH estimation method generates a more reliable asymmetry measure than the EGARCH model. The conditional variance between the stock portfolios is captured by EGARCH and GJR-GARCH. To complete the specification of the EGARCH and GJR-GARCH estimation methods, we state the conditional variance equations respectively written as:

$$\text{In } (\sigma^2_{i,,t}) = \omega + \alpha_j \left| \frac{u_{t-1}}{h_{t-1}} \right| + \beta_j \text{In}(\sigma^2_{it-1}) + \chi_j \frac{u_{i-1}}{h_{i-1}} + \mu_{it} \quad (2)$$

$$\sigma^2_{i,t} = \omega + \alpha_j \varepsilon^2_{i,t-1} + \beta_j \sigma^2_{i,t-1} + \chi_j I_{i,t-1} \varepsilon^2_{i,t-1} + \mu_{it} \quad (3)$$

In equations 2 and 3, ω denotes the permanent component of the conditional variance; a_j is the coefficient for the prior period news; β_j is the coefficient of prior period (lagged) conditional volatility; and χ_j is the coefficient that captures the asymmetric – leverage effect. The news has asymmetric effects on volatility. That is, in equation 2, the leverage exist if χ_j is < 0, since χ_j is normally negative, negative shocks (bad news) produce more volatility than positive shocks (good news). In equation 3, the asymmetric effect is captured by $I_{i,t-1}$ is an indicator dummy variable that takes on a value of one if $\varepsilon^2_{i,t-1}$ is negative; zero otherwise. In equation 3, good news, $\varepsilon_t > 0$ and bad news $\varepsilon_t < 0$, have different impacts on the conditional variance σ^2_i; good news has an effect of a_j, whilst bad news has an effect of $a_j + \chi_j$. Leverage effect exists, if $\chi_j > 0$, bad news increases volatility.

