The Role of Macroeconomic Variables in the Johannesburg Stock Exchange's Oil and Gas Stock Returns

SB Molele
University of Limpopo

Abstract: The study pursued an investigation into the role of macroeconomic variables on the stock return volatility of the JSE's Oil and Gas sector, South Africa. The study focused on Brent crude oil prices, exchanger rate (R/$), Broad money supply and Gold Price as the selected macroeconomic variables. The GARCH–GED model to incorporate volatility was employed. Additionally, variance decomposition and impulse response were arrayed to test for shocks and forecast using secondary monthly data for the period 2007-2015. The findings were that change in oil prices and broad money supply had a positive and significant effect on the sector stock returns, 1% and 10% respectively, while changes in exchange rates and gold price had a negative and significant effect at 1%. There was clustering of volatility detected in the sector returns, but faded at a moderate speed. A recommendation is that both the oil price and exchange rate must be monitored by market players as they have significant positive shock effect in the short-run and persist in the long-run. Risk, portfolio managers and interest players should keenly monitor gold prices to negate any losses due to gold positive performance as an alternative to the Oil and Gas sector.

Keywords: GARCH Model, Macroeconomic variables, Stock returns, Volatility

1. Introduction

South Africa's oil and gas sector has received much needed boost with the discovery of gas deposits off the coast of Southern Cape. This is sure to have an enhancement on the overall share value of the Oil and Gas sector index in the Johannesburg Stock exchange (JSE) inducing the exchange of stocks through buying and selling over the counter. It is also acknowledged that the stock market does not operate autonomously, but rather influenced by other factors, such as political and economic factors (JSE, 2015). To this effect, a number of studies document that a relationship exists between macroeconomic variables and stock returns (Bilson *et al*., 2001; Mangani, 2009; Chinzara, 2011; Masuduzzaman, 2012; Gupta & Modise, 2013).

The macroeconomic variables chosen for the paper were as a result of current concerns and also as provided by literature. Firstly, Brent crude oil as the primary element in the oil and gas sector is expected to have an influence through pricing, and secondly, exchange rates are also expected to influence the sector with oil as a heavily imported commodity in South Africa. It is revealed by National Energy Regulation South Africa (NERSA) that the majority of South Africa's crude oil is supplied by three countries, namely Saudi Arabia, Nigeria and Angola which supply 89% of South Africa's total crude imports (NERSA, 2017). Thirdly, Broad money supply (M3) is included because of the government's cash injection in the sector through its industrial action plan; and finally, the gold price is included on the bases that gold is seen as a safe haven. The gold price in particular acts as a stimulus to certain industries through demand for products to be used on the mines, isolated as a macroeconomic variable due to the fact that its determination is largely divorced from other domestic economic variables (Van Rensburg, 1995).

The sector's stocks were halted for trading in 2015 December and resumed in March 2018. According to the author relevant studies are lacking in the South African context. To this effect, it is significant to provide research study on the role of macroeconomic indicators on the sectors stocks. Additionally, address uncertainty over the role or how the sector stock returns reacts to the macroeconomic variables amid the expected gains in the sector. This study is expected to add to literature, thereby, advancing the relationship and how some economic factors affect the sector. It is also hoped that it might assist both private and public investors to capture any risks from the economy. Hence, beneficial to asset and portfolio managers on the stock market sector analysis especially regarding risk return nexus on equities, to be successful when trading (Chinzara, 2011; Ramos & Veiga, 2011). Beneficial in that they may, to some degree mitigate economic risks and be successful in the stock market. Thus, the relationship between Brent crude oil prices, exchange rate, broad money supply and gold price on oil and gas stocks listed on the JSE warrants investigation. Most studies measuring the relationship between macroeconomic variables and the aggregate stock market share prices exists (Enisan & Olufisayo, 2009; Mangani, 2009; Ajayi & Olaniyan, 2016; Ali, Abdelnabi & Iqbal, 2016). This paper will help, to some degree, portfolio or equity traders keep abreast of the relationship of the oil and gas stock returns to the selected macroeconomic variables. The remainder of this paper is as follows: the next section is the underlying theories and literature review. This is followed by a section on methodological process to be followed. Section four presents the results and discussions. Finally, section five concludes and provides recommendations.

