

# Exchange Rate Volatility and Stock Market Performance in Nigeria

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## **Abstract:**

**T**he study examined the impact of exchange rate on stock market performance using monthly data of MCAP as indicators for stock market performance and monthly data on exchange rate as the parameter for measuring exchange rate volatility. Four different estimation techniques [Autoregressive Conditional Heteroscedasticity (ARCH), Generalised Autoregressive Conditional Heteroscedasticity (GARCH), Exponential Generalised Autoregressive Conditional Heteroscedasticity (E-GARCH) and Threshold Autoregressive Conditional Heteroscedasticity (TARCH)] were used. The results revealed that exchange rate has a positive relationship with market capitalization rate in Nigeria in all the four models examined in the study. However, the study showed that the volatility of variance of the residual among the four models differs from each other. It was discovered that there is no ARCH effect in the ARCH model, while there is ARCH and GARCH effect in the GARCH model. The study recommended that government should enforce policy to discourage importation of non-essential, less-productive goods and services and also create the enabling and favourable environment to encourage production and exportation of goods and services.

**Keywords:** stock price, foreign exchange rate, Ganger causality test, volatility, market capitalization

**JEL Classification Codes:** C1, C2, G1, G12

## Introduction

The Nigerian stock market has advanced over time vis-à-vis the number of stock exchanges and other financial intermediaries, the number of listed stocks, trading volumes, market capitalization, investor population, turnover of stock exchanges and stock price indices. Developments in the stock market serves as a major indicator for growth and development for any nation. Stock market is one of the yardsticks for measuring the growth and development of an economy due to the fact that it reflects the potential viability and financial strength of corporate organizations listed on the stock exchange.

The stock market portrays the level of confidence of investors on various sectors in the economy. It is a reflection of the productive sector's strength and indicates expectations about the stability of the financial system. Persistent increases in the stock indices would encourage banks to increase loans and advances, both for direct investment in the stock market and other sectors of the economy. Foreign investors benefit from higher returns on investment at the stock market. There is direct inflow of foreign portfolio investment into the economy, which will boost the capital base of banks and induce further increase in lending thereby leading to growth and development of the economy.

The rate of exchange is one of the most important macroeconomic variables in developing and developed countries. It affects inflation, and causes changes in exports and imports thereby influencing price of commodities traded. Adjasi, Harvey and Agyapong (2008) suggested that fluctuations in the foreign exchange market of a country impact its trade and investment. For instance, a stable rate of exchange would positively affect decisions affecting household consumption and incomes, firms' investment, employment and import, as well as government's debt and fiscal, monetary policies and trade balance. Garba (1997) opined that exchange rate stability could discourage speculation in the foreign exchange market and reduce capital flight.

Furthermore, Yucel & Kurt (2003) showed that floating exchange rate decreases export markets competitiveness, and negatively affect the domestic stock market of export-dominated

economies; but positively affect the stock market of import-dominated country by lowering its costs of input. An import-oriented country like Nigeria usually experience instability in prices in the presence of exchange rate volatility due largely to its economy which heavily depend on imports of capital and consumer goods as well as raw materials.

However, researchers hold different views on the possible relationship between exchange rate volatility and stock markets in that two notable schools of thought emerged from empirical studies: those who advocate that there exists an association between exchange rate and stock market (Dimintrova, 2005; Sohail & Hussain, 2009; Mohammad, Adnan, Hussain and Ali, 2009) and those who maintained that there exists no connection between exchange rate and stock market (Bhattacharya & Mukherjee, 2003; Stavarek, 2005, Gay, 2016). These divergent opinions clearly suggest that this topical issue of whether or not there is a nexus between exchange rate and stock market is not yet concluded.

The circumstances that led to the study arose because of the implication of volatility of exchange rate on the Nigerian stock market. Frequent changes in exchange rate adversely affect imports. Consequently, exchange rate fluctuations lead to increase in the value of imported items and ultimately increase the price of goods and services in the country. In addition, volatility of exchange rate discourages capital flight and positively influences export. Volatility of exchange rate is usually determined by differentials in inflation rate, interest rate, political instability, current account deficits, economic performance and external debts as this ultimately affects the number of investors in the stock market (Aliyu, 2009).

