External macroeconomic shocks and stock price behavior in Nigeria: Structural vector autoregressive approach

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ABSTRACT

This research work investigates the relationship between external macroeconomic shocks and stock price behavior in Nigeria. Variables such as exchange rate (EXR), US real interest rate (USRINTR) and world oil price (WOP) are adopted to capture external macroeconomic shocks while all share price index is used to proxy stock price. The research work uses Johansen cointegration and structural vector autoregressive model as the estimation method. Findings from the study confirm that no long-term co-movement exists between the stock price and the selected external shocks. Findings from the study equally show that both US real interest rate (USRINTR) and world oil price (WOP) are the major external shock predictors of the stock price in Nigeria.

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Introduction

Mobilization and effective management of domestic resources are crucial for the pursuit of self-sustaining development which are central to the attainment of economic growth and eradication of poverty in any country. Meanwhile, the effective and efficient mobilization and transformation of domestic resources into productive activities can only be achieved through a sound financial system that will provide the link between savings and investments (Alile, 1997). Financial system is the institution and operation that mobilize financial resources from surplus spending sectors and channel these resources to the deficit spending sectors for productive use (Barakat, Elgazzar and Hanafy, 2016).

In this regard, stock market is part of the financial system that mobilizes and provides long-term finances for sustainable development of a country. The stock market is a veritable tool through which government and firms can fund new and existing projects. Big and successful companies are most of the times lucky because they can finance their investments through their retained companies' profits, but this is quite difficult for the infant companies to achieve because of their fresh start-up. But with the help of sound and viable stock markets, infant companies could be able to mobilize funds for the purpose of their investment start-up. Stock markets provide a solid base upon which listed companies pool the much-needed long-term capital for their economically viable investment (Giri and Joshi, 2017).

However, the aggregate effect of sound and viable stock markets can effectively be felt on economic growth depending on how the stock markets respond to the external shocks. Chen, Roll and Ross (1986) posited that global financial shocks are easily transmitted to domestic financial markets because of the strong harmonization among national stock markets. External shocks arise when unexpected change in an external factor affects the domestic economic parameters. In this regard, countries that depend majorly on foreign markets are more vulnerable to external shocks. Nigeria as an emerging market is internationally integrated with the rest of

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the world, and it is therefore believed that its financial sector particularly the stock market will be strongly influenced by the external macroeconomic shocks.

The effect of 2007/2008 global financial instability which started in USA and later extended to African countries were majorly felt by the stock markets in Nigeria. For example, with the emergence of the financial crisis, the stock market indices in Nigeria declined by about 76% between 2010 and 2011 (World Bank, 2013). Prior to the emergence of the global financial crisis, the Nigerian stock prices had increased. Between 2002 and 2007, the Nigerian all share price index increased to ₦12.6 trillion in 2006 (World Bank, 2013). With this tremendous achievement, there was a great investment by domestic and foreign investors in the Nigerian stock markets. But with the outset of global financial meltdown, international investors started to pull out their capital from the stock market which eventually resulted to significant volatility and sharp decline in stock prices in the Nigerian stock market (Kolapo, Oke and Olaniyan, 2015).

A very large number of studies have examined the relationship between macroeconomic shocks and stock market performance in Nigeria. However, most of these past studies have not been conclusive enough about the relationship between the two concepts. This is as a result of the fact that most of the past studies in Nigeria concentrated on the impacts of domestic macroeconomic shocks on stock market without taking into a cognizance the effect of growing stock market integration. This research work therefore contributes to the existing literature by incorporating external macroeconomic variables into the structural vector autoregressive model (SVAR) so as to genuinely investigate the behaviors of stock price in Nigeria.

The other sections of the paper are organized as follows; section two explains a brief review of empirical literature, section three discusses the research method while section four captures the discussion of findings. Section five explains the conclusion and policy recommendation of the study.

Literature Review

Nijam, Ismail and Musthafa (2015) examined the effect of macroeconomic variables on stock market performance in Sri Lanka from 1980 to 2012. By using ordinary least square (OLS) method, the study confirmed that stock market index and macroeconomic variables have long-run relationship. Findings from the study also revealed that economic growth proxied by real GDP growth rate (RGDPgr), exchange rate and interest have significant impact on all share price index but balance of payment had insignificant impact on all share price index during the period under review.

