CHAPTER 4

DATA ANALYSIS AND INTERPRETATION

4.1. Preamble

The results of the research are presented in this part based on the many analyses that were done. The analysis starts by providing a descriptive statistical analysis for the investigation of exchange rate volatility on the Nigerian stock market. The data used for this research are monthly statistics from 2004 through 2022, as mentioned in Chapter 3.

4.2. Data Presentation

Table 4.1: Descriptive Analysis of the Raw Data Before taking Log of Returns

	ASI	CBNX	BDCX	INF
Mean	32531.02	217.336	260.6021	12.53921
Standard Error	661.4453	6.587781	10.27845	0.28402
Median	29579.93	160.675	165.57	12
Standard Deviation	9987.605	99.47332	155.2012	4.288605
Sample Variance	99752250	9894.941	24087.4	18.39213
Kurtosis	0.319811	-0.77934	0.575456	0.680037
Skewness	0.9846	0.841437	1.179412	0.57462
Range	45800.49	329.18	673.66	25.2
Minimum	19851.89	116.79	118.7	3
Maximum	65652.38	445.97	792.36	28.2
Confidence Level(95.0%)	1303.358	12.98102	20.25337	0.559652

Source: Authors Computation Using Excel

Table 4.1 report the standard summary for the four variables employed in this study. The distributions of the data are positively skewed for all the variables. Comparing the data to their log returns in table 4.2, ASI and INF are negatively skewed while CBNX and BDCX are positively skewed. The mean log returns for INF is negative at -.021% per month, the mean log returns of LASI, CBNX and BDCX is also close to zero and it is at 0.35%, 0.52% and 0.7% respectively. The kurtosis which measures the peakness of the distribution of the variables, is fairly substantial in the log returns of CBNX and INF at 40.65 and 19.59 in table 4.2, compared to table 4.1 with a negative kurtosis for CBNX (-0.779). the kurtosis for other variables in table 4.2 stood at 4.438 and 4,318 for both ASI and BDCX respectively. The Kurtosis can be either leptokurtic if its value is higher than 3, mesocratic if equal to 3 and platykartic if its less than 3. A positive kurtosis indicates that the distribution has a heavier tail than the normal distribution while the negative kurtosis indicates a lighter tail distribution than the normal distribution. The kurtosis of the variables on table 4.1, displayed all variables as platykartic.

The monthly standard deviation of the log returns shows that INF (inflation in Nigeria) had the most volatile movement: 0.1297, while the least currency volatility was recorded in CBNX with a value of 0.0254. however, the data also shows that in the FX market, the BCDX seems to be the most active.

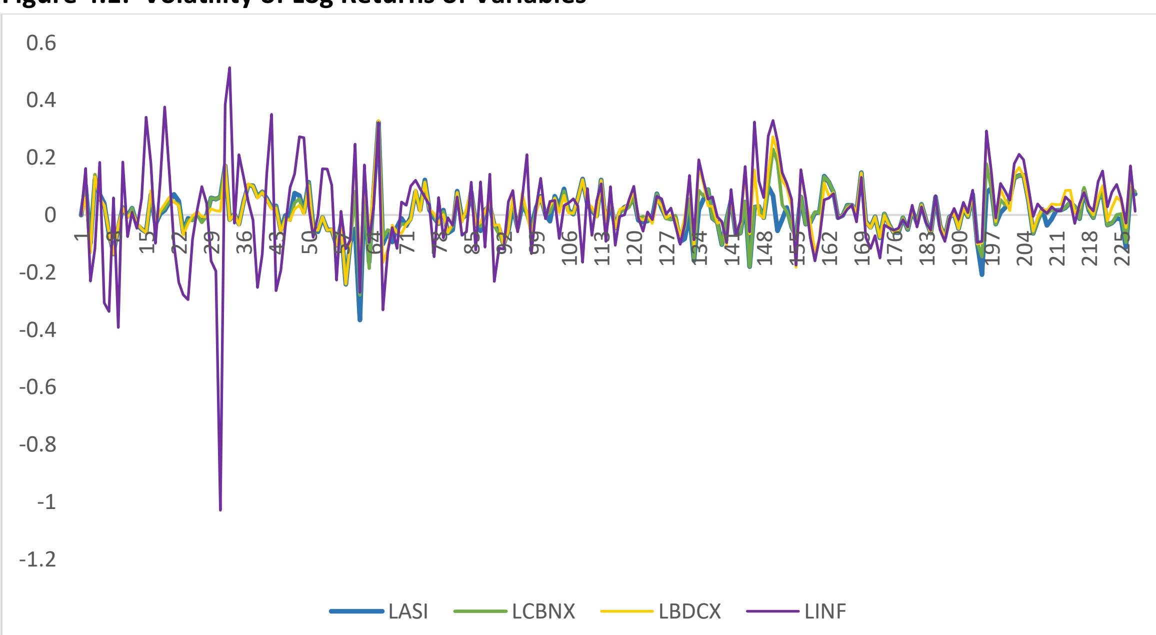
Table 4.2. Descriptive Analysis of Log Returns of Variables

