Forecasting the Nigerian Gross Domestic Product in Correspondence to Crude Price Fluctuations

Siddhant Jhawar
Student at Daly College, Residency Area, Indore, Madhya Pradesh, 452001, India

Abstract
The study aims to find a long-run empirical correlation between crude prices and the Nigerian Economy. Therefore, the Independent Variable for the study is the natural log of crude prices and the Dependent Variable would be the economic activity in Nigeria (Operationalized using the natural log of GDP). The research explores the Vector Autoregression Model (VAR Model), Serial Correlation LM Test, VAR Granger Causality/Block Exogeneity Wald Tests, Forecast Error Variance Decomposition (FEVD), and the Impulse Response Functions (IRFs). The time period of the study was from 1998 to 2008 (annual statistics were used), and the findings from the Augmented Dickey-Fuller Unit Root Test indicates that lngdp is stationary for an optimal maximum lag of 1 in 1st Level, including Intercept in the test equation. Furthermore, lngdp is found to have a causal impact on lncp. This finding is complemented by the findings of FEVD and the IRFs. The empirical analyses show that the lngdp is a strong determining factor of the lncp fluctuations and directly influences forecasts of the same, *ceteris paribus*. In the final analysis, the the researchers recommend that the Central Bank of Nigeria, while making policies relating to economic growth, should involve indicators of external commodity markets and should diversify from an oil-dependent economy to an economy which would be less susceptible to Dutch Disease.
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1.1 Introduction

Nigeria is generally referred to as an 'Oil Economy' because of the country's large amount of oil reserves. Yet, the Petroleum Sector in Nigeria currently contributes to less than 10 percent of the country's GDP.1 To these ends, the study analyzes the ramifications of changes in the market prices of the Crude Petroleum on the GDP. Furthermore, the study accounts for the cyclical nature of the commodity prices and compares it with the cyclical nature of the Nigerian GDP to find any possible lags in the time series of both sets of data. Economic cycles and fluctuations have an impact on each of the country's economic performance.2 Economic development includes trends of economic growth and cycle that indicates the period when real development is different from the default trend.3 Hamilton, Blanchard and Gali, viewed changes in the price of oil as an imperative source of economic fluctuations, in which the resultant effect led to global shock, capable of affecting many economic activities instantaneously.4 This shock is generally discerned to have a similar consequence due to events like fall in growth rate, high unemployment rate, or a high inflation rate, while the magnitude and the reasons of these shocks' effects may differ. While using the Impulse Response Functions, the sets of data (Appendix 4.0 Correlational Analysis, Table 1) showed that a one standard deviation (σ) shock, impulse, or innovation given to lncp will result in a decrease in lngdp until the 2nd period, whereas from the 2nd period forth it would result in an increase in the lngdp. For an import-dependent economy, a surge in the crude price will lead to shock in the economy, vice versa for an export-dependent economy. Wherein, Nigeria adheres to the latter case.

There are many established empirical analyses on the macroeconomic consequences of oil price shocks to net exporting countries, this is based on the dependency between oil price and the business cycle which can be explained through the impact of the oil price shocks on aggregate demand.4 Economists opine that an increased crude price would reduce the national real output by initially causing a decrease in the aggregate supply. Since higher energy (raw material in an economic, production process) prices imply that firms will purchase less energy, and the quantity demanded of energy by the firms can be assessed by an analysis of the Price Elasticity of Demand of energy in the market and the $\%\Delta Price$. Consequently, the productivity - operationalized as the efficiency of the production of a good or service expressed using a ratio of the output created by the number of inputs involved in the production process - of any given volume of capital and labor would diminish and cause a loss of potential real output. The aforementioned changes in the economic conditions, without exception, would cause a decrease in the numbers of factors of production and real wages. The following negative spiral would engender a leftward shift in the Aggregate Demand.

1.2 Rationale Behind the Study

As a result of the author's awareness of the significance of fluctuations of crude oil prices on the economic growth of the 'Oil Economy',1 the brainwave to execute this study emerged. External supply-side shocks have the ability to adversely affect international trade, consumption, as well as the investment injected into the economy. An increase in the crude prices can reduce trade deficits in the short-run and make a major contribution to the balance of payments, which is particularly relevant for developing economies, such as Nigeria. The primary purpose behind this research is to analyze the sole impact of crude oil price fluctuations on the GDP growth in Nigeria, *ceteris paribus*.

2.0 Methodology

The statistical models aim at exploring the correlation and trend existing between the crude oil prices on the nominal national output (GDP). The data employed is an annual measure of central tendency sourced from Statista and The World Bank. The data sets cover a time period of 1998 to 2008. All the variables are operationalized in United States Dollars (US$). The Nigerian GDP acts as a proxy of the aggregate Nigerian economic activity. Before applying any time series, the statistical properties of the variables were tested to determine both the long-run and the short-run causal relationships and the summary of the statistics of all variables in this econometric analysis.