2. Literature Review

2.1 Theoretical Literature

Two theoretical perspectives were adopted in determining the effects of oil prices and exchange rates movements on oil and gas sector stock returns, which are Arbitrage Pricing Theory (APT) and Efficiency Market Hypothesis (EMH). Ross (1976) hypothesizes the APT where various economic risk factors may explain stock market returns. This theory adopts an idea that stock market returns may be impacted by and explained through risk elements of micro and macroeconomic fundamentals. It is acknowledged that stock returns remain exposed to systematic economic news, priced accordingly in relation to economic risks which require accomplished and simple intuitive financial theory to measure the economic exposure (Ouma & Muriu, 2014). This theory provides a more realistic explanation to the variations in stock prices as it allows for a wider selection of various factors that determine stock return.

EMH is based on the assumption that prices of securities in financial markets fully reflect all available information, which views expectations of future prices as equal to optimal forecasts using all currently available information (Mishikin & Serletis, 2011). Hence, stock prices determination quickly adjusts as information of relevant economic or sector indicators become available. Nordin *et al*. (2014) puts forward three forms of market hypothesis, but the most relevant hypothesis is the stronger form of market efficiency which has received much attention and subject of much study in the financial markets, because it provides the basis to asses which indicators offer much information to asset pricing. The equilibrium returns of securities is influenced by numerous risk factors, as efficient market hypothesis views expectations of future prices, henceforth the returns, as equal to optimal forecasts using all currently available information making it relevant to the study at hand.

2.2 Empirical Literature Review

There is some empirical evidence on stock market sector analyses, specifically in the South African context, where much analysis was done for the JSE indices as opposed to more sector specific studies. For instance, Gupta & Modise (2013) supported that macroeconomic variables such as crude oil prices and money supply do not contain much information to predict South African stock returns. These sentiments somewhat gave impetus to Ramos & Veiga (2011) that oil and gas sector in developed countries responds more strongly to oil price changes than in emerging markets. However, other studies encompassing volatility such as Mangani (2009) found that gold prices do largely influence stock return volatility giving credence to Mongale & Eita (2014) that increase in commodity prices has a positive association with stock market performances. A more recent study by Szczygielski & Chipeta (2015) also found that oil prices, money supply (M3) and exchange rates had a positive and significant influence on South African Stock Returns. West & Macfarlane (2013) addressed the empirical question of whether macroeconomic variables drive future stock market returns in South Africa. They examined data over a 45-year period from 1965 to 2010 through the use of Johansen multivariate cointegration, Granger causality and innovation accounting. Findings as per the VECM model estimates revealed that inflation and money supply had a positive relationship with the 'all share stock index' over the long run. A negative relationship was found for the South African 10-year Government Bond Yield, measure of interest rate, the rand dollar exchange rate and GDP.

Following on Tripathi & Kumar (2015) on Brazil, Russia, India, China and South Africa (BRICS) study; stock returns had significant negative relationship with current inflation, current exchange rate, long run inflation and long run interest rate. Hsing (2014) examined the effects of selected macroeconomic variables on the stock market index in South Africa applying the exponential GARCH model. Findings indicated that the stock market index is positively influenced by the growth rate of real GDP. Ntshangase *et al*. (2016) found that money supply, interest rate, inflation, exchange rate and government expenditure influence the stock market. An assessment of the effects of currency volatility on the Johannesburg Stock Exchange, the GARCH model was used in establishing the relationship between exchange rate volatility and stock market performance (Mlambo *et al*., 2013). A very weak relationship between currency volatility and the stock market was confirmed, furthermore, since the South African stock market is not really exposed to the negative effects of currency volatility, government can use exchange rate as a policy tool to attract foreign portfolio investment.