	LASI	CBNX	BDCX	INF
Mean	0.003569	0.005152	0.007096	-0.00021
Standard Error	0.004764	0.001687	0.0023	0.008591
Median	0.000589	0	0.000887	0.006447
Standard Deviation	0.071934	0.025476	0.034732	0.129719
Sample Variance	0.005175	0.000649	0.001206	0.016827
Kurtosis	4.438391	40.65173	4.318068	19.58648
Skewness	-0.43146	5.587164	0.44299	-2.06669
Range	0.689399	0.273643	0.286127	1.573671
Minimum	-0.36588	-0.03383	-0.14138	-1.04145
Maximum	0.323516	0.239814	0.144751	0.532217

Source: Authors Computation Using Excel

Below is a chart that shows the movement of the log returns of the variables. This chart shows how volatile the returns of these variables are distributed over the period under review.

Figure 4.1: Volatility of Log Returns of Variables



Source: Authors computation using Excel

4.3. Data Analysis

Following the descriptive analysis above, we conduct a unit root test using the Augmented Dickey Fullers test to test for stationarity of the data set. After which we run a GARCH (1,1) process on the log returns of the dataset to find out the volatility level of the variables. A granger causality test is used to determine the causal relationships between the variables. Likewise, a co-integration test, and Vector Auto Regressive impulse function will be conducted to determine the response to shocks between variables.

4.3.1. Unit Root Test

In order to determine if the variables have stationary properties, a unit root test was carried out. The unit root test shows the order of integration of each of the variables. This is carried out in order to avoid spurious regressions on the models. The unit root test also shows if the variables exhibit a stochastic trend.

In figure 1 above, the volatility of log returns seemingly shows us that the data is stationary. Tables 4.3, shows the result of a regression analysis of the log returns of the variables, where LASI is the dependent variable (Y_t) and LCBNX, LBDCX, and LINF are the explanatory variables.

Table 4.3: Regression Statistics

Multiple R	0.188351604
R Square	0.035476327
Adjusted R Square	0.022558599
Standard Error	0.071118171
Observations	228

Source: Authors computation using Excel.

A Dublin Watson test was conducted to test for auto-correlation in the residuals of log returns in the regression model. The Dublin Watson(DW) statistic will always have a value ranging from 0 and 4. Between 0 and 2 indicates a positive autocorrelation, while values above 2 to 4 indicates a negative autocorrelation. A value of 2.0 shows that there is no autocorrelation detected in the variables. The result derived from the DW test is 1.8124 and since the DW statistic is greater than the R Square of the regression Statistic, we can conclude that the regression is not spurious and the dataset is stationary.