Winful, Sarpong and Sarfo (2016). assessed the effect of macroeconomic variables on stock market performance in 41 emerging economies from 1996 to 2011. By adopting four econometric methods, which comprise of: ordinary least square (OLS) method, dynamic ordinary least square (DOLS), Newey-West and fully modified ordinary least squares (FMOLS) techniques, findings of the study revealed that exchange rate depreciation and decline in CPI have negative and significant impacts on stock market performance. The study equally confirmed that a rise in money supply had no positive effect on stock market performance.

Ouma and Muriu (2014) investigated the effect of macroeconomic variables on stock market performance in Kenya from 2003 to 2013. The study employed ordinary least square (OLS) estimation techniques while Arbitrage Pricing Theory (APT) and Capital Asset Pricing Model (CAPM) form their theoretical back-up. Findings from the study revealed that money supply and inflation have significant and positive impact on stock returns. The study also established that exchange rate has negative impact on stock returns and interest rate has no significant relationship with stock returns

Ndiovu, Faisal, Resatoglu and Tursoy (2018) investigated the relationship between macroeconomic variables and stock price in South Africa from 1981 to 2016. Findings from the study revealed that interest rate, money supply and inflation have positive effect on stock prices. The study also showed that exchange rate has negative and significant impact on stock prices during the period under review. In another dimension, Kirui, Wawire and Nono (2014) employed the Engle-Granger two-step method and Threshold Generalized Autoregressive conditional Heteroskedasticity (TGARCH) model to examine the impact of macroeconomic variables on stock market returns in Kenya. Findings from the study revealed that exchange rate has significant relationship with stock returns. The study also showed that GDP, inflation and Treasury bill rates have insignificant relationship with stock market returns.

Ayunku and Etale (2015) employed the secondary data sourced from CBN statistical bulletin from 1977 to 2010 to investigate the determinants of stock market development in Nigeria. Findings from the study showed that market capitalization, credit to private sector and exchange rate are the predictors of stock market development. The study equally showed that inflation and saving rate have negative impact on stock market development in Nigeria.

Omodero and Manga (2019) employed the Ordinary Least Square (OLS) method to investigate the impact of macroeconomic variables on stock market returns in Nigeria. Findings from the study showed that swapping scale and financing cost have no significant impact on the stock market returns while the swelling rate has negative and significant impact on the stock returns. Results from the study also revealed that GDP has significant and positive impact on the stock market returns. Also, Kolapo, Oke and Olaniyan (2018) made use of Autoregressive Distributed Lag (ARDL) model to examine the effect of macroeconomic variables on stock market performance in Nigeria from 1986 to 2015. Findings from the study revealed that GDP and money supply have significant impacts on stock market performance in Nigeria. Findings from the study equally confirmed that there is a long-run relationship between macroeconomic variables and stock market performance in Nigeria.

Ejem, Ogbonna and Ogbulu (2020) investigated the dynamic relationship between stock market returns and macroeconomic variables in Nigeria. By employing Autoregressive Distributed Lag (ARDL) model, findings from the study revealed that GDP and interest rate have positive and significant relationship with the stock market returns, while inflation has negative and significant impacts on the stock market returns. Results from the study also showed that exchange rate has significant relationship with the stock market returns.

Gates (2020) employed ex-post factor research design and Autoregressive Distributed Lag (ARDL) estimation techniques to examine the impacts of unstable macroeconomic indicators on stock price in Nigeria from 2009 to 2018. Finding from the study revealed that foreign reserves have significant and negative impacts on stock price behavior. Results from the study equally showed that interest rate has significant and negative impacts on stock price behavior, while inflation rate has positive and significant impacts on stock price in Nigeria.