EMPIRICAL RESULTS AND DISCUSSIONS

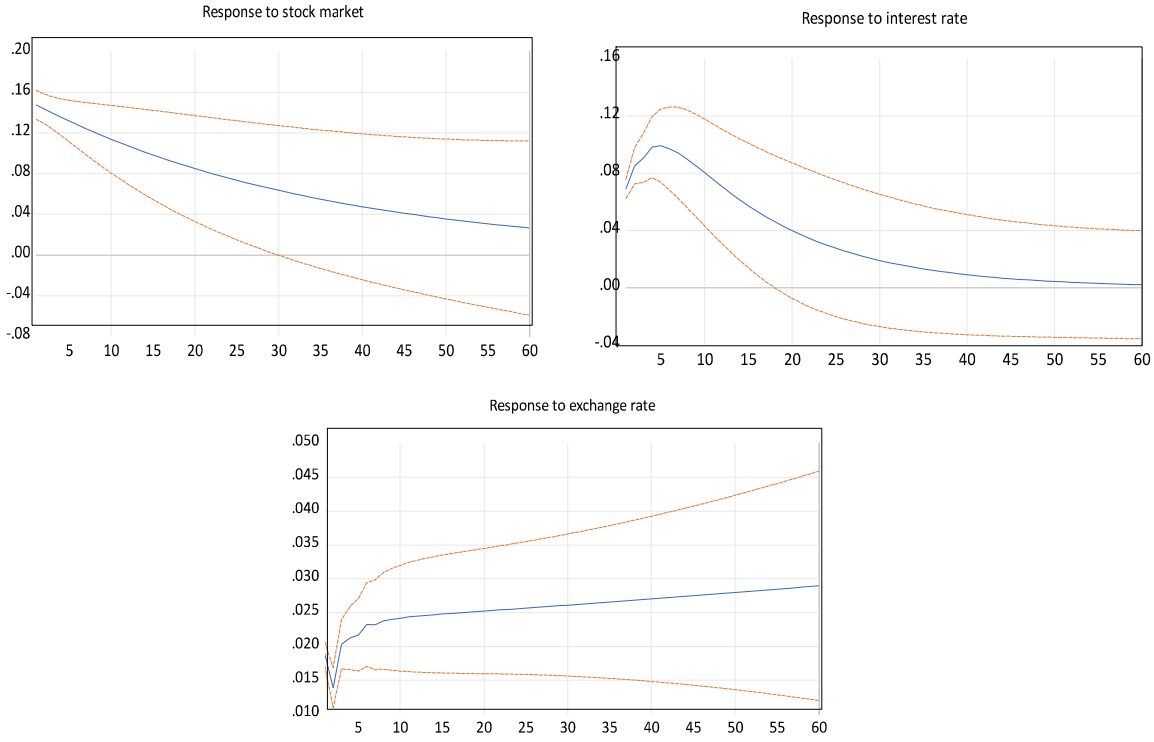
Impulse Response

This section reports the results of the impulse responses of stock market, interest rate and exchange rate shocks. To strengthen our empirical claims, we first carry out impulse responses of the stock market, interest rate and exchange rate using vector autoregression (VAR) analysis. We employed our three variables in the model to examining three innovations using Cholesky factors. We estimate a vector autoregression base on the log levels of the variables. In all cases, the dynamic response following a shock is calculated by using Monte Carlo simulations for 1000 repetitions. We used the optimal lag structure for the VAR based on the Akaike Information Criterion (AIC). In figure 1, we displayed the dynamic impulse responses over a 60-month horizon. Each figure shows the solid lines within the panels indicating the point of calculations of the impulse responses, and the dashed lines designate plus/minus two standard error bands. The impulse responses in figure 1 suggest that the shock to Ghana stock market has the largest impact in responses of the other endogenous variables in the VAR and that seem to be applicable in all the countries. A shock to Ghana and South Africa interest rate makes domestic financial assets more appealing and these prevail upon the appreciation of the domestic currency. A shock to

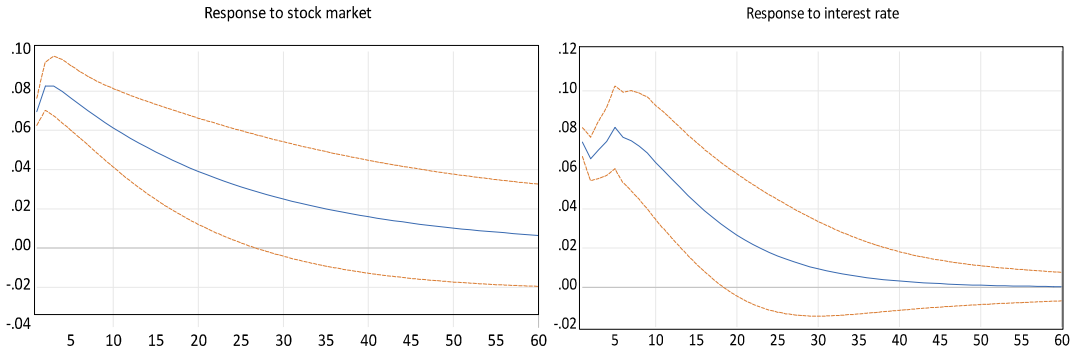
Nigeria interest rate increases up to 5-month horizon after initial fall before return to the baseline by the end of 60 months. As a result of a lack of competitiveness of the external sector of the economy, the domestic currency is uninterruptedly under pressure (Javid and Munir, 2010). The various countries' currencies have been under pressure due to weak economic fundamentals. Shocks to Nigeria and South Africa exchange rate have a direct impact on their economies through different channels. A positive shock has stimulus values on the economy, for example, stimulus relative prices, and net exports just to mention a few**.** A shock to Ghana exchange rate has similar effects on the economy; it initially falls before rising and equilibrium are never achieved by the end of 60 months. Overall results suggest that the combinations of factors might have to contribute negative effects of interest rates and exchange rates in these countries.