Many empirical studies use different estimation techniques including granger causality test, ARCH and GARCH models respectively. The outcomes differed remarkably and therefore, are inconclusive. Based on this shortcoming, this study contributes to the existing body of knowledge by adopting four different estimation techniques [Autoregressive Conditional Heteroscedasticity (ARCH), Generalised Autoregressive Conditional Heteroscedasticity (GARCH), Exponential Generalised Autoregressive Conditional Heteroscedasticity

(E-GARCH) and Threshold Autoregressive Conditional Heteroscedasticity (TARCH)] for measuring volatility and comparing them to investigate whether there are differences in their results and also choosing the best model that explains the volatility of market capitalization rate in Nigerian stock market. Granger causality test and Johansen Co-integration test was used to investigate whether there is relationship between stock market capitalization (MCAP) rate and exchange rate in Nigeria. It is against this background that the study examined the impact of exchange rate on stock market performance using monthly data of MCAP as indicators for stock market performance and monthly data on exchange rate as the parameter for measuring exchange rate volatility.

The rest of this article is organised into four sections. Section two discusses the concepts of exchange rate, stock market and various empirical evidences related to the study. Section three provides the exposition of theoretical framework, conceptual framework, model specifications, estimation techniques and sources of data. Section four includes analysis of data and discussion of results while section five summarises the paper with some concluding remarks.

### Literature Review

Exchange rate is generally defined as the price for which the currency of a country is exchanged with the currency of another country. In the light of this definition, two components of exchange rate are identified: the domestic currency and a foreign currency (Mohammad, Adnan, Hussain and Ali 2009; Zubair, 2013)). Factors influencing exchange rate include inflation rates, interest rates, trade balance, internal harmony, political stability, high degree of transparency in the conduct of leaders and administrators, general state of the economy and quality of governance (Mbat, 2001).

**According to Aliyu (2009), determinants of exchange rate include differentials in inflation rate, differentials in interest rate, current account deficits, public debts, terms of trade, political stability and economic performance.** It is not gainsaying to assert that a country exhibits a rising currency value with a consistently low inflation rate, as the purchasing power rises relative to other currencies. Also, differentials in inflation rate are usually accompanied with higher interest rates.

**Frequent changes in interest rate are also a major determinant of volatility of exchange rate, as** foreign capital is induced by higher interest rates, which also cause the exchange rate to increase (Aliyu, 2009). Furthermore, a large debt causes increase in inflation rate and with high inflation, debt is serviced and ultimately paid off in the future with cheaper real foreign currency. **Besides,** a country's terms of trade would be favourably improved if export prices rise by a greater rate than that of its imports. As a country's terms of trade increases, there will be greater demand for its exports, which, in turn, leads to revenue increase from exports and ultimately induces greater demand for the country's currency (indicating an increase in its currency value). Political instability and **economic performance also greatly influence exchange rate volatility,** as stable countries with strong economic performance will inevitably attract foreign investors as a safe haven to invest their capital. For example, political turmoil is capable of engendering crisis of confidence in a currency and induce capital movement to the currencies of more stable countries.

Furthermore, **current account deficits** also influence changes in exchange rate. The current account is the trade balance between a country and other countries it engages with in international trade, showing all payments for

goods, services, interests and dividends between the countries. A current account deficit is an indication that a country's expenditure on foreign trade is more than it earns from it, and that to make up the deficit, it has to borrow capital from foreign sources. In that situation, the foreign currency requirement of the country far exceeds what it obtains through exports sales, and the demand for its products by foreigners is far less than its supply of its own currency. The resultant excess demand for foreign currency drops the exchange rate of the country until prices of domestic goods and services becomes cheaper for foreigners, and imported goods become too expensive to generate sales for domestic interests.