A size effect of macroeconomics factors in New York stock exchange returns were investigated by employing a VECM Model (Shubita & Al-Sharkas, 2010). It was found that inflation and interest rates had an inverse relationship to market stock returns in United States of America (USA). Contrary to that study, Jareno & Negrut (2016) found that consumer price index was insignificant to U.S stock returns. Park & Ratti (2008) examined oil price shocks and stock markets in the U.S and 13 Europeans countries over the period 1986-2005. The findings in retrospect to European countries suggest that oil price shocks contribute variably and depress stock market returns significantly. Oil price shocks had a greater impact than interest rates in stock market return variability. Ajayi & Olaniyan (2016) studied the dynamic relations between macroeconomic variables and stock prices for United Kingdom (U.K) and South Africa employing the VECM model spanning from March 2000 to December 2009. The U.K results reflect that stock prices are positively related to industrial production, however, had a negative relationship with inflation. An impact of several macroeconomic variables on the Dow Jones Sustainability and Dow Jones Wilshire 5000 indexes, using a GARCH model and monthly data for the period January, 2000 to January, 2008 was examined (Sariannidis *et al*., 2010). The results show that changes in returns of crude oil prices affect negatively the U.S. stock market; the exchange rate volatility affects negatively the returns of the U.S. stock market.

Hsieh (2013) used exponential GARCH to find that New Zealand's stock market index was positively influenced by real GDP and the world stock market index and negatively affected by the ratio of the government debt to GDP, the domestic real interest rate, the nominal NZD/USD exchange rate and the domestic expected inflation rate. Dhaoui & Khraief (2014) examined empirically whether oil price shocks impact stock market returns using monthly data for eight developed countries (US, Switzerland, France, Canada, UK, Australia, Japan and Singapore) from January 1991 to September 2013 applying the EGARCH model. It was found that at the 5% significance level the oil price exerts significant effect on returns for three countries (US, Switzerland, Canada) and on volatility, only Switzerland had a significant effect of oil price. Arouri & Nguyen (2010) investigated the relationships between oil price changes and sector stock market returns in Europe over the last turbulent decade. Results confirmed the significance of oil price shocks as a factor affecting sector returns in Europe, oil and gas sector index included. Additionally, Granger causality results show that there is bidirectional causality between oil price changes with the oil and gas sector among other sectors.

3. Research Methodology

3.1 Data and Model Specification

The model embraces the role of macroeconomic variables movements on oil and gas stock returns volatility listed on the JSE. The study employed secondary monthly data spanning the period 2007 to 2015. Data on variables such as Brent crude oil prices and exchange rate were collected from InetBFA, while data on money supply and gold prices were collected from the South African Reserve Bank (SARB). The time span is chosen purely because on data availability. The oil and gas stock indices were converted into continuously compounded returns by subtracting the logarithm of last month's index from the logarithm of the current month's index, then multiplying by 100 (Brook, 2008). The general empirical model for oil and gas stock returns is specified as follows:

$$OilGas_t = \beta_0 + \beta_1 OILP_t + \beta_2 EXR_t + \beta_3 M3_t + \beta_4 GP + \varepsilon_t \quad (1)$$

Where $OilGas$ denotes growth rate in sector returns, $OILP$ is Brent crude oil prices, EXR is exchange rate, $M3$ is broad money supply and GP is gold prices.

3.2 Estimation Technique

To obtain the set objectives the General Autoregressive Conditional Heteroscedasticity (GARCH) model was employed to measure volatility. Volatility, as measured by the standard deviation or variance of returns, is often used as a crude measure of the total risk of financial assets (Brook, 2002). Variance decomposition and impulse response function were carried out to measure the shock effect and forecast variance on the sector returns. Lastly, diagnostic and stability test were conducted to check the viability of the chosen model.

3.2.1 Unit Root Tests

Unit root is run to purely avoid spurious results and determine stationarity level (Brooks, 2002). Unit root testing determines the properties of the variables since they are macro-economic variables of a time series in nature. For this purpose, the study utilised the Augmented Dickey Fuller test (ADF). Attari & Safdah (2013) affirmed that ADF contains extra lags for the dependent variable to remove serial autocorrelation. One criticism of the ADF test is that it cannot distinguish between unit root and near unit root process (Naik, 2013). A solution is offered by Phillips & Perron (1988), who finds a non-parametric way of adjusting the estimated variance so that the tabulated distribution is valid (Sjo, 2008). Therefore, the Phillips & Perron (1988) unit root testing is utilised to conclude with certainty the order of integration.