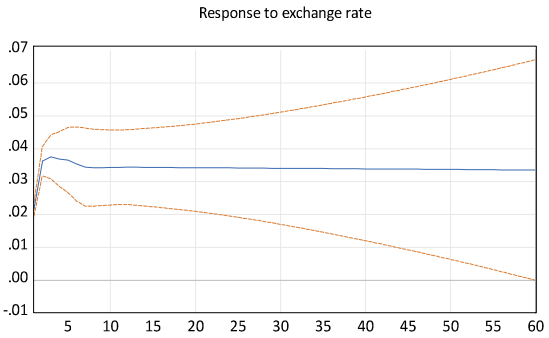
FIGURE 1
IMPULSE RESPONSES

Ghana Impulse Responses

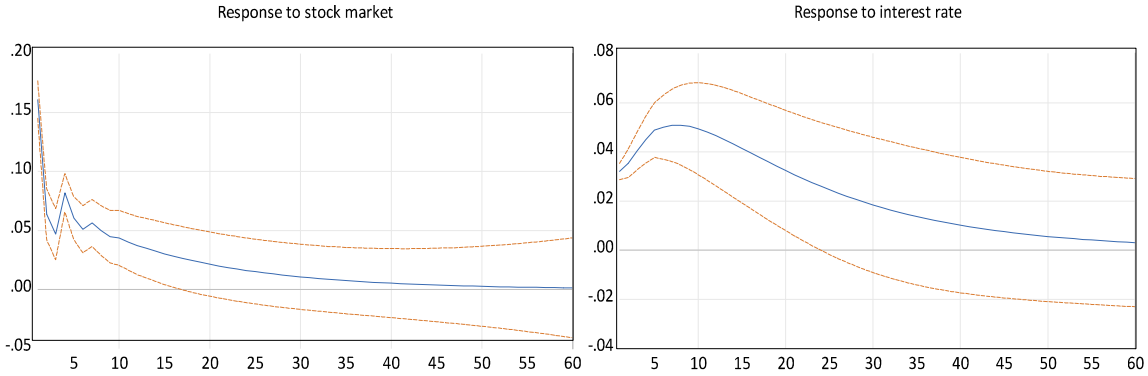


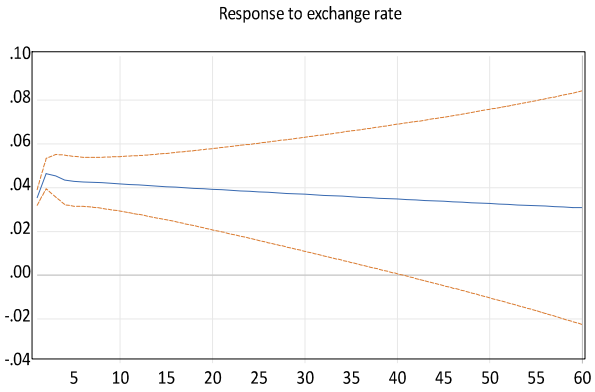
Nigeria Impulse Responses





South Africa Impulse Responses





DESCRIPTIVE STATISTICS

In this section, we report the descriptive statistic of the data. For comparison, as can be seen in Table 1, the mean values of stock market returns are positive signifying that the positive changes in stock price indices surpass negative changes with Nigeria haven the highest mean value of 10.2165, followed by South Africa, 9.9521 and Ghana, 7.9757 respectively. Ghana interest rate and Nigeria stock market return and interest rate are negatively skewed. This suggests that the mean and the median are less than the mode of the data set. The values of kurtosis indicate that the Nigeria stock market return, interest rate and exchange rate have the highest values followed by South Africa and Ghana. Kurtosis is significant for all the variables under consideration. The Jarque-Bera statistic rejects normality assumption.

TABLE 1
SMMARY STATISTICS OF 216 OBSERVATIONS OF THE RETURN SERIES
MEAN EQUATION OF GJR-GARCH AND EGARCH

Country	Mean	Max.	Min.	Std. dev	Skewness	Kurtosis	Jarque-Bera
Ghana							
Stock return	7.9757	9.2924	6.8459	0.6915	0.1247	1.8758***	11.9344***
INR	2.8424	3.5639	2.2083	0.3511	-0.1146	1.7302***	14.9836***
FX	1.0554	1.8532	0.5481	0.4294	0.5502***	1.7407***	25.1712***
Nigeria							
Stock return	10.2165	11.0822	9.2300	0.3763	-0.3191*	3.3666***	4.8747***
INR	2.2787	2.9967	1.4183	0.2976	-0.3865**	3.4239***	6.9956***
FX	5.1194	5.7357	4.7273	0.3227	1.0006***	2.6116***	37.4029***
South Africa							
Stock return	9.9521	10.7245	9.1888	0.2546	0.4694***	3.1253***	8.0738***
INR	1.9807	2.5447	1.5933	0.2409	0.5600***	2.6885***	12.1615***
FX	2.2193	2.7961	1.7457	0.2914	0.3134*	1.7091***	18.5342***