2.1 Variables

Independent Variable (IV) : Natural Logarithmic of Crude Oil Prices (denoted by '*lncp*')
Dependent Variable (DV) : Natural Logarithmic of Nominal GDP (denoted by '*lngdp'*)

2.2 Estimation Procedure and the Selection of an Optimal Time Lag

The ideal lag length must be determined in order to prevent overstating or understating the real amount of lag, as well as to avoid biased estimates of accepting the null hypothesis when it should be rejected, and vice versa. For instance, too many lags can cause a loss of degrees of freedom, statistically insignificant coefficients, and multicollinearity; whereas, too few lags can cause specification errors. A level VAR model of order is estimated using the largest possible order of the integration of the basic variables and the ideal lag length, and zero restrictions tests are performed on lagged coefficients of the regressors up to the optimal lag. The study used Time Series data; therefore, it was ensured that all data collected was on an annual basis. The statistical analysis used the Ordinary Least Squares (OLS) to estimate the parameters. Cointegration techniques were used to evaluate the relationship between crude oil prices and the economic growth in Nigeria. The Vector Autoregressive Model (VAR) and Variance Decomposition Model were utilized so that they provide estimates of both the short-run and long-run. If variables are not stationary, co-integration between variables is found to occur and refuses to die off after taking their first difference (Setargie, 2015).

Since the dependence of the DV on the IV is rarely instantaneous, the DV, very often, responds to the IV with a lapse of time (lag).

The study utilised LR: Sequentially modified LR test statistic, FPE: Final Predict Error, AIC: Akaike Information Criterion, SC: Schwarz Information Criterion, and HQ: Hannan-Quinn Information Criterion to deduce the optimal lag (k) for the assessment of the VAR Model. Since the maximum minimizations occur at the second lag length, and FPE and AIC are better choices for smaller samples, the proposed k=1.

The Optimal Lag Selected is Lag 1. (Appendix 4.2.1 and Appendix 4.2.2).

2.3 Vector Auto Regression (VAR) Model

The objective of the analysis is to identify the interdependencies between the variables, namely Gross Domestic Product (lngdp) and Crude Prices (lncp). Each variable in the model is stated as independent in the specification as a function of its latency and the lag of other variables in the model. In other words, the DV is a function of its lagged values and the lagged values of the IV in the model. The model takes into consideration 2 independent, exogenous error terms, which are ε_{1t} , ε_{2t} . These stochastic error terms are interpreted as structural innovations, impulses, or shocks. Interpretation of the Short Run coefficients is as in any other linear model: they are c*eteris paribus* effects and inference can be based on the usual ordinary least square method (OLS) standard errors and test statistics.

$$\ln gdp_t = \alpha + \sum_{i=1}^{k} \beta_i \ln gdp_{t-i} + \sum_{j=1}^{k} \gamma_j \ln cp_{t-j} + \varepsilon_{1t} \quad (1)$$

$$\ln cp_t = \delta + \sum_{i=1}^{k} \beta_i \ln cp_{t-i} + \sum_{j=1}^{k} \gamma_j \ln gdp_{t-j} + \varepsilon_{2t} \quad (2)$$

(Appendix 4.3). Derived from the estimates are the following equations for the model:

$$lngdp = c(1).lncp + c(2).lngdp(-1) + c(3) \tag{3}$$

$$lncp = c(4).lngdp + c(5).lncp(-1) + c(6) \tag{4}$$

2.4.0 Augmented Dickey-Fuller Unit Root Test on D[lnGDP]

Maximum Lags used for each condition were 1, but the Lag Length for each condition remained 0; the Selection Criterion was the Akaike Info Criterion (AIC). These stationarity tests were performed because there lies a need to estimate the maximum order of integration of the DV.

2.4.1 In Level, Included in Test Equation: Intercept

(Appendix 4.4.1). Because the Absolute Value of the Augmented Dickey-Fuller t-Statistic is lower than all the three absolute, test critical values, the null hypothesis stating 'ln(GDP) has a unit root' cannot be rejected at any given significance level.

2.4.2 In Level, Included in Test Equation: Trend and Intercept

(Appendix 4.4.2). Known is that the @Trend("1998") and the constant term is statistically significant. Because the Absolute Value of the Augmented Dickey-Fuller t-Statistic is lower than all the three absolute, test critical values, the null hypothesis stating 'ln(GDP) has a unit root' cannot be rejected at any given significance level.

Therefore, in Level the series is *non-stationary*.

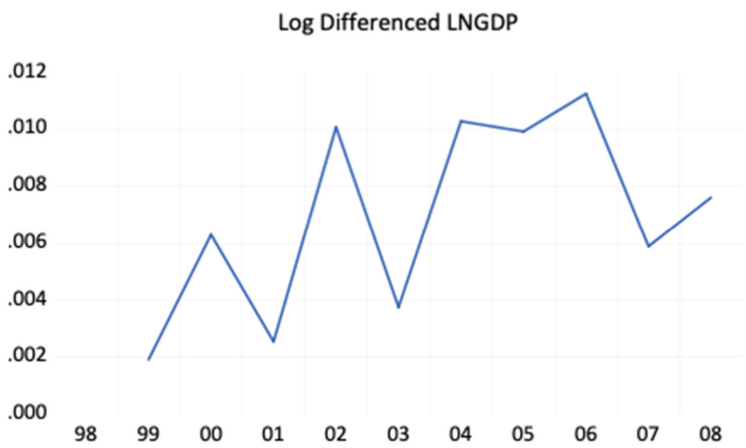
2.4.3 In 1st Level, Included in Test Equation: Intercept

(Appendix 4.4.3). Because the Absolute Value of the Augmented Dickey-Fuller t-Statistic is lower than only one of the three absolute, test critical values (at the 1% significance levels), the null hypothesis stating 'ln(GDP) has a unit root' is to be rejected. Hence, in 1st Level and only when the constant is included as an exogenous, the series is stationary.