3.2.2 Generalised Autoregressive Conditional Heteroskedasticity

Based on the volatility of variables under investigation, the GARCH model was employed to find the estimates. Volatility is a process of change in behaviour, value or investment over the time and cumulative persistence of that change to the next phase (Ahmad & Ramzan, 2016). However, the GARCH model is an extension of the autoregressive conditional heteroscedasticity (ARCH) model. Sariannidis *et al*. (2010) gave the specifics of the ARCH model, in that, it allows the conditional variance of a time series to change over time as a function of past squared errors by imposing an autoregressive structure on conditional variance and allowing volatility shocks to persist over time.

The ARCH model through the 'ARCH-effect' is used as the first stage of detecting volatility, by testing whether heteroskedasticity is present allowing the study to run any chosen GARCH. The ARCH's ability to capture the non-linearity and volatility clustering in stock return data is one of its benefits. In a linear regression model, with or without lagged-dependent variables, ordinary least square (OLS) is the appropriate procedure if the disturbances are not conditionally heteroskedastic by running or testing the Lagrange multiplier (LM), the ARCH-LM test (Engle, 1982). The standard GARCH model is given by the following equation:

$$OilGas_t = \beta_0 + \sum_{i=1}^{k=1} \beta_1 OILP_t + \sum_{i=1}^{k=1} \beta_2 EXR_t + \sum_{i=1}^{k=1} \beta_3 M3_t + \sum_{i=1}^{k=1} \beta_4 GP + \varphi_1 \sqrt{h} + \varepsilon_t \quad (2)$$

$$\mu_t / \Omega_{t-1} \sim N(0, h_t^2) \quad (3)$$

$$h_t^2 = \beta_0 + \lambda_1 \varepsilon_{t-1}^2 + \Phi_1 h_{t-1}^2 \quad (4)$$

Where β_0 in Equation 1 is the intercepts of the regression and represents the risk free rate, β_1, β_2, β_3, β_4 are the coefficients of the variables and ε_t is the residual errors of the regression. β_j, λ_1 and Φ_1 are coefficients to be estimated (j=0,1,2), h_t^2 is the conditional variance which is dependent on lagged values of square errors and lagged values of the conditional variance, Ω_{t-1} is the set of all information available at time $t-1$. λ_1 and Φ_1 are the ARCH and GARCH coefficient, respectively, and all other terms assumes the usual interpretations of the GARCH model. Equation 3 is the conditional mean return expression, while Equation 4 gives the distribution of the error term, conditional upon available information. Equation 4 gives an expression for the volatility of returns. Henceforth, the third term, h_{t-1}, is the GARCH model, measuring the impact of last period's forecast variance. λ_1 and Φ_1 help in confirming the presence of ARCH and GARCH effects.

3.2.3 Impulse Response Function and Variance Decomposition

The impulse response function is meant to trace the effect of a one-time shock function to one of the innovations on current and future values of the endogenous variables. In essence, the impulse response describes the oil and gas stock return's reaction as a function of time to the underlined macroeconomic variables at the time of the shock and subsequent points. Thereby, shows the effects of shocks on the adjustment path of the variables (Brooks, 2002). The impulse response uses the