Notes: *, ** and *** denote the statistical significance at 5%, 10% and 1% levels, respectively

Table 2 shows the diagnostic tests of the mean equation to discriminate the two estimation methods and allow us to make a comparison between the three countries used in the study. The table also indicates the coefficient estimates under both GJR-GARCH and EGARCH. The coefficients α_i for Ghana are positive and negative respectively which are significant under both GJR-GARCH and EGARCH method. The coefficients α_i for Nigeria and South Africa are positive and significant under both GJR-GARCH and EGARCH estimation methods. As anticipated the coefficients for λ_i are positive and statistically significant under both estimation methods for all countries. These results show a compelling indication of the presence of stock markets in these countries. It is not surprising that the coefficient λ_i for South Africa is significantly high than Nigeria and Ghana since the stock market in South Africa is the most developed market in African. Both coefficients δ_i and ϕ_i which represents interest rate and exchange rate for Ghana under both GJR-GARCH and EGARCH have negative shocks on the stock market returns and these shocks are economically highly significant. We expect negative shocks to have a much larger impact on the Ghanaian stock market than positive shocks on similar magnitude. The coefficient for ϕ_i which is a negative shock, a depreciation of the home currency (Ghana Cedis) leads to a decline in the value of industries (Luehrman, 1991). A depreciation of the home currency will give rise to significant import price adjustment, which means that importers demand for the US dollar (foreign currency) will increase thereby putting pressure on the central bank to deal with the negative exposure. The sensitivity of stock markets to changes in the interest rate and the exchange rate is a sign of interest rate and exchange rate exposure of the market. The coefficients δ_i which represent interest rate are negative and significant for Nigeria under both GJR-GARCH and EGARCH methods. Negative shock leads to greater volatility than positive shock which is volatile to the Nigeria stock market. Jareño et al. (2016) indicate that a change in interest rate will significantly increase or decrease the financial firms' stock market returns. Similarly, the coefficients ϕ_i which represent exchange rates are positive and statistically significant for Nigeria under both methods. A positive value of the Nigeria Naira is good news for Naira bad news for USD. Indeed a higher Naira/USD volatility may reflect the Nigeria stock market over high Naira value. However, this

does not mean that Nigeria economy was better than the US during the period under review. Thus coefficients ϕ_i are positive and statistically significant; this implies that an increase in volatility is compensated for a higher stock market return. Consequently, the stock market return will increase in response to changes in the volatility of the returns. In the case of South Africa, both coefficients δ_i and ϕ_i which represent interest rates and exchange rates under the GJR-GARCH estimation method are negative and significant on the stock market return. These negative shocks to interest rate and exchange rate have long-run significant influence causing the South Africa stock market to take a lengthy period to recover to the pre-shock levels. Furthermore, a shock to the exchange rate volatility can generate higher prices of imported goods and services leading to economic uncertainty. Interestingly, both coefficients δ_i and ϕ_i under the EGARCH method are positive and significant on the stock market return. That is, the sign of the volatility coefficient for the interest rate is positive and significant on the stock market return. This suggests that the stock market gets higher returns when interest rate volatility is low. These findings of the study have significant implications for policymakers, investors and managers. Positive interest rates and exchange rates for Nigeria do not mean that Nigeria economy was better than the US under the period review but that depends on other factors. In the same way, the sign of the volatility coefficient for exchange rare is positive and significant on the stock market return. This indicates that the South Africa stock market gets higher returns as a result of the appreciation of South Africa Rand against the US dollar. Under the GJR-GARCH estimation method, negative shocks to interest rate and exchange rate for South Africa are higher than that of Ghana and Nigeria. GJR-GARCH estimation method produces bigger coefficients than the EGARCH estimation method for Ghana and Nigeria. Thus, the GJR-GARCH estimation method outperforms the EGARCH estimation method. However, an interesting revelation occurred for South Africa, EGARCH estimation method generates bigger coefficients than the GJR-GARCH estimation method. Finally, the majority of coefficients are positive compared to negative coefficients.