The capital market comprises of all financial institutions put in place for dealings in medium and long-term loanable funds (Ekezie, 2002). It can also be described as a financial market for both corporate and government financial instruments, and for the mobilization and utilization of long-term funds for development (Osinubi, 2006). According to Akingunola, Adekunle and Ojodu (2012), liquidity is provided by the stock market mainly by enabling deficit economic units (firms) to raise required funds through sales of securities with relative ease and speed. That is, the stock market is an avenue for raising long-term funds from the surplus economic units through the intermediation process to the deficit economic units (Mbat, 2001). Hence, the stock market can influence investment and economic growth in general through this catalyst role. It can further be described as a loose network of economic transactions, a kind of public market but not a discrete entity or physical facility, for trading in company stocks and derivatives at a negotiated price. These include financial instruments quoted on a stock exchange and those that are privately traded.

Basically, the stock exchange market is a market for the sale and purchase of shares, stocks, government bonds, debentures and other approved securities through the members of the exchange. It therefore provides the essential facilities for companies and government to raise money for business expansion, and finance development projects through investors who own shares in companies for the ultimate benefit

of the overall society. The stock market is one of utmost importance as means through which companies raise needed money. This allows businesses to be publicly traded, or raise additional capital for expansion by selling shares of ownership of the company in a public market (Mishkin, 2000). According to Subair (2009), stock market can be measured by market capitalization (MCAP). **Lawal & Ijirshar (2013) further explained that market capitalization is also another major measurement of stock market performance.** Market capitalization (also known as market value) is the share price times the number of shares outstanding. **However,** Zubair (2013) asserted that at all share index (ASI) can also be used to measure stock market performance.

### Empirical Review

Adjasi, Harvey and Agyapong (2008) observed the relationship between stock market and foreign exchange market in a study that examined the impact of exchange rates movements on Ghana's stock market. The nexus between exchange rate volatility and stock market volatility was established using the exponential generalised autoregressive conditional heteroskedasticity (E-GARCH) model. The result revealed that there was negative relationship between exchange rate volatility and stock market returns.

*Bhat & Shah (2015) examined the link between exchange rate fluctuations and volatility of stock returns in Pakistan. Estimation parameters such as ARCH, GARH models, Unit root test, Johanssen Co-integration test and Granger causality test were used in the study. The volatility was tested using ARCH, GARCH, E-GARCH and T-GARCH. Unit root test revealed that both series are stationary at level. Co-integration test reveals that both variables are co-integrated to each other. Ganger causality test also show bi-directional causal relationship between the two variables.* Adjasi & Biekpe (2005) examined the connection between exchange rate movements and stock market returns in seven African countries. The co-integration tests showed that in some of the countries in the short-run, exchange rate depreciation led to decreases in stock market prices and in the long-run, exchange rate depreciations led to increases in stock market

returns. Also, a Granger causality tests revealed that the exchange rate movement Granger-caused stock market returns in some of the countries, while stock market returns Granger-caused exchange rate movement in others.

Using the Johansen co-integration tests, Olugbenga (2012) considered the effects of exchange rate on stock market development in Nigeria both in the long-run and short-run from 1985 to 2009. The specified bi-variate model and subsequent empirical results revealed a positive and significant short-run stock market performance to exchange rate but a negative and significant long-run stock market performance to exchange rate. In addition, the results of the Granger causality test strongly suggest that the causation runs from exchange rate to stock market performance; implying that exchange rate volatility effectively explained variations in the Nigerian stock market. Subair & Salihu (2013) used error-correction model (ECM) to examine the impact of exchange rate volatility on the Nigerian stock market. The study generated exchange rate volatility via GARCH process and found that it exerts a strong negative effect on the Nigeria stock markets. However, it was discovered that inflation rate and interest rate respectively failed to show any long-run relationship with stock market capitalization largely due to the fact that government was the major participant in the market. Mlambo, Maredza and Sibanda (2013) evaluated the impact of currency volatility on the Johannesburg Stock Exchange. The study specified an empirical model involving the use of generalised autoregressive conditional heteroskedasticity (GARCH) model to establish the connection between exchange rate volatility and stock market behaviour, using monthly South African data from 2000 to 2010. The result of the study suggested a weak connection between currency volatility and the stock market.