Table 1: Unit Root Tests

		Panel A: Stationarity at level I (0)			Panel B: Stationarity at first level I (1)		
Variables	**Model specification**	**ADF test**	**PP test**	**Results**	**ADF test**	**PP test**	**Results**
OilGas	Intercept	-2.413777	-2.377544	Non stationary	-11.70461	-11.7236	Stationary
	Trend and intercept	-2.143744	-1.961114	Non stationary	-11.83941	-12.2735	
	None	-0.460261	-0.507869	Non stationary	-11.74241	-11.7611	Stationary
OILP	Intercept	-1.880496	-1.733579	Non stationary	-6.357426	-6.38918	Stationary
	Trend and intercept	-1.796924	-1.604833	Non stationary	-6.448033	-6.48963	Stationary
	None	-0.513547	-0.430496	Non stationary	-6.374281	-6.40634	Stationary
EXR	intercept	0.835466	0.865273	Non stationary	-9.835317	-9.84053	Stationary
	Trend and intercept	-0.678735	-0.701016	Non stationary	-10.04903	-10.0491	Stationary
	None	1.954947	1.944601	Non stationary	-9.563426	-9.62437	Stationary
LM3	intercept	-2.315663	-1.657102	Non stationary	-7.653431	-8.02593	Stationary
	Trend and intercept	-3.90623	-3.622247	Stationary	-3.102292	-5.02226	Stationary
	None	10.38232	6.474112	Non stationary	-8.022509	-8.02251	Stationary
LGP	intercept	-2.353641	-2.277052	Non stationary	-8.657160	-8.59796	Stationary
	Trend and intercept	-0.68337	-0.739907	Non stationary	-7.968137	-7.96617	Stationary
	none	1.092230	0.936583	Non stationary	-11.70461	-11.7236	Stationary

Source: Author's computation with E-Views 9.0

VAR system to examine how each of the variables responds to innovation the other variables, which is, mapping out a dynamic response path of variable due to one standard deviation shock on each other.

West & Macfarlane (2013) postulated that unlike the impulse response function, which trails the effects of shocks to one variable on the other variable in the VAR, the variance decomposition, however, separates the variation of the macroeconomic variables into the constituent shocks of the VAR. Henceforth, a measure of the contribution of each type of shock to the forecasted error variance entails running forecast error variance decomposition (Brooks, 2002). Ordering of the variables is important to differentiate the calculation of impulse responses and variance decompositions because they are almost similar.

4. Results and Discussion

4.1 Stationarity Tests

Table 1 above presents the PP and ADF test results by testing the null hypothesis that the oil and gas stock indices and the four macroeconomic variables non-stationary. Unit root tests were run for all variables at intercept, trend and intercept, and at none, incorporating all regression forms to conclude the level of stationarity for all variables.

Table 1 indicates that only money supply is stationary at trend and intercept, therefore cannot be stated with certainty that it is stationary at level since it is non-stationery at intercept and none. The tests were carried out at all regression forms based on the automated SIC lag length for ADF and PP automated at Newey-West using Bartlett Kenel. The variables are showing signs of trending and the data is influenced by time at all specifications, hence, the variables are non-stationary at level, that is, the null hypothesis is maintained and thus holds at level. The same procedure was followed at panel B, however, all the variables were tested for unit root at first difference to test the null hypothesis. Both the ADF and PP concluded that the variables are stationary after first differencing, that is, integrated at an order of I (1).

4.2 Generalized Autoregressive Conditional Heteroscedasticity (GARCH) Model

Before proceeding with estimating the model, the residuals were examined for heteroscedasticity. There's a strong evidence of ARCH effect in the model residual series as seen by the ARCH-LM test in Table 2 on the following page. The null hypothesis of no ARCH effect is rejected and concludes that there is presence of ARCH effects. Therefore, this paves the way to utilise the GARCH because there is the presence of heteroscedasticity.

Table 2: ARCH-LM Test

F-statistic	4.511745	Prob. F(1,99)	0.0362
Obs*R-squared	4.402266	Prob. Chi-Square(1)	0.0359

Source: Author's computation with E-Views 9.0

Table 3: GARCH Model Estimates of the ML ARCH - GED

Panel A: Mean equation					**Panel B: Variance equation**				
Variables	**coefficients**	**Std. Error**	**z-Stat**	**Prob**	**Variables**	**coefficients**	**Std. Error**	**z-Stat**	**Prob**
@SQRT (GARCH)	-0.9084	0.4205	-2.1601	0.030	C	0.028	0.023	1.235	0.216
OILP	0.5340	0.0346	15.426	0.000	ARCH:RESID(-1)^2	0.052	0.014	3.594826	0.003
EXR	-0.1729	0.0511	-3.3785	0.007	GARCH(-1)	0.478	0.204	2.346	0.018
M3	0.5792	0.3263	1.7749	0.075	**0.531**				
GP	-0.3818	0.0536	-7.1171	0.000					
C	0.2027	0.1314	1.5428	0.122					