TABLE 2
ESTIMATES OF THE MEAN EQUATION OF GJR-GARCH AND EGARCH REGRESSION COEFFICIENTS FOR THE SERIES

Variable	Coefficients	Standard error	Z-statistics	P-value
Ghana				
GJR-GARCH				
α_i	0.0079***	0.0012	6.5262	0.0000
λ_i	9.8429***	0.0007	14536.55	0.0000
δ_i	-0.3999***	0.0066	-60.8872	0.0000
ϕ_i	-0.5311***	0.0095	-55.6619	0.0000
EGARCH				
α_i	-0.2229***	2.57E-06	-86722.49	0.0000
λ_i	9.4426***	0.0001	65726.85	0.0000
δ_i	-0.3379***	7.30E-06	-46316.40	0.0000
ϕ_i	-0.5930***	1.38E-05	-43097.21	0.0000
Nigeria				
GJR-GARCH				
α_i	0.0984***	0.0108	9.0861	0.0000
λ_i	10.1174***	0.1475	68.6095	0.0000
δ_i	-0.1562***	0.0157	-9.9519	0.0000
ϕ_i	0.1672***	0.0263	6.3660	0.0080
EGARCH				
α_i	0.0921***	0.0032	28.6900	0.0000
λ_i	10.0425***	0.0021	4743.595	0.0000
δ_i	-0.3025***	0.0048	-62.5949	0.0000
ϕ_i	0.2110***	0.0004	491.3877	0.0000
South Africa				
GJR-GARCH				
α_i	0.7653***	0.0009	897.7711	0.0000
λ_i	47.6139***	2.52E-05	1889443	0.0000
δ_i	-7.7556***	0.1051	-73.7539	0.0000
ϕ_i	-7.3447***	0.1028	-71.4292	0.0000
EGARCH				
α_i	17.3357***	0.5746	30.1705	0.0000
λ_i	67.8092***	1.6232	41.7743	0.0000
δ_i	0.1783**	0.0572	3.1176	0.0018
ϕ_i	0.6115***	0.0475	12.8689	0.0000

Notes: *, ** and *** denote the statistical significance at 5%, 10% and 1% levels, respectively

VARIANCE EQUATION AND ASYMMETRIC IMPACT OF GJR-GARCH AND EGARCH

We present the results of both variance equations and asymmetric impact of GJR-GARCH and EGARCH methods in Table 3. The coefficient ϖ for the permanent component in the conditional variance equation is normally negative and significant under both GJR-GARCH and EGARCH estimation methods. It is believed that the negative sign for ϖ is not encouraging, it is bad for the permanent component for conditional volatility in uncertainty times. It is only positive and significant for Nigeria under GJR-GARCH estimation method. The coefficient α_j measures the effects for past period news have a substantial effect on the current conditional volatility for all stock markets returns for all countries. The 2007 global financial crisis influences the conditional volatility on the stock markets throughout the sample period under review. These stock markets are incorporated with the world markets, as the volatility in the world market upsurges the volatility in these stock markets also raises. The coefficient for α_j is positive and statistically significant for 83.33% under the GJR-GARCH and EGARCH methods. The coefficient α_j for past period news for Ghana is considerably high under the GJR-GARCH method compared to South Africa and Nigeria whilst Nigeria is notably high under the EGARCH method relative to Ghana and South Africa. The coefficient β_j captures past conditional volatility does not seem to impact on the current conditional volatility. Here the coefficient β_j is significant for 66.67% (100%) of data set under the GJR-GARCH (EGARCH) estimation methods. These coefficients are significant to suggest that the time-varying volatilities when stocks market price change. Indeed under both methods, the coefficient β_j suggests less volatility in stock market prices in these emerging economies which indicates a lower level of risk for investors. Thus, the coefficient β_j result shows that investors face less risk in South Africa stock market followed by Ghana and Nigeria respectively. The sum of α_j and β_j is close to one (an IGARCH (1,1) procedure, Lai and Joseph, 2010). In most cases, α_j is normally positive and significant. Under the IGARCH method, current shocks have an unlimited persistence on imminent volatility (see e.g. Lai and Joseph, 2010). When the sum of α_j and β_j is less than one, in this case, 83.34%, the persistence of volatility shocks is feebler. The coefficient χ_j for asymmetry is significant for Ghana and Nigeria under both GJR-GARCH and EGARCH estimation method. The coefficient χ_j for asymmetry is insignificant for South Africa under both GJR-GARCH and EGARCH estimation methods. The coefficient χ_j for asymmetry is significant in 66.67% for both GJR-GARCH and EGARCH methods. The significant χ_j coefficients for GJR-GARCH and EGARCH are positive for all countries, except for GJR-GARCH for South Africa which is negative. The coefficient χ_j is significant in 66.67% in extreme cases prove that there is evidence of a moderate presence of asymmetries do exist. Nevertheless, the sign of is negative in the GJR-GARCH method for only South Africa and positive in the EGARCH method for all countries indicating that there exist weak leverage effects. The leverage effect, the net stock market value is decreased, the higher the debt ratio causes the market to be volatile.