Research And Methodology

Theoretical Framework

The concept of the relationship between the external macroeconomic shock price behavior takes its theoretical back-up from the Arbitrage Pricing Theory (APT). Arbitrage Pricing Theory (APT) is the multifarious asset valuing model which is used to evaluate asset prices. This model was first propounded by Ross (1976), but thereafter revised by (Azeez and Yonoezawa, 2003). The Arbitrage Pricing Theory is presented as follows:

$$R_{it} = \beta_i + \theta_{ij}F_j + \dots \dots \dots \theta_{ik}F_k + \mu_{it}$$

Where:

R_{it} is the return on asset

β_i is the expected return

θ_{ij} is the responsiveness of the return on asset to the variation in parameter loading

F_j are the macroeconomic factors

μ_{it} is the error term

The above model therefore indicates that the gains on asset are controlled by the parameter responsiveness which could be positive or negative. However, one of the shortcomings of APT as noticed by Elton, Gruber and Brown (2003) is that the model failed to identify the specific factors that control asset returns. It is on this note that Azeez and Yonoezawa (2003) now modified the APT model by providing a two-step test. The first step presents the use of time series to identify a set of variables loading for the asset. The second step is the simple regression analysis to present the parameter loading in a cross-section regression. However, the modified version of APT model proposed by Azeez and Yonoezawa (2003) equally failed to incorporate global factors as they only focused on the domestic macroeconomic variables. In this regard, this research work therefore modifies this model by incorporating the external macroeconomic variables.

Model Specification

Based on the theoretical proposition of Arbitrage Pricing Theory (APT) which was first initiated by Ross (1976) but thereafter revised and modified by Azeez and Yonoezawa (2003); therefore, with the modification of incorporating external macroeconomic variables, the model for this study is hereby specified as follows:

$$SP_t = \alpha_0 + \alpha_1 EXR_t + \alpha_2 WRGDPgr_t + \alpha_3 USRINTR_t + \alpha_4 WOP_t + \mu_t$$

Where:

SP is the Stock Price

EXR is the Exchange Rate

WRGDPgr is the World Real Gross Domestic Product growth rate

WOP is the World Oil Price

μ_t is the error term

Model Build-up for Structural Vector Autoregressive

This research work adopts a five-variable SVAR model. The model is the same with the one employed by Li, Iscan and Xu (2010), Raghvan, Silvapulle and Athanasopoulos (2012) and Pirovano (2012). The model present Nigeria as an economy that constitute a structural-form equation as follows:

$$G(L)Y_t = W_t$$

Where:

$G(L)$ is the $n \times n$ and $n \times k$ matrix polynomial of the lag operator respectively.

Y_t is an $n \times 1$ vector of exogenous global factors

W_t is an $n \times 1$ vector of error term

The analysis of structural factors in this model calls for application of some restrictions on the elements of matrix A. Identification of $n \left[\frac{(n-1)}{2} \right]$ is needed to apply the necessary restrictions following the previous research works and economic theories.

Non-recursive Techniques of Model Identification

The application of restrictions on the elements of matrix in this study follows the style of Li *et al* (2010), Raghvan *et al* (2012) and Pirovano (2012). In the model, the exogenous vector $\{X_t: WOP, WRGDPgr, USRINTR\}$ is tagged the foreign block while the endogenous vector $\{Y_t: SP, EXR\}$ is presented as the domestic block which contains $\{SP\}$ as the target variable and $\{EXR\}$ as domestic policy variable. The equation based on the contemporaneous restriction is therefore presented as follows:

$$\begin{bmatrix} \mu WRGDPgr \\ \mu USRINTR \\ \mu WOP \\ \mu EXR \\ \mu SP \end{bmatrix} = \begin{bmatrix} 1 & 0 & \beta_{13} & 0 & 0 \\ \beta_{21} & 1 & \beta_{23} & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ \beta_{41} & \beta_{42} & \beta_{43} & 1 & \beta_{45} \\ \beta_{51} & \beta_{52} & \beta_{53} & \beta_{54} & 1 \end{bmatrix} \begin{bmatrix} \varepsilon WRGDPgr \\ \varepsilon USRINTR \\ \varepsilon WOP \\ \varepsilon EXR \\ \varepsilon SP \end{bmatrix}$$

Where $\mu WRGDPgr, \mu USRINTR, \mu WOP, \mu EXR, \mu SP$ are the error term for the endogenous variables and $\varepsilon WRGDPgr, \varepsilon USRINTR, \varepsilon WOP, \varepsilon EXR, \varepsilon SP$ are residuals that present the unexpected changes of each variable respectively.