Source: Author's computation with E-Views 9.0

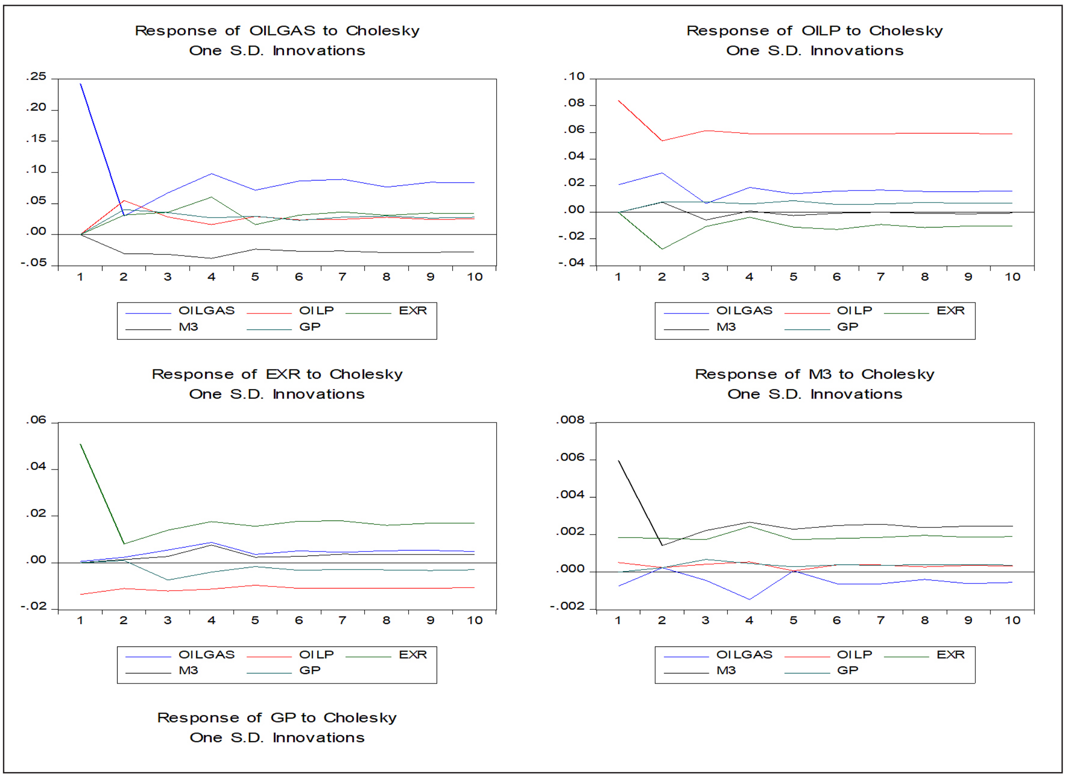
Now that heteroskedasticity is detected, the next step is to determine the GARCH estimates to investigate the role of the macroeconomic variables on the oil and gas stock returns while incorporating volatility. The commonly used GARCH (1,1) model estimating employing Generalised Error Distribution (GED). This estimation formation is favoured because Kosapattaarapim (2013) postulated that the best fitting model is GARCH (1,1) with GED.

The role of change in macroeconomic variables on the volatility of stock returns was analysed by estimating the GARCH-GED. Table 3 above reveals two panels; panel A presents the mean equation on the left side of the table and Panel B presents the variance equation of the model on the right side of the table, which measure the volatility effects of the macroeconomic variables. The mean equation revealed that change in Brent crude oil prices had a positive upshot on the sector returns, and statistically significant at 1%. These findings are in line and complement findings by Szczygielski and Chipeta (2015). This means that the sector stock returns are expected to react positively to an increase in Brent crude oil prices. However, change in exchange rate had a negative upshot on the sector's stock returns, which is also statistically significant at 1%. Hsing (2014) tested and found similar results with effective nominal exchange rates. Consequently, a depreciation of the Rand/Dollar exchange rate has a dampening effect on the oil and gas sector stock returns. This holds because as the Rand value declines, it means the cost of purchasing a unit barrel increases, therefore, impacting on the profit margins of the companies in the oil and gas sector, *ceteris paribus*.