2.4.4 In 1st Level, Included in Test Equation: Trend and Intercept

(Appendix 4.4.4). Because the Absolute Value of the Augmented Dickey-Fuller t-Statistic is lower than two of the three absolute, test critical values (at 1% and 5% significance levels), the null hypothesis stating 'ln(GDP) has a unit root' cannot be rejected at any any level except the 10% significance level. Even though the Augmented Dickey-Fuller t-Statistic is weakly significant at the 10% level, the null hypothesis that ln(GDP) has a unit root is rejected at the 10% level.

Therefore, the ln(GDP) is only stationary in the 1st Level with the Intercept included in the test equation. Therefore, in Level and with Intercept, the stationarity of the series implies that its mean, variance, and covariance are constant over time. In other words, the series is *time invariant*.



2.5 VAR Residual Serial Correlation LM Tests

The VAR residual serial correlation test is used before the assessment of the Forecast Error Variance Decomposition (FEVD) and Impulse Response Functions (IRFs) to ascertain the sufficiency of the lag selection criterion used in the evaluation of a chosen multivariate model. It is used to verify restrictions on an unbounded model, and it is based on the confined optimum likelihood test. From the Breusch-Godfrey Serial Correlation LM Test (Appendix 4.5), there is no serial correlation, which is the null hypothesis for the test. The findings show that there is no serial association, allowing the study to move forward with forecasting. This implies that the null hypothesis is not rejected.

2.6 VAR Granger Causality/Block Exogeneity Wald Tests

(Appendix 4.6.1 and Appendix 4.6.2). Known is that lngdp is the DV and at 5% significance level, we fail to reject (accept) the null hypothesis that there is no causality between the lagged coefficients of the IV and those of the DV; furthermore, the findings stipulate that the exogeneity of the DV is decided by several exogenous factors to the model.

However, the findings also show that when lncp is the DV, we can reject the null hypothesis because the probability of Chi-square is lower than 0.05 or an alternative approach is that the probability value of the F-statistic is lower than 0.05, which implies that there lies a causality between the two variables.

Therefore, the lagged coefficients of lngdp have a causal impact on the lagged coefficients of lncp, and a plausible conclusion includes how the results invariably show that shocks in the economy (i.e. economic condition, which is operationalized using GDP) are a determining factor for the changes in the commodity markets (i.e. crude oil markets), since causality is noted.

2.7.0 Forecast Error Variance Decomposition (FEVD) and Impulse Response Functions (IRFs)

We generate forecast error variance decompositions (FEVD) and impulse response functions (IRF) from the calculated VAR Model, which are used to measure the dynamics of interrelationships, interactions, and the degree of causative relationships among the variables in the system. Variance decomposition divides variation in an endogenous variable and further into component shocks to the VAR Model, whereas impulse response functions track the implications of a shock to one endogenous variable on the VAR Model's other variables.

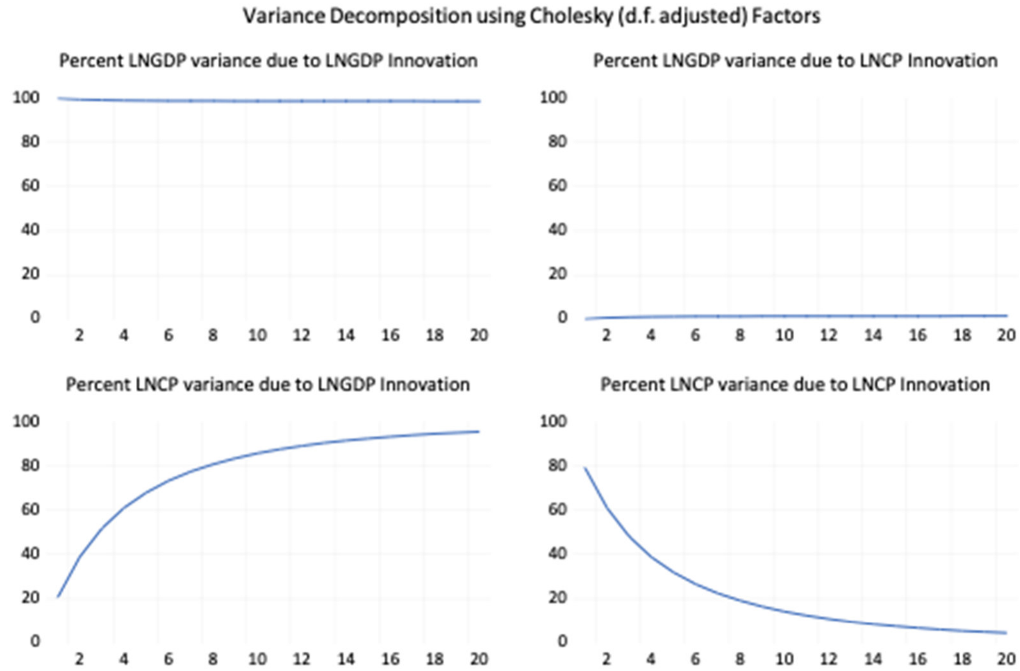
The VAR innovations can be linked in real time while modeling FEVD and IFRs. – i.e., a shock in one variable might have an influence on other variables due to their synchronous connection. Because shock to individual variables cannot be detected independently due to the contemporaneous correlation, the reactions of one variable to innovations in another variable of interest cannot be properly described in isolation.