To confirm the above observation, the Augmented Dickey Fuller (ADF) was carried out to test for stationarity. The hypothesis of the Augmented Dickey Fuller t-test is

H_0: θ = 0 (data needs to be differenced to be stationary)

$H_{1:}$ θ < 0 (data is stationary and does not need to be differenced)

Where θ is the lag of the dependent variable. If p-value is less than or equal to 0.05 significance level, we will fail to reject the H_0 and conclude the time series data is not stationary and should be differenced. Where the p-value is higher than 0.05 significance level, we reject the H_0 and accept the alternative and conclude that the time series data is stationary and does not need to be differenced. The result of the test is reported below:

Table 4.4: Augments Dickey-Fuller Test

		LASI	LCBNX	LBDCX	LINF
ADF Statistics		-7.193008202	-7.19097901	-3.568194585	-4.881470106
n_lags		2.48E-10	2.50E-10	0.006399014	3.79E-05
p-value		2.48E-10	2.50E-10	0.006399014	3.79E-05
Critical Values:					
	1%	-3.459884913	-3.45988491	-3.460849271	-3.461136478
	5%	-2.87453107	-2.87453107	-2.874953188	-2.87507888
	10%	-2.57369384	-2.57369384	-2.573919054	-2.573986117

Source: Authors computation using Python Jupyter notebook

From the table above, the p-values of the variables; LASI, LCBNX, LINF and LBDCX is less than the significance level (0.05), and also the ADF statistics is less than any of the critical values. We reject the null hypothesis and conclude that the time series of these variables are stationary and will not need to be differenced.

Table 4.5: GARCH Analysis of Dependent and Explanatory Variables.

Variable	Coefficient	Std. Error	z-Statistic	Prob.
LCBNX	-0.323127	0.180367	-1.791492	0.0732
LBDCX	-0.210672	0.120147	-1.753450	0.0795
LINF	-0.006205	0.024720	-0.251011	0.8018
Variance Equation				
C	0.000864	0.000439	1.968166	0.0490
RESID(-1)^2	0.165406	0.083671	1.976856	0.0481
GARCH(-1)	0.659837	0.146693	4.498075	0.0000

R-squared	0.026183	Mean dependent var	0.003569
Adjusted R-squared	0.017527	S.D. dependent var	0.071934
S.E. of regression	0.071301	Akaike info criterion	-2.507098
Sum squared resid	1.143862	Schwarz criterion	-2.416852
Log likelihood	291.8091	Hannan-Quinn criter.	-2.470686
Durbin-Watson stat	1.789934		

Source: Author's Computation using E-views version 12.0

4.3.2. Mean Equation

The sign of the coefficient of LCBNX, LBDCX, and LINF are negative; which shows that a one percent point of increase in inflation rates (INF) decreases the returns on the All share index by 0.006 percentage points.

Also, a one percent point increase in the Central banks official exchange rate (CBNX) and the parallel market exchange rate (BDCX) will also decrease the returns in the All Share index by 0.32 and 0.21 percentage points respectively and is more statistically significant than the log of inflation rate as shown by their p-values in table 4.5 above. Result indicates that there is a negative relationship between inflation rate, CBN exchange rate, BDC exchange rate and the All Share Index in Nigeria.

4.3.3. Variance Equation

The variance equation represents the GARCH model and it is in this equation that the volatility of the exchange rates was captured. Results showed that both the ARCH-GARCH values are very significant with p-values of 0.0000. the sum of the coefficients of the ARCH-GARCH parameters (0.165406 + 0.659837) is relatively close to 1 which means that shocks to the conditional variance will be relatively persistent. Thus since the GARCH parameter is significant, a large excess return either positive or negative in value will lead future forecast of the variance to be high for a prolonged period of time.

4.3.4. Diagnostics test

4.3.4.1. Heteroskedasticity Test

The ARCH test was conducted too check for the presence of heteroscedasticity in the residuals after using the GARCH model.

Table 4.6: ARCH-LM Test.