Change in broad Money supply has a positive effect on the sector stock returns, but only statistically significant at 10%. These findings are in line with Szczygielski & Chipeta (2015) and Hsing (2014) who also found a positive relation. Henceforth, an injection or increase in money supply has an added benefit in the said sector stock returns. Change in gold prices has a negative effect on the Oil and gas sector returns, significant at 1%. Since literature is lacking in the South African context; foreign studies do advocate for such findings. Moore (1990) found that gold prices and the stock markets had a negative correlation, that is, when gold prices were rising, the stock markets were declining in the New York Stock Market. Perhaps, the notion that gold plays a vital role as a safe haven is affirmed. As gold prices rise, investors view gold as an alternative instead of other markets like the oil and gas sector, affecting the sector undesirably.

The variance equation in panel B illustrates that, the ARCH and GARCH coefficients were found to be significant, with both estimates appearing as positive. This offers evidence of ARCH and GARCH effect on volatility of stock returns. Henceforth, this displays that there is volatility clustering in the oil and gas market. In all the significant macroeconomic variables volatilities associated with each do not last for long before it fades away as evidenced through the low values. The non-negative estimates of the ARCH is in line with Engle (1982) and Bollerslev's (1986), as observed in the table, a positive sing.

Figure 1: Response of Cholesky One S.D Innovation



Source: Author's computation with E-Views 9.0

4.3 The Response of Stock Returns to Shocks in Each Macroeconomic Variable

To examine the signs and persistence of the short-run response of the Oil and Gas stock returns to one standard error shocks in each of the macro-economic variables, impulse response functions was estimated as revealed by Figure 1. Attention is placed only on the first illustration of Figure 1, that is, response of oil and gas to one standard deviation in the macro-economic variables which illustrates effect of shock in Brent crude oil price, exchange rate, broad money supply and gold prices. There were visible shocks in the second month for oil price and the fourth month for exchange rate. This seem to suggest that oil prices shock effect on the stock returns is quite instant, while in the exchange rate there is some delay though still quite in the short-run. These are relevant and expected outcomes as Wakeford (2006) asserts that the most immediate, direct effect of an oil shock is a rise in the price levels of liquid fuels for transport and other uses, and in the costs of oil-based petrochemicals. The gold price shock effect seems to be quite stable from the first month till the last period. However, contrary to mean effect the shock effect is positive.

A shock effect in broad money supply has a negative and consistent response effect in the sector returns throughout the period of ten months. This suggests that though the effect is negative the shock doesn't trend in any undesirable way to be of concern.

4.4 Variance Decomposition Results

Table 4 on the following page presents the variance decomposition results which illustrates as to how much of the forecast error variance for any variable is explained by shocks to each descriptive variable. The focus is solely placed on the dependent variable, the Oil and Gas sector returns. The objective is to observe the effects of shocks to the regressed variable in the short and long-run. Short-run indicator is represented by the third period, while the long-run indicator in represented by the tenth period.

The results reflect a positive shock on oil and gas returns, OILP, EXR, M3 and GP. The shock in oil and gas returns causes 85.55% of the fluctuations in the sector returns, that is, Oil and gas's own shock. Furthermore, the shocks in OILP causes about 5.04% of the fluctuation in the sector returns; shocks in EXR causes about 3.02% fluctuations in the sector returns, and shocks in M3 and GP causes about 2.58% and

Table 4: Variance Decomposition

Variance of Decomposition	Period	S.E	OilGas	OilP	EXR	M3	GP
OilGas	1	0.242868	100.0000	0.000000	0.000000	0.000000	0.000000
	3	0.274280	85.55268	5.036931	3.019027	2.581164	3.810202
	10	0.387244	76.15645	5.376925	7.825196	5.207713	5.433720