TABLE 3
VARIANCE EQUATION OF GJR-GARCH AND EGARCH

	ϖ	α_j	β_j	χ_j	GED	$\alpha_j + \beta_j = 1$
Ghana						
GJR	-2.18E-05	1.1224***	-0.6406***	0.3418***	4.0105***	0.4818***
	(2.42E-05)	(0.1273)	(0.1512)	(0.0317)	(0.8235)	
EGARCH	-1.4002***	0.8602***	-0.5862***	0.9951***	1.8804***	0.2740***
	(2.09E-05)	(1.27E-05)	(1.58E-05)	(1.68E-05)	(0.1530)	
Nigeria						
GJR	0.0015***	0.6285***	-0.2672***	0.4016***	5.7557***	0.3613***
	(0.0003)	(0.1005)	(0.1019)	(0.0410)	(1.5138)	
EGARCH	-2.4428 ***	1.1011***	0.3490***	0.6411***	3.6896***	1.4501***
	(0.0962)	(0.0482)	(0.0466)	(0.0337)	(0.7296)	
South Africa						
GJR	-0.0903*	0.8324***	-0.0477	-0.2953	6.1183**	0.7847***
	(0.0512)	(1.95E-09)	(0.1485)	(0.1964)	(1.9518)	
EGARCH	-3.4187***	-0.0014*	0.0041***	0.0048	1.1294***	0.0027***
	(0.0383)	(0.0008)	(0.0006)	(0.0049)	(0.1365)	

Notes: *, ** and *** denote the statistical significance at 5%, 10% and 1% levels, respectively

Besides, we also perform asymmetric impacts of negative and positive changes and the results are presented in Table 4. In Table 4, good news has more impact on the volatility than the bad news. Both GJR-GARCH and EGARCH methods show that good news has an impact on volatility more than bad news under different hypotheses. Our results indicate that response asymmetries of positive and negative interest rate and exchange rate changes do exist on all stock market returns. For all stock market returns positive shocks has an impact on volatility more than negative shocks. These stocks market are more sensitive to good news than bad news due to interest rate and exchange rate fluctuations. For example, the EGARCH method for Ghana, the impact of good news on conditional volatility is about 407 times more than bad news.

TABLE 4
THE MAGNITUDE OF NEWS IMPACT OF VOLATILITY

Country	Bad News	Good News
Ghana		
GJR-GARCH	0.7806	1.1224
EGARCH	0.0049	1.9951
Nigeria		
GJR-GARCH	0.2269	0.6285
EGARCH	0.3589	1.6411
South Africa		
GJR-GARCH	0.5371	0.8324
EGARCH	0.9952	1.0048

The table presents asymmetric impacts of negative and positive changes. The asymmetry is defined as $\alpha_j + \chi_j / \alpha_j$ for GJR-GARCH method and $\left|-1+\chi_j\right| / 1+\chi_j$ for EGARCH method.

CONCLUSION

This paper sought to determine the impact of exchange rate and interest rate volatility on stock market returns in Ghana, Nigeria and South Africa using EGARCH and TGARCH, also known as GJR-GARCH models. We find a positive shock to interest rate and exchange rate lead to persistence increase in the price levels over the 60-month horizon. The coefficient for the permanent component in the conditional variance equation is normally negative and significant under both GJR-GARCH and EGARCH estimation methods. Our empirical findings suggest that asymmetry in the conditional volatility of the stock market is pretty weak. Our results indicate that response asymmetries of positive and negative impact interest rate and exchange rate changes on all stock market returns.