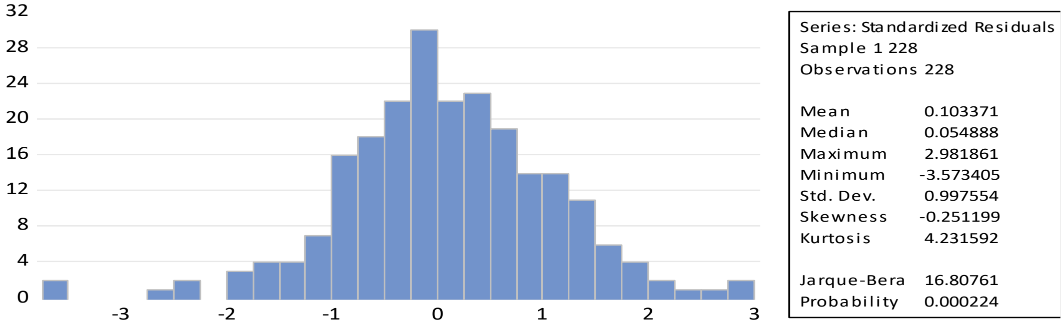
F-statistic	0.297658	Prob. F(1,225)	0.5859
Obs*R-squared	0.299907	Prob. Chi-Square(1)	0.5839

Source: Author’s Computation using E-views version 12

Table 4.6 shows that ARCH test. Engle’s LM test indicates that there is no ARCH effect. The p-value of the f-test and the Chi-Square are not significant as they are above 0.05 significance level. Hence we will fail to reject the null hypothesis which state that there is no ARCH effect in the model.

4.3.4.2. Normality Test.

Figure 4.2: Histogram Normality Test



Source: Author's Computation Using E-Views version 12

The normality test result above showed that the GARCH model best reduced the problems of fat tails and volatility clustering. The kurtosis is leptokurtic and the model distribution is negatively skewed, but it should also be noted that the residuals have been drawn towards normality.

4.3.5. Granger Causality test

The Granger causality approach was used to study the relationship of causality structures between variables. A statistical hypothesis test for detecting whether one-time series is helpful in predicting another is the Granger causality test. The null hypothesis would be rejected at that level if the probability value is less than 0.05 level of significance.

The hypothesis is that:

H_0: LCBNX, LBDCX or LINF do not Granger cause LASI

H_1: LCBNX, LBDCX or LINF Granger cause LASI

Table 4.7. Granger Causality test of variables.

	LCBNX/LASI	**LBDCX/LASI**	**LINF/LASI**
Parameter F test	1.0043 (0.3173)	11.1376 (0.0010)	0.7354 (0.3920)
SSR based Chi^2-test	1.0178 (0.3130)	11.2867 (0.0008)	0.7453 (0.3880)
likelihood ratio test	1.0043 (0.3136)	11.1376 (0.0009)	0.7440 (0.3884)

Source: Author's Computation Using Python Jupyter notebook

In table 4.7, the pair of LCBNX and LINF to LASI (Log returns of the All Share Index) showed that the variables do not Granger cause fluctuations in the returns of the all share index. The f-statistic are relatively low and not significant at 0.05 level of significance as shown in the table above. Therefore, we fail to reject the null hypothesis that CBN exchange rate and Inflation does not granger cause volatility in the stock market returns. The parallel market Volatility on the other hand has a high significance level as well as a higher f-stats than the others, showing that there is a relationship between movement in NGR/USD in the parallel market and the returns on the stock market. Hence we reject the null hypothesis that LBDCX do not Granger cause LASI volatility and accept the alternate hypothesis that parallel market rates affects return on Nigerian the stock market