The variables in the first 3 rows in equation 4 comprise of $WRGDPgr, USRINTR$ and WOP which represent the global macroeconomic variables. In agreement with the work of Li *et al* (2010), domestic macroeconomic shocks do not influence the global shocks, but the domestic macroeconomic variables are believed to be controlled by the global shocks. The model gives room for the EXR in the 4th row to be controlled by all variables, Raghvan *et al* (2012) posited that exchange rate is a monetary variable which respond swiftly to all information. The last row presents stock price as the target variable. Stock price is allowed to be driven by all variables. Pirovano (2012) reported that stock price is a dynamic variable that reacts to new information quickly in the market.

Sources of Data

This study employs quarterly secondary data that spans the period between 1990Q1 and 2019Q4. Data on $WRGDPgr, USRINTR$ and WOP which capture the external macroeconomic shocks are sourced from International Monetary Fund (IMF) world economic outlook statistical bulletin. Data on stock price and exchange rate which represent the domestic variables are sourced from Central Bank of Nigeria (CBN) statistical bulletin.

Results and Discussions

Unit Root Test Results

This section of the study presents the individual nature of the variables by examining the stationarity of the parameters which is also called unit root test. In this study, Philip-Peron unit root test is employed to determine the order of integration and thus presented in the table below:

Table 1: Philip-Peron Unit Root Test

Variables	Test-statistics	Probability value	Integration order
SP	-6.3435	0.0000***	I(1)
EXR	-4.2147	0.0031***	I(1)
USRINTR	-5.8401	0.0014***	I(1)
WRGDPgr	-6.3135	0.0000***	I(1)
WOP	-4.6748	0.0015***	I(1)

(***) indicates 1% significance level

Source: Author's Computation

The results of the P-Peron unit root test above showed that all the variables are not stationary at levels but they are stationary after their first difference. This indicates that all the series are integration of order one, that is, I(1).

Johansen Cointegration Test

Based on the Philip-Peron unit root test which revealed that all series attained their stationarity after the first difference; in this regard, it is necessary to determine the long-run relationship among the parameters. This is quite necessary so as to establish the fitness in the adoption of Vector Autoregressive (VAR) or Vector Error Correction Mechanism (VECM). According to Sim (1980), VECM is correctly adopted and used when long-run relationship exists among the series, while VAR is appropriately used when long-term co-movement is not ascertained among the variables.

Table 2: Results of Johansen Cointegration Test

Max. Rank	Eigen-value	Trace statistics	5% critical value
0	0.652114	154.2398	158.1106
1	0.613216	141.0485	151.3462
2	0.527842	125.6613	128.4759
3	0.403412	99.2611	101.2019
4	0.396521	72.5103	84.5432
5	0.265337	42.4675	50.1498

Source: Author's Computation

The cointegration test results above revealed that the null hypothesis of no cointegration is accepted. This is because of the trace statistics value that are less than the critical value at 5% significance level. The implication of this result is that there is no cointegrating relationship among all the series in the study.

Results of the Structural Vector Autoregressive Impulse Response Function and Variance Decomposition

Based on the fact that the long-term co-movement cannot be determined in the result of Johansen cointegration test among the series in this study; in this regard, the adoption of structural vector autoregressive estimation techniques is therefore appropriate to be used in the study (Sim, 1980).