The interest rates and exchange rates establishments in these stock markets are different. The exchange rates between the Ghana Cedi/USD depreciated with volatility exhibiting import-driven demand growing. That is, the exchange rates between Ghana Cedi/USD with values varying from 0.5481 to 1.8532 (SD of 0.4294) is the extremely volatile currency amid these countries; while the exchange rates between South Africa Rand/USD with values varying from 1.7457 to 2.7961 (SD of 0.2914) is the slightest volatile currency amid these countries (Su et al, 2012). Both the interest rates and exchange rates in Ghana have a negative relationship with the stock market return under both methods. The interest rates in Nigeria have a negative relationship with the stock market return under both GJR-GARCH and EGARCH method. Mysteriously, interest rates and exchange rates in South Africa have a negative relationship under the GJR-GARCH method, while a positive relationship under the EGARCH method with the stock market returns.

The 2007 global financial crisis influences the conditional volatility on the stock markets throughout the sample period under review. These stock markets are incorporated with the world markets, as the volatility in the world market upsurges the volatility in these stock markets also raises. Both GJR-GARCH and EGARCH methods show that good news has an impact on volatility more than bad news under different assumptions. The GJR-GARCH estimation method outperforms the EGARCH estimation method in predicting coefficients. These findings of the study have significant implications for policymakers, investors and managers in these stock markets to make effectual investment strategies. There should be a policy to control the exchange rates movement. This current research used two asymmetric models, GJR-GARCH and EGARCH; future research may consider using symmetric models to conduct further studies in Asia or South American countries to ascertain whether interest rates and exchange rates have a positive or negative impact on stock market return.

REFERENCES

Bredin, D.S.H., Nitzshe, D., & O'Reilly, G. (2007). UK stock returns and the impact of domestic monetary policy shocks. *Journal of Business, Finance and Accounting*, 34(5–6), 872–888.

Caporale, G. M., Hunter, J., & Ali, F. M. (2013). *Brunel University, Department of Economics and Finance.* Working paper No.13-07.

Cho, J. J., Elyasiani, E., & Kopecky, J. K. (1992) The sensitivity of bank stock returns to market, interest and exchange rate risks. *Journal of Banking and Finance*, 16, 983-1004.

Christie, A. A. (1982). The stochastic behaviour of common stock variances: Value, leverage and interest rate effects. *Journal of Financial Economics*, 407-432. https://doi.org/10.1016/0304-405X(82)90018-6

Chuliá, H., Martens, M., & Van Dijk, D. (2010). Asymmetric effects of Federal funds target rate changes on S&P 100 stock returns, volatilities and correlations. *Journal of Banking & Finance.* DOI: 10.1016/j.jbankfin.2009.09.012

Corhay, A., & Rad, A. (1996). Conditional heteroskedasticity adjusted the market model and an event study. *The Quarterly Review of Economics and Finance*, 36, 529-538. https://doi.org/10.1016/S1062-9769(96)90050-2

Dinenis, E., & Staikouras, K.S. (1998). Interest rate changes common stock returns of financial institutions: Evidence from the UK. *The European Journal of Finance*, 4(2), 113-127.

Engle, R. F. (2001). The use of ARCH/GARCH models in applied econometrics. *Journal of Economic Perspectives*, 15, 157-168. DOI: 10.1257/jep.15.4.157

Engle, R.F., & Ng, V. K. (1993). Measuring and testing the impact of news on volatility. *Journal of Finance*, 48, 1749-1778. https://www.jstor.org/stable/2329066. DOI: 10.2307/2329066

Faff, W. R., Hodgson, A., & Kremmer, L. M., (2005). An investigation of the impact of interest rate and interest rate volatility on Australian financial sector stock return distributions. *Journal of Business Finance and Accounting*, 32(5 and 3), 0306-686x. DOI: 10.1111/j.0306-686X.2005.00620.x

Flannery, J. M., & James, M. C. (1984). The effect of interest rate changes on the common stock returns of financial institutions. *The Journal of Finance*, 39(4), 1141-1153. Retrieved from https://www.jstor.org/stable/2327618. DOI: 10.2307/2327618

Frenkel, J. A. (1983). Exchange rates and international macroeconomics. *Chicago*, 49. Chicago University Press.