Table 4.8. Reverse Granger causality Test of Variables

	LASI/LCBNX	**LASI/LBDCX**	**LASI/LINF**
Parameter F test	3.0724 (0.0810)	3.5262 (0.0617)	0.7630 (0.3833)
SSR based Chi^2-test	3.1135 (0.0776)	3.5734 (0.0587)	0.7732 (0.3792)
likelihood ratio test	3.0924 (0.0787)	3.5456 (0.0597)	0.7719 (0.3796)

Source: Author's computation using Python Jupyter notebook

A reverse granger causality test was carried out to find out if the returns on the stock market, Granger causes volatility in other variables. The result of this test as shown in the f-stats and p-values of the variables in table 4.8, portrayed that stock market returns (LASI) does not granger cause any of the other explanatory variables. Although the p-values of LCBNX and BDCX were close to the significant level at 0.05, the result showed a relatively significant relationship between the variable at 10% significance level, we still fail to reject the null hypothesis and conclude that LASI has no causal relationship with the other explanatory variables. This indicates that there is a one-way causal relationship between returns on the Parallel market exchange rates and the returns on the Nigerian stock market, and no directional causal relationship between stock returns and other variables.

4.3.6. Co-Integration Test Result

The co-integration test was carried out to determine the existence of a long run relationship between the variables under consideration using the Johansen co-integration test.

The hypothesis states that;

H_0: There is no co-integration (no long run relationship exists among variables)

H_1: There is co-integration (long run relationship exist among variables)

Table 4.9: Johansen Trace and Maximum Eigenvalue Co-Integration Test

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.274643	179.8566	40.17493	0.0000
At most 1 *	0.194241	108.2532	24.27596	0.0000
At most 2 *	0.151818	60.09161	12.32090	0.0000
At most 3 *	0.099504	23.37247	4.129906	0.0000

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.274643	71.60344	24.15921	0.0000
At most 1 *	0.194241	48.16157	17.79730	0.0000
At most 2 *	0.151818	36.71914	11.22480	0.0000
At most 3 *	0.099504	23.37247	4.129906	0.0000

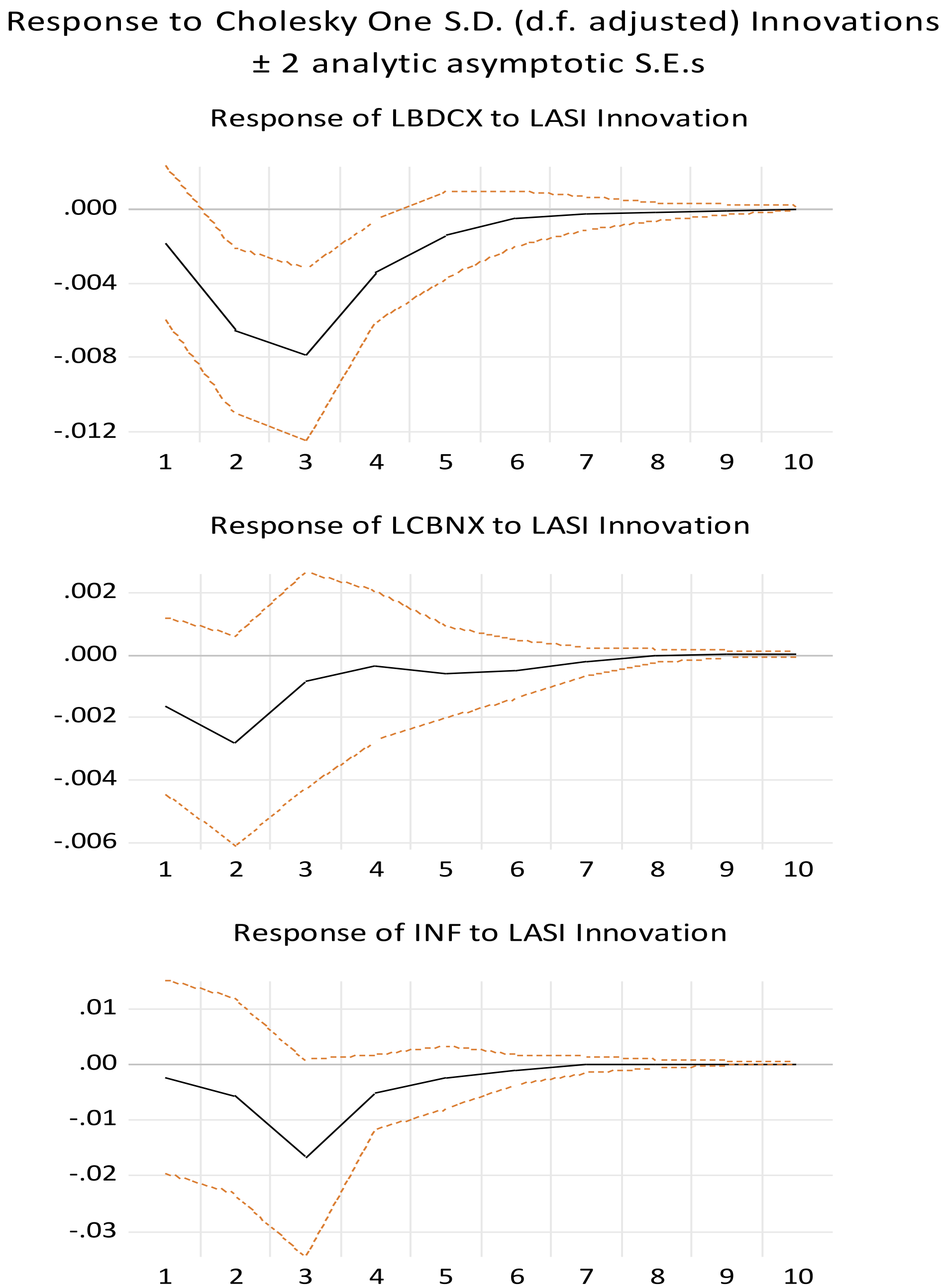
Source: Author's Computation on E-views version 12