### Theoretical Framework

There are various theories explaining the nexus between exchange rate volatility and stock market behaviour. Such theories include flow and stock models. By definition, flow models describe the effect of exchange rate volatility on the firm's international competitiveness as well as the balance of trade position (Choi, Fang and Fu, 2009). Movements in prices of shares in the

stock market directly affect aggregate demand via wealth and liquidity effects, which indirectly cause changes in rate of exchange. For instance, a drop in the prices of stocks decreases local investors' wealth and decreases liquidity in the economy. The liquidity reduction further decreases rates of interest, which in turn, induces outflow of capital and eventually causes the currency to depreciate.

On the other hand, stock models are models that concentrate on the capital account of balance of payment. In this model, the exchange rate equates demand and supply for financial assets (stocks and bonds). Therefore, price movements of financially held assets is significantly affected by expectations of relative currency movements. With this, exchange rate movements may influence stock price movements. For example, if the Nigerian currency depreciates against the currency of a trading partner (say, the US dollar), returns on the latter's currency will increase. Such development will encourage investors to transfer funds from domestic financial assets in favour of dollar denominated assets which consequently will reduce prices of local stocks. This, in turn, makes the depreciating local currency to negatively affect stock market returns (Adjasi & Biekpe, 2005).

### Model Specification

The model used for the study is adapted in line with the study of Olugbenga (2012). Based on the monthly data available in the Nigerian stock market, the study captures MCAP as dependent variable and exchange rate as the independent variable. Thus, the model used for the study is specified as:

$$MCAP = f(EXR) \quad \dots(1)$$

$$MCAP = \beta_0 + \beta_1 EXR + \mu \quad \dots(2)$$

where:

MCAP = Market capitalization

EXR = Exchange rate

$\mu$  = Error term

### Variance Equation

$$GARCH = C(3) + C(4)*RESID(-1)^2 + C(5) * GARCH(-1) \quad \dots(3)$$

where:

GARCH = Variance of the Residual

C(3) = Constant of the Residual

C(4)\*RESID(-1)^2 = Arch effect of the Residual

C(5)\*GARCH(-1) = Garch effect of the Residual

The data employed for the study are secondary in nature covering the period from 1986 to 2014. The

estimation techniques employed in the study are descriptive statistics, unit root test, residual test, ARCH test, ARCH, GARCH, E-GARCH, T-GARCH, Granger Causality test and Johansen Co-integration test

**Result and Discussion**

**Table 1: Descriptive Statistics**

	MCAP	EXR
Mean	2761.235	79.40648
Median	377.7813	101.8266
Maximum	14027.71	169.6800
Minimum	5.8248	0.999600
Std. Dev	3949.048	61.09231
Jarque-Bera Prob	0.0000	0.0000

Source: Author’s Computation, (2016)

The table above shows that the mean for MCAP is 2761.235, median is 377.7813, maximum value is 14027.71, minimum value is 5.8248, and the standard deviation value from mean is 3949.048, while the Jarque-Bera probability value is 0.0000. The table also revealed that the mean for EXR is 79.40648, median is 101.8266, maximum value is 169.68, minimum value is 0.999, and the standard deviation value from mean is 61.092, while the Jarque-Bera statistic shows that all return series are not normally distributed.

**Unit Root Test: Dickey Fuller Test**

**Table 2: Market Capitalization Rate**

	t-Statistics	Critical Value 1%	Critical Value 5%	Critical Value 10%	Prob Value
MCAP at Level	-0.3588	-3.4492	-2.8697	-2.5712	0.9137
MCAP at first Difference	-7.8762	-3.4492	-2.8697	-2.5712	0.0000

Source: Author’s Computation, (2016)

The table above shows that MCAP is not stationary at level, but stationary at first differencing at the probability value of 0.0000, which is less than 5% level of significance.