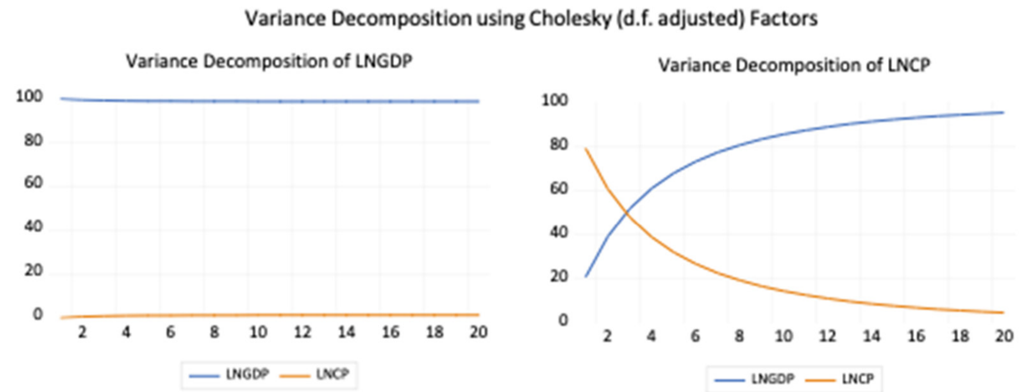
To orthogonalise impulses and address this identification challenge, the study employed the Cholesky methodology, which utilizes the inverse of the Cholesky component of the residual covariance matrix. A pre-specified causative ordering of the variables is required for the method to work.

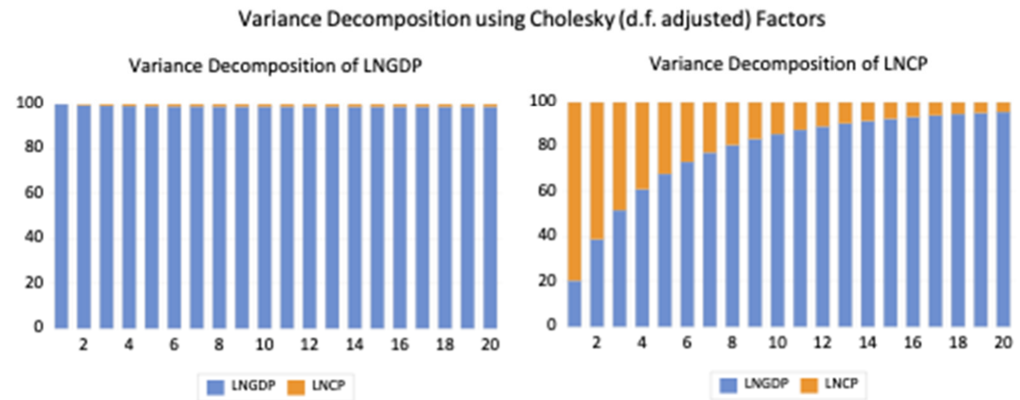
2.7.1 Forecast Error Variance Decomposition

(Appendix 4.7, Appendix 4.8, and Appendix 4.9). The study utilized the Cholesky factorization and forecasted the variables upto 5 periods, which are equivalent to 5 years. Shocks in the predicted variable's residual contribute more to its variance than shocks in other variables in the initial period when predicting a variable. For instance, the shocks in the lngdp contributed more to its variance, 100.00%, in the 1st period, down to 98.64% in the 20th period of the forecasted period. While the lncp contributions to the lngdp variance decomposition started at the 2nd period, 0.60%, and increased with periods till the 5th periods, 1.36%. Therefore, the decomposition shows that lncp has an impact on the lngdp volatility, and that in the future, lngdp will be responsive to lncp volatility, even though the contributions are *statistically insignificant*.

Whereas, the contributions of lngdp in the variance of lncp start from the 1st period, 20.62%, and increase till the 20th period, 95.54%. The results imply that lngdp would account for a majority proportion of the contributions from the 3rd period, 51.87%. Furthermore, till the 20th period, lngdp would be responsible for 95.54% of lncp volatility. Therefore, the results suggest that lngdp plays a *statistically significant* role in lncp fluctuations, and not vice versa.