The result of the co-integration test as seen in table 4.8 above reveals that all the equations are co-integrated at 5% level of significance and their maximum Eigenvalue and trace statistics are greater than their critical values. Therefore, the study will reject the null hypothesis and conclude that there exists a long run equilibrium relationship between the variables.

4.3.7. VAR Impulse Response Function

The impulse response function (IRF) shows how endogenous variables in a model react to shocks the economy experiences over a specific period of time. In other words, the IRF shows how adjustments to one variable affect changes to other endogenous variables. IRF is relevant to this study since it may be used to determine the effects of unexpected shocks to exchange rate measures on stock market performance as well as how other variables fare. An IRF's ability to track the propagation of a single shock inside a set of equations makes it a helpful tool for assessing economic policy.

Figure 4.3: Impulse Response of the Explanatory Variables to Innovations in LASI



Source: Author's Computation Using E-views version 12

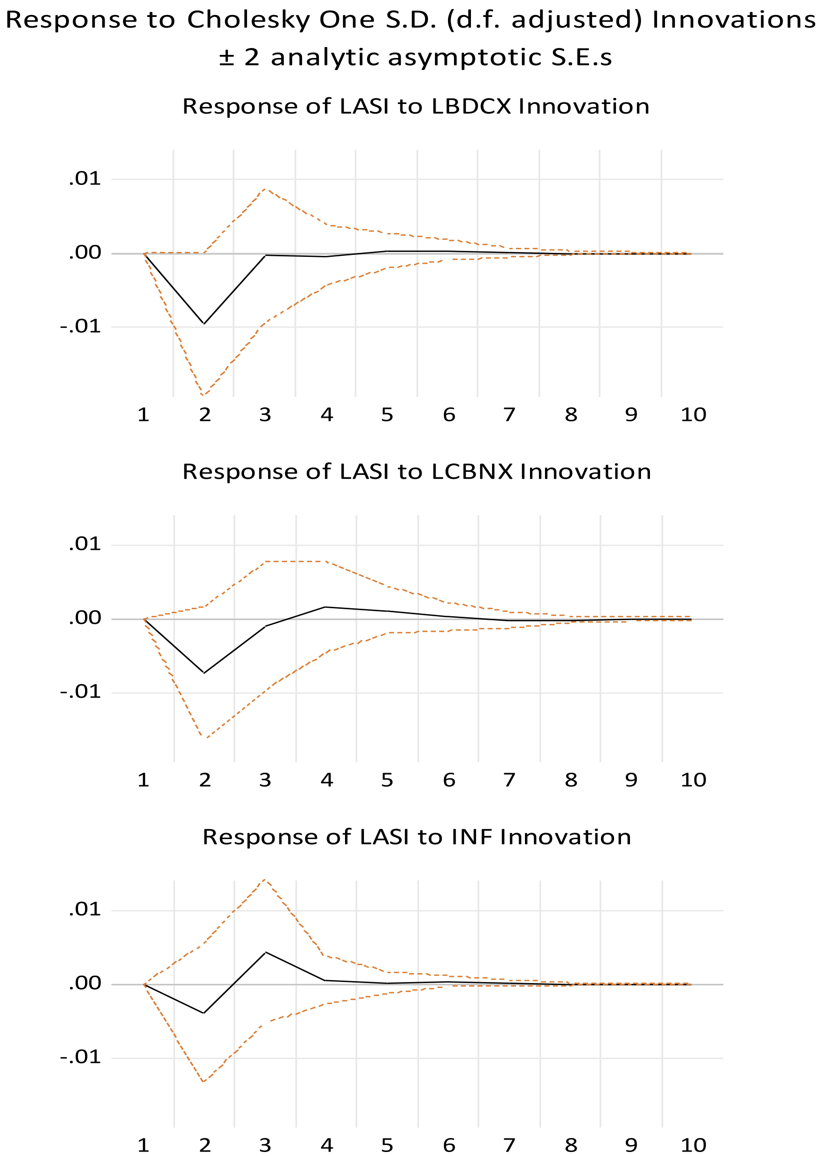
The graph above shows the impulse response of the explanatory variables to a 1 standard deviation shock of the log returns of the All Share Index (LASI). In the graph showing the response of log returns of the Bureau De Change Exchange rates (LBDCX) to LASI, we see an initial sharp decline in the response from period 1 to period 2(though on the negative side).

The decline continues but at a reduced rate from period 2 to period 3 from where there is a sharp rise till period 4 after which there is a gradual increase from period 5 till stability is achieved from period 7 till period 10. It should be noted that the response is negative through periods 1 to 7 where it become stable through periods 8 to 10.