Figure 1: Response of Stock Price to External Macroeconomic Shocks

Table 3: Variance Decomposition of Stock Price with respect to Selected Macroeconomic Shocks

PERIOD	S.E	WRGDPgr	USRINTR	WOP	EXR
3	2.621142	0.014326	0.731426	0.814110	0.024376
6	2.934125	0.024621	0.423141	0.532163	0.025314
9	3.104963	0.026367	0.234679	0.346174	0.036710
12	3.617816	0.031432	0.142623	0.232172	0.051432

Source: Author's Computation

Figure 1 depicted the impulse responses of stock price to selected external shocks in Nigeria. Also, in order to have a robust clarification of the contributions of external shocks to the behavior of stock price in Nigeria, the results of variance decomposition were equally shown in table 3. Results from the SVAR impulse response function confirmed that a standard deviation innovation from both US real interest rate (USRINTR) and world oil price (WOP) inflicted negative and significant impacts on Nigerian stock price. These results of impulse response function are also in agreement with the results of variance decomposition in table 3. This is quite obvious as the shocks from both USRINTR and WOP accounted for about 73% and 81% deviation in stock price in the 3rd quarter respectively; but the explanation power decreased strongly to about 14% and 23% respectively in the twelve quarter. However, the results of SVAR impulse response function are quite different in the case of world real GDP growth rate (WRGDPgr) and exchange rate (EXR) as the responses of stock price (SP) to a standard deviation shock from WRGDPgr and EXR are though positive, but the positive impacts are not significant during the period under review. Results from the variance decomposition also justified this as the shocks from both WRGDPgr and EXR explained about 1% and 2% variation in stock price in the third quarter respectively; but the proportionate innovative power increased sluggishly to about 3% and 5% respectively in the 12th quarter.

Discussion of Findings

In an attempt to guide against false regression in this research work, Philip-Peron unit root test was conducted. Findings from the test results showed that all variables attained their stationarity after the first difference which means that any crisis to the variables will die out over time. Results from the Johansen cointegration test revealed that there is no long-term relationship between the stock price and the selected external macroeconomic shocks. This lack of cointegrating relationship might be linked to the impact of behavioral finance on the relationship between external macroeconomic shocks and stock market which is quite rampant in the emerging markets particularly Nigeria. This finding equally corroborates the assertion of Frimpong (2011) who posited that psychological influence through investor's cognitive or emotional biases may impair investor's decisions on stock returns thereby leading to lack of long-run correlation between external macroeconomic factors and stock price

Finding from the result of SVAR impulse response function and variance decomposition showed that the response of stock price to a standard variation in US real interest rate (USRINTR) is negative and significant. The reason for this finding might be hinged on the strong countercheck of the United State Federal Reserve Bank to combat the aftermath distraint of the global financial/economic crisis in 2007. This step taken by the Federal Reserve Bank through their introduction of unconventional monetary policy really crippled most of the financial assets in the emerging markets particularly in Nigeria (Mthuli and Daniel, 2013). Of utmost importance is also the finding from the results of SVAR impulse response function and variance decomposition which revealed that the response of stock price to a standard innovation shock in world oil price (WOP) is negative and significant. The reason behind this finding might be due to the decline in the international oil price, resulting from the global financial/economic meltdown in 2007, which greatly affect the financial asset markets of the African oil producing countries including Nigeria, with its ripple effects still being felt up till date (Bjornland, 2019).

Conclusion

Resulting from the findings in this study, this research work therefore concludes thus: First, there existed no long-run relationship between the stock price and the selected external macroeconomic shocks in Nigeria during the period under review. Second, USRINTR and WOP are the two major external shock predictors of stock price in Nigeria during the period under review.

In view of the aforementioned conclusion, the following recommendations are therefore proffered so as to aid appropriate policy formulation for the growth of stock market in Nigeria. A strong sensitivity of stock price to the US real interest rate (USRINTR) is a perfect signal to the government, policy analysts and investors in Nigeria that US monetary policy shocks should be monitored. In this regard, Nigerian government should try and tighten its fiscal policy in the face of rising capital inflows caused by unwanted unconventional monetary policy any time it shows up. Moreover, a high response of stock price to world oil price (WOP) is a clear indication that the policy analysts, investors and government in Nigeria should take a close watch on oil price as a relevant determinant of stock market. Nigerian government should take the advantage of declining oil price and embark on total and genuine removal of oil subsidies. Fiscal resources generated from fuel subsidies removal could therefore be channeled towards the development of stock market in Nigeria.

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