2.7.2 Response Functions (IRFs)

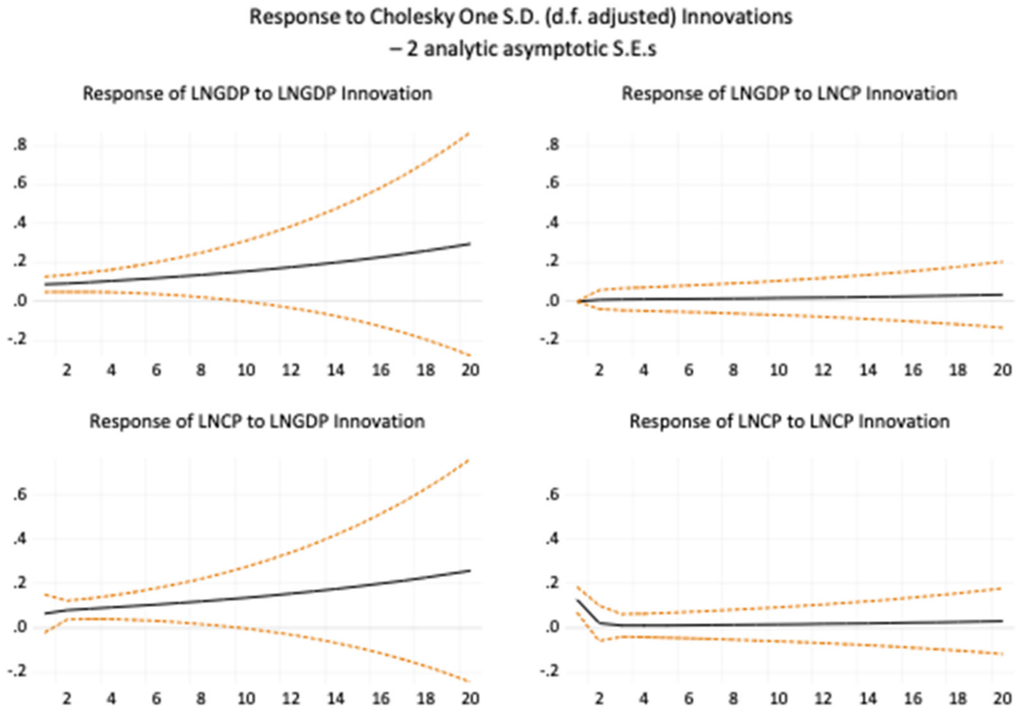
(Appendix 4.9, Appendix 4.10.1, Appendix 4.10.2, Figure 1: Responses of lngdp to lngdp, Figure 2: Responses of lngdp to lncp, Figure 3: Responses of lncp to lngdp, and Figure 4: Responses of lncp to lncp). *All the figures are on the next page.*

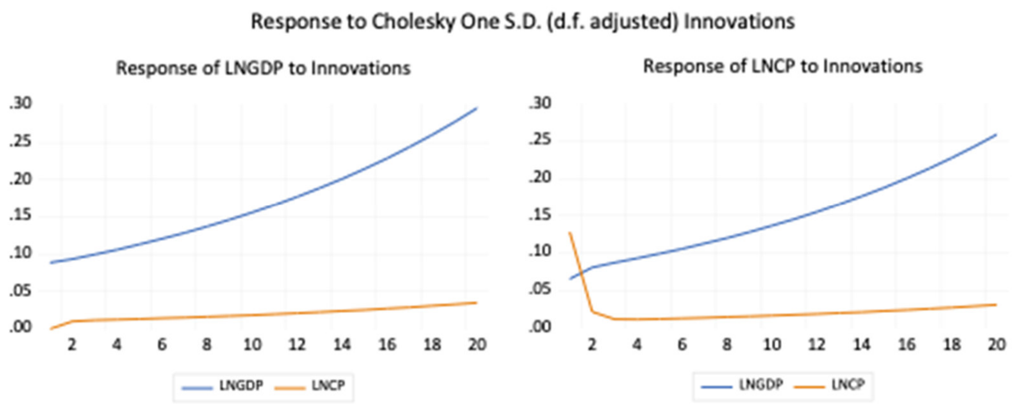
In Figure 1, the change in its own shocks, which are positive and not fading, prompted the lngdp to respond in real time. The implication, therefore, is that a one standard deviation shock, impulse, or innovation given to lngdp will result in an increase in lngdp for all the 20 periods, without exceptions. The response of lngdp does not show a meaningful response to orthogonal changes in lncp. While the response of lngdp to lncp is statistically insignificant, it does show a positive trend throughout as shown in Figure 2.

Overall, lngdp shows a positive response to innovations in both lngdp and lncp. However, a greater positive response is seen with innovations in lngdp throughout the 20 periods (Figure 5: Responses of lngdp to Innovations).