The response of the log returns of the CBN exchange rate(LCBNX) to LASI, shows a gradual decline in exchange rate at the initial stage (from period 1 to period 2). From period 2 to period 3, there is a significant increment in exchange rate till period 4 where a gradual increase is seen till period 5. Equilibrium is achieved from period 8 as seen in the chart. The response of LCBNX to a one Standard Deviation shock of LASI as shown in the chart is also negative and reaches stability in period 8.

The Inflation response to LASI shock, we note that there is a negative impact from periods 1 to 5 after which it converges back to zero. There was an initial gradual decline from period 1 which peaked at period 3 after which it sharply increased from period 3 to period 4. Period 4 to 7 showed a gradual increase until it converged completely at period 8.

Figure 4: Impulse Response of LASI to innovations of the Explanatory Variables



Source: Author's Computation using E-views version 12

Figure 3 above shows the impulse response of the explanatory variables to a 1 standard deviation shock of the log returns of the All-Share Index (LASI). The first chart shows the response of log returns of the Bureau De Change Exchange rates (LBDCX) to LASI innovations, we see an initial sharp negative impact in the response from period 1 to period 2. The decline continues but at a reduced rate from period 2 to period 3 from where there is a sharp rise till period 4 after which there is a gradual increase from period 5 till it converges at period 7. It should be noted that the response is negative through periods 1 to 7 where it become stable through periods 8 to 10. Figure 4 shows the response of LASI to a 1 standard deviation shock to LBDCX. There is a sharp negative impact in response from period 1 to 2 and a sharp rise in response from periods 2 to 3 before converging back to zero.