Glosten, R. L., Jagannathan, R., & Runkle, E. D. (1993). On the relation between the expected value and the volatility of the nominal excess return on stocks. *Journal of Finance*, 48(6), 1779 – 801. https://doi.org/10.1111/j.1540-6261.1993.tb05128.x

Jareño, F., & Navarro. E., (2010). Stock interest rate risk and inflation shocks. *European Journal of Operational Research*, 201(2), 337–348.

Jareño, F., Ferrer, R., & Miroslavova, S., (2016). US stock market sensitivity to interest and inflation rates: A quantile regression approach. *Applied Economics*, 48(26), 2469-2481. https://doi.org/10.1080/00036846.2015.1122735

Javid, M., & Munir, K., (2010). The price puzzle and monetary policy transmission mechanism in Pakistan: structural vector autoregressive approach. *Pakistan Development Review*, 49(4), 449-460. DOI:10.2307/41428668

Jong, A., Ligterink, J., & Macrae, V. (2006). A firm specific analysis of the exchange rate exposure of Dutch firms. *Journal of International Financial Management and Accounting*, 17, 1–28. https://doi.org/10.1111/j.1467-646X.2006.00119.x

Joseph, L. N., &Vezos, P. (2006) The sensitivity of US banks' stock returns to interest rate and exchange rate changes. *Managerial Finance*, 32(2), 182-199.

Kanas, A., & Karkalakos, S. (2017). Equity flows, stock returns and exchange rates. *International Journal of Finance and Economics*, 22, 159-168.

Kasman, S., Vardar, G., & Tunc, G. (2011) The impact of interest rate and exchange rate volatility on banks' stock returns and volatility: Evidence from Turkey. *Economic Modelling*, 28, 1328-1334. http://doi.org/10.1016/j.econmod.2011.01.015

Lai, B., & Joseph, L. N. (2010) Pricing-to-market and the volatility of UK export prices. *Applied Financial Economics*, 20(18), 1441-1460. DOI: 10.1080/09603107.2010.496722

Luehrman, T. A., (1991). Exchange rate changes and the distribution of industry value. *Journal of International Business Studies*, 22, 619-649.

Nam, K., Pyun, S. C., & Kim, S-W. (2003). Is asymmetric mean-reverting pattern in stock returns systematic? Evidence from Pacific-basin markets in the short-horizon. *International Financial Markets, Institutions and Money*, 13, 481–502. Doi 10.1016/S1042-4431(03)00019-2

Nelson, D. (1991) Conditional heteroscedasticity in asset returns: A new approach. *Econometrica*, 59, 347-370. Retrieved from http://www.jstor.org/stable/2938260

Olugbode, M., El-Masry, A., & Pointon, J. (2014). Exchange rate and interest rate exposure of UK industries using first-order autoregressive exponential GARCH-in-mean (EGARCH-M) approach. *The Manchester School*, 82(4), 409 - 464. http://dx.doi.org/10.1111/manc.12029.

Papadamou, S., & Siriopoulos, C. (2014). Interest rate risk and the creation of the monetary policy committee: Evidence from banks' and life insurance companies' stocks in the UK. *Journal of Economics and Business*, 71, 45–67. http://dx.doi.org/10.1016/j.jeconbus.2013.09.001

Paul, M. T., & Kimata, J. D. (2015). The linkages, persistence, asymmetry in the volatility, the price discovery and efficiency, and the effect of the US subprime mortgage financial crisis on the spot and the futures market's returns: the case of India. *Applied Economics*, 47. DOI:10.1080/00036846.2015.1085641

Su, C-W., Chang, T., & Lin, Y-S., (2012). Revisiting purchasing power parity for African countries: with nonlinear panel unit-root tests. *Applied Economics*, 44, 3263-3273.

Suriani, S., Kumar, D. M., Jamil, F., & Muneer, S. (2015). Impact of exchange rate on the stock market. *International Journal of Economics and Financial Issues*, 5, 385-388.

Verma, P. (2016). The impact of exchange rates and interest rates on bank stock returns Evidence from U.S. banks. *Studies in Business and Economics*, 11(1), 124-139. DOI 10.1515/sbe-2016-0011