Figure 3 shows how lncp responds to innovations in lngdp with a positive, instantaneous, and non-dissipating trend. This indicates that the lncp (crude oil prices) would continue to increase, inducing inflation in the long-run, until the government adopts a contractionary or a deflationary policy in response to induce a recessionary phase (cut down on economic activity by decreasing the lngdp); since, the recessionary phase trades-off increased rates of inflation, the government would have to conduct a cost-benefit analysis to deduce which action would reduce the marginal opportunity cost the most. Whereas, in Figure 4 a one standard deviation shock, impulse, or innovation given to lncp will result in a decrease in lncp until the 2nd period, whereas from the 2nd period forth it would result in an increase in the lngdp. The dropped lncp due to innovations in lncp till the 2nd period demonstrates a tendency of achieving normality in the short run.

Overall, lncp shows a positive response in short run to, only, lngdp, and a negative response to, only, lncp. However, lncp shows a positive response to both lngdp and lncp in the long run.





3.0 Conclusion and Reccomendation

The scope of this study is to develop a direct relationship between oil prices and Nigerian economic activity. We were able to demonstrate that crude oil prices had a statistically negligible impact on economic activity. Economic activity, on the other hand, has a positive and considerable influence on oil prices. Nigeria is a well-known truth that it is both an oil-producing and non-oil-producing economy. Oil income is one of the main sources of funding for the import. As an oil-producing economy, there are tendencies of having Dutch disease syndrome and economic pass-through.5

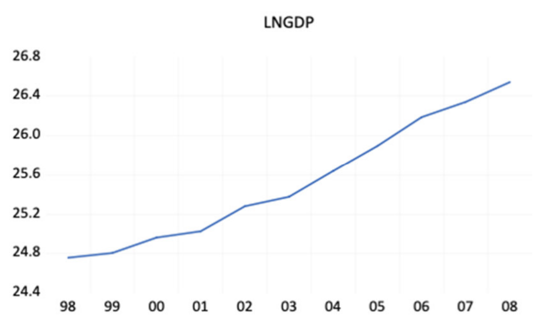
According to both theoretical and empirical assessments, Nigerian economic activity is a significant determinant of global crude prices; crude prices are intimately correlated to inflationary or deflationary impulses, and hence are affected by government policies on economic activity in Nigeria.

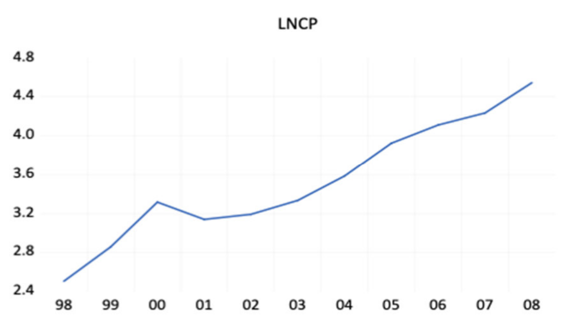
As a result, when policymakers enact policies relating to the aggregate level of economic activity, they should pay heed to the aggregate price level and external commodity markets, which can be accomplished by simultaneously measuring the domestic market and the economies of the country's trading partners. To avoid the Dutch illness syndrome, the economy should be diversified away from oil and toward non-oil industries.

4.0 Appendix

4.1 Data Sets

Year	Nominal GDP/billions$	ln(GDP)	Nominal Crude Oil Prices/$	ln(CP)
1998	54.604	24.75934549	12.28	2.507971923
1999	59.373	24.80710541	17.44	2.858766418
2000	69.449	24.96385851	27.60	3.317815773
2001	74.030	25.02773625	23.12	3.140698044
2002	95.386	25.28119765	24.36	3.192942443
2003	104.912	25.37638774	28.10	3.335769576
2004	136.386	25.63875494	36.05	3.584906864
2005	176.134	25.89451091	50.59	3.923753928
2006	236.104	26.18753822	61.00	4.110873864
2007	275.626	26.34231071	69.04	4.234686047
2008	337.036	26.54345559	94.10	4.544358047





4.2.1 VAR Lag Order Selection Criterion for lngdp

Endogenous Variables: lngdp

Exogenous Variables: c

Sample: 1998 2008
Included observations: 9

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-7.314080	NA	0.371806	1.847573	1.869487	1.800283
1	10.90410	28.33939*	0.008156*	-1.978689*	-1.934862*	-2.073269*
2	11.44933	0.726968	0.009196	-1.877629	-1.811887	-2.019499

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

**indicates lag order selected by the criterion.*

4.2.2 VAR Lag Order Selection Criterion for lncp

Endogenous Variables: lncp

Exogenous Variables: c

Sample: 1998 2008
Included observations: 9

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-6.175986	NA	0.288722	1.594664	1.616577	1.547374
1	2.965519	14.22012*	0.047601*	-0.214560*	-0.170732*	-0.309140*
2	2.965552	4.42e-05	0.060583	0.007655	0.073397	-0.134215