The response of the log returns of the CBN exchange rate(LCBNX) to LASI, shows a gradual response to the negative impact in exchange rate at the initial stage (from period 1 to period 2). From period 2 to period 3, there is a significant increment in exchange rate response till period 4 where a gradual increase is seen till period 5. Convergence is achieved from period 8 as seen in the chart. The response of LCBNX to a one Standard Deviation shock of LASI as shown in the chart is also negative and converges in period 8. This also corresponds to the response to shocks from LBCNX innovations to LASI except for the short period of positive impact from period 3 to 6 before it converges to zero.

The Inflation response to LASI shock, we note that there is a negative impact from periods 1 to 5 after which it converges back to zero. There was an initial gradual decline from period 1 which peaked at period 3 after which it sharply increased from period 3 to period 4. Period 4 to 7 showed a gradual increase until it converged completely at period 8. In response to the shock from INF to LASI, there was an initial negative impact in period 1 to 2. The impact moved from negative to positive within periods 2 to 3 and slowly converged to zero in period 4.

4.4. Discussion of Findings

The goal of the study is to determine whether there is a connection between exchange rate and stock market return volatility. The results of the unit root test demonstrated that the log of the variable returns would not result in an erroneous model. A Dublin Watson and a straightforward OLS regression were performed. The DW test statistics were higher than the regression R-squared, providing us with an initial proof that the data is stationary. This was further supported by the ADF test, which reported a significant p-value for all the variables at 0.05, and so we reject the null hypothesis to conclude that the log of the returns of the variables is stationary.

The GARCH model revealed that the exchange rate and other explanatory variables have a negative relationship with the returns in the All-Share index in the Nigerian Stock market. It was also discovered that the volatility of the variance of the residuals in the model is positive and significant at 5% confidence interval. The diagnostic test conducted by the study showed that there is no ARCH effect in the GARCH model conducted in this study. Despite being negatively skewed, the normality test revealed that the model followed a normal distribution.

To determine whether any of the variables may be used to predict another variable, the study used a Granger causality test. The test's findings demonstrated that, in contrast to the other variables, the parallel market price volatility could be used to forecast the volatility of returns in the Nigerian stock market. This was in contrast to the other variables, which were unable to do so. The stock market returns could not be used to predict the volatility of other variables because the study did not reveal a substantial reverse granger causality. This is consistent with other research's investigations that have been done.

The Johansen method was used in the study to test for co-integration. Four co-integrating equations were identified by the Johanssen trace and maximal Eigenvalue co-integration tests, both at the 5% level of significance. The investigation thus supports the existence of a robust long-term equilibrium connection between the variables.

The magnitude of the variables' reactions to shock in the other variables is demonstrated by the impulse response function. The impulse response test used in this study yielded results that were generally unfavorable for every variable examined. The impulse in the dependent variable had a negative impact on the explanatory factors. We found that the impulse response of LASI to LBDCX was higher than that of the other explanatory factors, compared to the response of the dependent variable to innovations in the explanatory variableThe largest impulse response of LASI to LBDCX innovations is at -0.01, which is nearly 125 times the impact of the maximum impulse response of LBDCX to LASI innovation, which was at -

0.008. Other variables, in contrast, have relatively low response shape between -0.008 and -0.002 impulse points. This indicates that, in contrast to the other explanatory variables, which showed little to no negative response aside from the reaction to inflation, which experienced both very long periods of negative and positive reaction before settling to zero, the returns in the stock market have a significant negative reaction to shocks in the parallel market exchange rates.