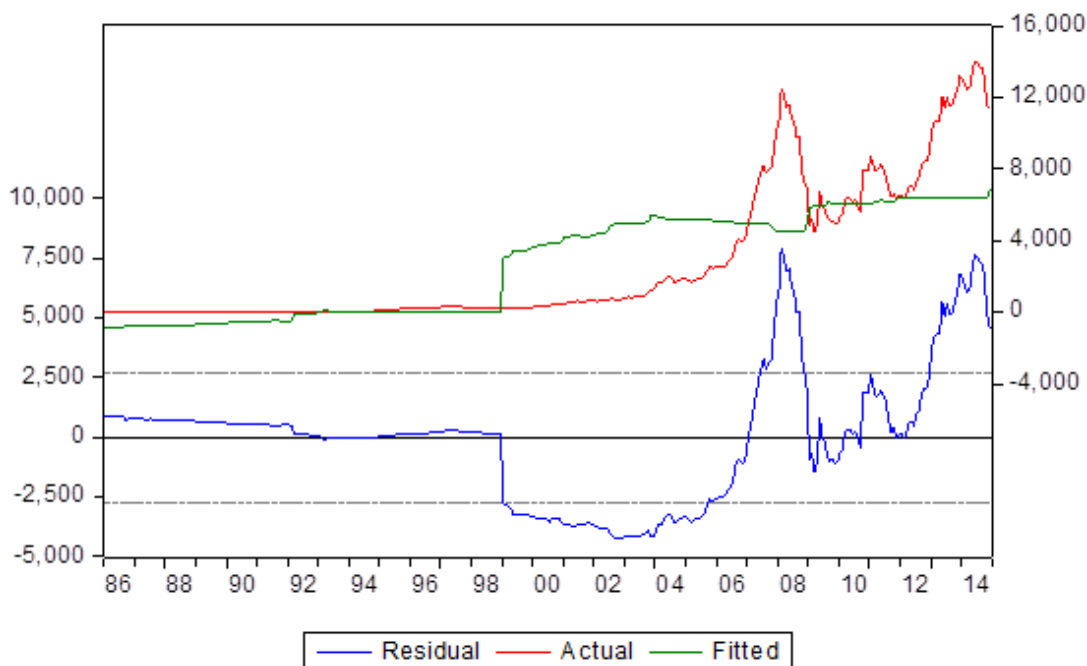
**Table 3: Exchange Rate**

	T-Statistics	Critical Value 1%	Critical Value 5%	Critical Value 10%	Prob Value
EXR at Level	-0.3496	-3.4492	-2.8697	-2.5712	0.9143
EXR at first Difference	-17.4819	-3.4492	-2.8697	-2.5712	0.0000

Source: Author’s Computation

The table above shows that EXR is not stationary at level, but stationary at first differencing with a probability value of 0.0000, which is less than 5% level of significance.

**Residual Test of Volatility**



The residual test above shows that period of low volatility tends to be followed by period of low volatility for a prolonged period. Again, period of high volatility tends to be followed by period of high volatility for a prolonged period. Thus, this suggests that residual or error term is conditionally heteroskedastic. Therefore, there is justification to examine the ARCH family model.

**Table 4: Heteroskedasticity Test: ARCH Model for MCAP**

F-Statistics	0.9666
Obs*R-squared	0.968
Prob	0.3263
Prob (Chi-Square)	0.3249

Source: Author's Computation

The probability chi-square for the heteroscedasticity test is 0.3263, which is greater than 5%. This implies that the null hypothesis which states that there is no ARCH effect in MCAP should not be rejected, while the alternative hypothesis which states that there is ARCH effect in the model should not be accepted.

**Table 5: Heteroskedasticity Test: ARCH Model for EXR**

F-Statistics	3.2577
Obs*R-squared	3.2459
Prob	0.0720
Prob (Chi-Square)	0.0716

Source: Author's Computation

The probability chi-square for the heteroscedasticity test is 0.0720, which is greater than 5%. This implies that the null hypothesis which states that there is no ARCH effect in MCAP should not be rejected, while the alternative hypothesis which states that there is ARCH effect in the model should not be accepted.