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

**indicates lag order selected by the criterion.*

4.3 Vector Autoregression Estimates

Sample (adjusted): 1999 2008
Included observations: 10 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	LNGDP	LNCP
LNGDP(-1)	0.997732	0.787114
	(0.18286)	(0.29706)
	[5.45624]	[2.64971]
LNCP(-1)	0.078308	0.167067
	(0.18920)	(0.30735)
	[0.41389]	[0.54357]
C	-0.031800	-16.96170
	(4.03340)	(6.55225)
	[-0.00788]	[-2.58868]
R-squared	0.983835	0.947083
Adj. R-squared	0.979216	0.931964
Sum sq. resids	0.054747	0.144476
S.E. equation	0.088436	0.143664
F-statistic	213.0125	62.64110
Log likelihood	11.84875	6.996765
Akaike AIC	-1.769749	-0.799353
Schwarz SC	-1.678974	-0.708578
Mean dependent	25.60629	3.624457
S.D. dependent	0.613429	0.550779

Determinant resid covariance (dof adj.)	0.000128
Determinant resid covariance	6.28E-05
Log likelihood	20.00027
Akaike information criterion	-2.800054
Schwarz criterion	-2.618503
Number of coefficients	6

4.4.1 Augmented Dickey-Fuller Unit Root Test in Level on D[lnGDP], Included in Test Equation: Intercept

Null Hypothesis: LNGDP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on AIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.431777	0.9968
Test critical values:	1% level	-4.297073	
	5% level	-3.212696	
	10% level	-2.747676	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 10

Sample (adjusted): 1999 2008
Included observations: 10 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGDP(-1)	0.070309	0.049106	1.431777	0.1901
C	-1.609386	1.248937	-1.288605	0.2335

R-squared	0.203979	Mean dependent var	0.178411
Adjusted R-squared	0.104476	S.D. dependent var	0.088480
S.E. of regression	0.083730	Akaike info criterion	-1.945572
Sum squared resid	0.056086	Schwarz criterion	-1.885055
Log likelihood	11.72786	Hannan-Quinn criter.	-2.011959
F-statistic	2.049984	Durbin-Watson stat	2.504555
Prob(F-statistic)	0.190095		

4.4.2 Augmented Dickey-Fuller Unit Root Test in Level on D[lnGDP], Included in Test Equation: Trend and Intercept

Null Hypothesis: LNGDP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on AIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.338137	0.3813
Test critical values:	1% level	-5.295384	
	5% level	-4.008157	
	10% level	-3.460791	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations a may not be accurate for a sample size of 10

Sample (adjusted): 1999 2008
Included observations: 10 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGDP(-1)	-0.486410	0.208033	-2.338137	0.0520
C	11.96287	5.078583	2.355552	0.0507
@TREND("1998")	0.106168	0.039053	2.718540	0.0298

R-squared	0.612789	Mean dependent var	0.178411
Adjusted R-squared	0.502157	S.D. dependent var	0.088480
S.E. of regression	0.062430	Akaike info criterion	-2.466227
Sum squared resid	0.027282	Schwarz criterion	-2.375451
Log likelihood	15.33113	Hannan-Quinn criter.	-2.565807
F-statistic	5.538992	Durbin-Watson stat	2.720731
Prob(F-statistic)	0.036126		

4.4.3 Augmented Dickey-Fuller Unit Root Test in 1st Level on D[lnGDP], Included in Test Equation: Intercept

Null Hypothesis: D(LNGDP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on AIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.269602	0.0493
Test critical values:	1% level	-4.420595	
	5% level	-3.259808	
	10% level	-2.771129	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations a
may not be accurate for a sample size of 9

Sample (adjusted): 2000 2008
Included observations: 9 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGDP(-1))	-1.058331	0.323688	-3.269602	0.0137
C	0.203187	0.063677	3.190892	0.0153

R-squared	0.604303	Mean dependent var	0.017043
Adjusted R-squared	0.547775	S.D. dependent var	0.127244
S.E. of regression	0.085569	Akaike info criterion	-1.885861
Sum squared resid	0.051254	Schwarz criterion	-1.842033
Log likelihood	10.48637	Hannan-Quinn criter.	-1.980441
F-statistic	10.69030	Durbin-Watson stat	2.134002
Prob(F-statistic)	0.013682		

4.4.4 Augmented Dickey-Fuller Unit Root Test in 1st Level on D[lnGDP], Included in Test Equation: Trend and Intercept

Null Hypothesis: D(LNGDP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on AIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.834388	0.0692
Test critical values:	1% level	-5.521860	
	5% level	-4.107833	
	10% level	-3.515047	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations a
may not be accurate for a sample size of 9

Sample (adjusted): 2000 2008
Included observations: 9 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGDP(-1))	-1.407603	0.367100	-3.834388	0.0086
C	0.145508	0.068265	2.131524	0.0770
@TREND("1998")	0.019852	0.012528	1.584541	0.1642

R-squared	0.721038	Mean dependent var	0.017043
Adjusted R-squared	0.628051	S.D. dependent var	0.127244
S.E. of regression	0.077603	Akaike info criterion	-2.013212
Sum squared resid	0.036134	Schwarz criterion	-1.947470
Log likelihood	12.05945	Hannan-Quinn criter.	-2.155082
F-statistic	7.754149	Durbin-Watson stat	1.725627
Prob(F-statistic)	0.021709		

4.5 VAR Residual Serial Correlation LM Test

Sample: 1998 2008
Included observations: 10

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	1.729037	4	0.7854	0.423620	(4, 8.0)	0.7879

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	1.729037	4	0.7854	0.423620	(4, 8.0)	0.7879

*Edgeworth expansion corrected likelihood ratio statistic.