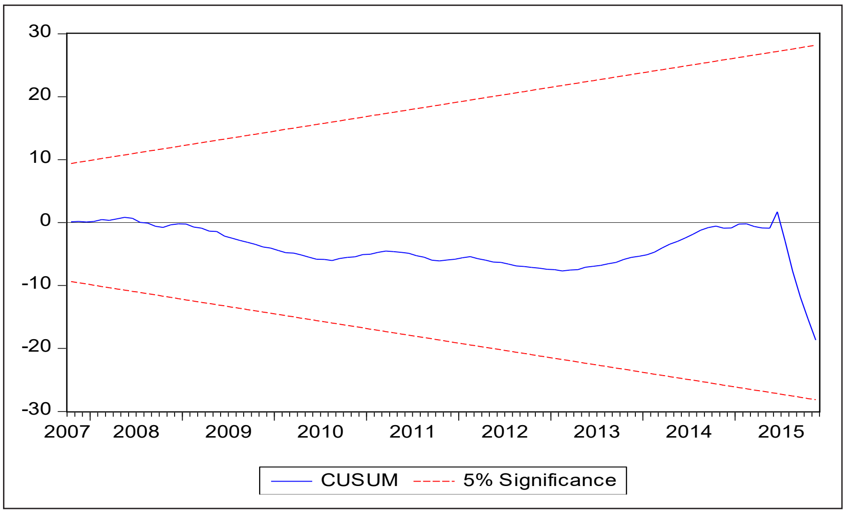
Source: Author's computation with E-Views 9.0

Table 5: Heteroscedasticity Test, ARCH

F-statistic	0.198968	Prob. F(1,100)	0.6565
Obs*R-squared	0.202544	Prob. Chi-Square(1)	0.6527

Source: Author's computation with E-Views 9.0

Figure 2: CUSUM Stability Test



Source: Author

3.81% fluctuations in the sector returns in the short-run (third month) respectively. In the long-run (tenth month) the shocks are still minimal, however, with EXR showing some improved shock effect. Oil and gas shock and effect on itself causes a 76.16% fluctuations, while EXR causes a 7.83% fluctuations in the sector returns. OilP, M3 and GP shock effect trends is similar, hovering around the mean of 5% at 5.38%, 5.28% and 5.43% fluctuations respectively in the long-run.

4.5 Diagnostic Tests and Stability Results

After running the GARCH estimation, a post estimation diagnostic test is required to assess whether the heteroskedasticity problem is corrected. Table 5 shows the ARCH-LM test after the heteroscedasticity was run through the GARCH residual process.

The presence of heteroscedasticity is rejected through the ARCH test as revealed in Table 5. The probability of the 0.6565 greater 0.5 rejects the null hypothesis of heteroscedasticity. This test further justifies the reliability of the GARCH model, which then gives impetus to the results as significant and reliable. This test is also formulated on the same principle and similar formulas as the white test and the Bruesch Pagan test (Brooks, 2002).

Furthermore, in Figure 2 the CUSUM test output reports satisfying results, in that, the blue CUSUM line fluctuates inside the two red critical lines which is a condition for stability. Henceforth, the oil and gas stock returns model is stable and reliable, therefore these results could be trusted.

5. Conclusion and Recommendations

The study investigated the role of macroeconomic variables movements on the JSE's oil and gas stock return volatility for the period 2007 to 2015. Monthly time series data was used and GARCH, impulse response and variance decomposition techniques were employed for analysis. Incorporating volatility, it was found that Brent crude oil prices and broad money supply had a positive and significant effect on Oil and Gas sector stock return, at 1% and 10% respectively. Oil prices and broad money supply have the power to cause an effect in sector stock returns. Therefore, investors should be in the look-out for Brent crude oil price fall as this would yield a fall in stock returns, hence exposing investors to negative returns. While, exchange rates and gold price movements had a negative and significant effect on the sector stock returns, all at 1%. Gold prices increases poses as a risk exposure in that capital or funds may be shifted away from oil and gas stocks as gold is proven to be a safe haven asset. Depreciation of the Rand adds to the extent of the gravity to entice international investors to prefer gold commodity as opposed to the oil and gas stocks. As a recommendation, portfolio managers and interest players should keenly monitor gold prices to negate any losses due to gold positive performance.

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