**ARCH Model: Mean Equation**

$$MCAP = -829.44 + 38.808EXR$$

Variables	Coefficient	Prob
Constant	-829.44	0.3407
Exchange rate	38.808	0.0000

Source: Author's Computation

The above ARCH mean equation table revealed that exchange rate is statistically significant at 1% in explaining the volatility of market capitalization rate in Nigerian stock market. The table also revealed that ₦1 increase in exchange rate will induce market capitalization rate to increase by ₦38.808k. This suggests that there is a positive association between exchange rate and market capitalization rate.

**ARCH Model: Variance Equation**

$$GARCH = C(3) + C(4) * RESID(-1)^2 + C(5) * RESID(-2)^2 + C(6) * RESID(-3)^2 + C(7) * RESID(-4)^2 + C(8) * RESID(-5)^2$$

Variables	Coefficient	Prob
C	582867	0.0000
RESID(-1)^2	0.210017	0.8365
RESID(-2)^2	-0.011466	0.9939
RESID(-3)^2	0.302703	0.8228
RESID(-4)^2	0.560134	0.4941
RESID(-5)^2	-0.523964	0.1318

Source: Author's Computation

The probability chi-square for the heteroscedasticity test is 0.3263, which is greater than 5%. This implies that the null hypothesis which states that there is no ARCH effect in MCAP should not be rejected, while the alternative hypothesis which states that there is ARCH effect in the model should not be accepted.

**Table 5: Heteroskedasticity Test: ARCH Model for EXR**

F-Statistics	3.2577
Obs*R-squared	3.2459
Prob	0.0720
Prob (Chi-Square)	0.0716

Source: Author's Computation

The table above revealed that the ARCH effect of this model is not significant in explaining the changes in the variance of the residual. This model therefore assumes that the variance of the current residual is not related to the size of the previous periods' residual. Thus, there is no ARCH effect in the model and this implies that exchange rate does not influence volatility of market capitalization rate in Nigerian stock market.

**GARCH: Mean Equation**

$$MCAP = -30.545 + 5.8191$$

Variables	Coefficient	Prob
Constant	-30.545	0.0000
Exchange rate	5.8191	0.0000

Source: Author's Computation

The above GARCH mean equation table revealed that exchange rate is statistically significant at 1% in explaining the volatility of market capitalization rate in Nigerian stock market. The table also revealed that ₦1 increase in exchange rate will induce market capitalization rate to increase by ₦5.8191k. This suggests that there is a positive association between exchange rate and market capitalization rate.

**GARCH Model: Variance Equation**

$$GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH(-1)$$

$$GARCH = 0.1770 + 1.0020RESID(-1)^2 + 0.2413GARCH(-1)$$

Variables	Coefficient	Prob
C	0.1770	0.2300
RESID(-1) <sup>2</sup>	1.0020	0.0000
GARCH(-1)	0.2413	0.0000

Source: Author's Computation

The table above revealed that the ARCH and GARCH effect of this model is significant in explaining the changes in the variance of the residual at 1%. This model therefore assumes that the variance of the current residual is related to the size of the previous periods' residual. Thus, there is ARCH and GARCH effect and this implies that exchange rate does influence volatility of market capitalization rate in Nigerian stock market.

**TARCH Model: Mean Equation**

$$MCAP = -446.099 + 2.5049$$

Variables	Coefficient	Prob
Constant	446.099	0.0000
Exchange rate	2.5049	0.0000

Source: Author's Computation

The above TARCH mean equation table revealed that exchange rate is statistically significant at 1% in explaining the volatility of market capitalization rate in Nigerian stock market. The table also revealed that ₦1 increase in exchange rate will induce market capitalization rate to increase by ₦2.5049k. Thus, by implication, there is a positive relationship between exchange rate and market capitalization rate.

**E-GARCH Model: Mean Equation**

$$MCAP = -148.86 + 21.787$$

Variables	Coefficient	Prob
Constant	-148.86	0.0000
Exchange rate	21.787	0.0000

Source: Author's Computation

The above E-GARCH mean equation table revealed that exchange rate is statistically significant at 1% in explaining the volatility of market capitalization rate in Nigerian stock market. The table also revealed that ₦1 increase in exchange rate will induce market capitalization rate to increase by ₦21.787k. This suggests that there is a positive association between exchange rate and market capitalization rate.



### Comparison of ARCH, GARCH, TARCH and E-GARCH Model for MCAP

	AIC	SIC
ARCH	18.544	18.632
GARCH	14.734	14.778
TARCH	18.409	18.464
E-GARCH	16.248	16.292

Source: Author's Computation

The table above shows that comparison between the ARCH, GARCH, TARCH and E-GARCH model with the aim of choosing the best model that explains the volatility of stock market capitalization rate in Nigeria using Akaike info criterion and Schwarz criterion. The decision rule is that, the model with the least value of AIC and SIC is the best model. Based on the criteria the best model that explains the volatility of stock market capitalization rate in Nigerian is the ARCH model. This is because, it has a least value of 18.544 for AIC and 18.632 for SIC.

### Comparison of ARCH, GARCH, TARCH and E-GARCH Model for EXR

	AIC	SIC
ARCH	12.075	12.152
GARCH	11.096	11.130
TARCH	11.095	11.140
E-GARCH	10.443	10.487

Source: Author's Computation

The table above shows that comparison between the ARCH, GARCH, TARCH and E-GARCH model with the aim of choosing the best model that explains the volatility of exchange rate in in

### Johansen Co-integration Test

Hypothesied No. of CE(s)	Eigen Value	Trace Statistics	0.05 Critical value	Prob
None	0.014330	4.987624	15.49471	0.8101
At most 1	0.000108	0.036929	3.841466	0.8476

Source: Author's Computation

The table above revealed that the Eigen value at (None) which is 0.014330 is lesser than the trace statistics value of 4.987624 and the probability value is also 0.8101. Thus, this implies that there is no co-integration between MCAP and EXR in Nigeria. Thus, there is no long run relation between MCAP and EXR in Nigeria.

### Granger Causality Test

Null Hypothesis	F-Statistics	Prob
EXR does not Granger cause MCAP	1.40991	0.2201
MCAP does not Granger cause EXR	1.20220	0.3078

Source: Author's Computation

Granger Causality test is used to check the casual relationship between the variables, whether there is casual relationship between two variables or not. The results of the test show that there is no causal relationship between the variables. The null hypotheses EXR does not granger cause MCAP and MCAP does not granger causes EXR are not rejected. It is concluded that there is no bidirectional causal relationship between MCAP and EXR.

### Discussion of Findings

The study revealed that exchange rate has a positive relationship with market capitalization rate in Nigeria in all the four models (ARCH, GARCH, TARCH and E-GARCH) examined in the study. However, the study revealed that the volatility of variance of the residual among the four models differs from each other. It was discovered that there is no ARCH effect in the ARCH model, while there is ARCH and GARCH effect in the GARCH model. The mean equation of the four models gives the same result, while there are differences in the result of the variance equation among the four models. The study further revealed that there is no bidirectional causal relationship between MCAP and EXR and also there

is no long-run relationship between MCAP and EXR. The study adopts ARCH model as the best model as it gives the least value of AIC and SIC. Thus, there is no ARCH effect in the volatility of market capitalization rate in the Nigerian stock exchange. The implication of this is that variance of the current residual is not related to the size of the previous periods' residual. Exchange rate does not influence volatility of market capitalization rate in Nigerian stock market. However, exchange rate (EXR) has a positive relationship with stock market capitalization rate in Nigeria. Findings of the study reveal that investors cannot use information of one market to predict something about the other. The study recommends that government should enact policy to discourage

importation of goods and services and also create the enabling and favourable environment to encourage production and exportation of goods and services.

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