4.6.1 VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1998 2008
Included observations: 10

Dependent variable: LNGDP

Excluded	Chi-sq	df	Prob.
LNCP	0.171306	1	0.6790
All	0.171306	1	0.6790

Dependent variable: LNCP

Excluded	Chi-sq	df	Prob.
LNGDP	7.020970	1	0.0081
All	7.020970	1	0.0081

4.6.2 Pairwise Granger Causality Test

Sample: 1998 2008
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
LNCP does not Granger Cause LNGDP	10	0.17131	0.6913
LNGDP does not Granger Cause LNCP		7.02097	0.0330

4.7 Normality Test

Sample: 1998 2008
Included observations: 10

Component	Skewness	Chi-sq	df	Prob.*
1	0.026746	0.001192	1	0.9725
2	1.212289	2.449409	1	0.1176
Joint		2.450601	2	0.2937

Component	Kurtosis	Chi-sq	df	Prob.
1	1.353285	1.129862	1	0.2878
2	3.914655	0.348580	1	0.5549
Joint		1.478443	2	0.4775

Component	Jarque-Bera	df	Prob.
1	1.131055	2	0.5681
2	2.797989	2	0.2468
Joint	3.929044	4	0.4157

*Approximate p-values do not account for coefficient estimation

4.8 VAR Residual Heteroskedasticity Test

Sample: 1998 2008
Included observations: 10

Joint test:

Chi-sq	df	Prob.
13.91153	12	0.3064

Individual components:

Dependent	R-squared	F(4,5)	Prob.	Chi-sq(4)	Prob.
res1*res1	0.610830	1.961965	0.2388	6.108302	0.1912
res2*res2	0.469759	1.107418	0.4452	4.697588	0.3198
res2*res1	0.061371	0.081729	0.9845	0.613705	0.9615

4.9 Variance Decomposition using Cholesky (d.f. Adjusted) Factors

Variance Decomposition of LNGDP:

Period	S.E.	LNGDP	LNCP
1	0.088436	100.0000	0.000000
2	0.128975	99.39606	0.603939
3	0.163275	99.11186	0.888141
4	0.195079	98.96424	1.035760
5	0.225863	98.87603	1.123967
6	0.256411	98.81794	1.182057
7	0.287223	98.77710	1.222902
8	0.318656	98.74703	1.252970
9	0.350990	98.72414	1.275862
10	0.384463	98.70626	1.293742
11	0.419286	98.69201	1.307988
12	0.455657	98.68048	1.319519
13	0.493764	98.67103	1.328972
14	0.533796	98.66320	1.336803
15	0.575940	98.65665	1.343348
16	0.620387	98.65114	1.348856
17	0.667335	98.64648	1.353521
18	0.716987	98.64251	1.357492
19	0.769557	98.63911	1.360887
20	0.825268	98.63620	1.363800

Variance Decomposition of LNCP:

Period	S.E.	LNGDP	LNCP
1	0.143664	20.62222	79.37778
2	0.166067	38.93626	61.06374
3	0.187791	51.87416	48.12584
4	0.209759	61.14647	38.85353
5	0.232223	68.04482	31.95518
6	0.255374	73.33662	26.66338
7	0.279375	77.49364	22.50636
8	0.304373	80.82075	19.17925
9	0.330504	83.52364	16.47636
10	0.357905	85.74616	14.25384
11	0.386706	87.59194	12.40806
12	0.417042	89.13753	10.86247
13	0.449050	90.44072	9.559282
14	0.482871	91.54593	8.454069
15	0.518652	92.48788	7.512124
16	0.556545	93.29405	6.705949
17	0.596711	93.98651	6.013491
18	0.639320	94.58313	5.416870
19	0.684549	95.09855	4.901455
20	0.732589	95.54483	4.455168

Cholesky One S.D. (d.f. adjusted)
Cholesky ordering: LNGDP LNCP

**SE refers to the total variance error in forecasting lngdp.*
**SE refers to the total variance error in forecasting lncp.*

4.10.1 Response Functions (IRFs) for lngdp

Response of LNGDP:

Period	LNGDP	LNCP
1	0.088436	0.000000
	(0.01977)	(0.00000)
2	0.093344	0.010023
	(0.02183)	(0.02432)
3	0.099437	0.011675
	(0.02494)	(0.02811)
4	0.106018	0.012546
	(0.02916)	(0.03012)
5	0.113044	0.013387
	(0.03451)	(0.03205)
6	0.120536	0.014275
	(0.04098)	(0.03410)
7	0.128525	0.015222
	(0.04858)	(0.03628)
8	0.137044	0.016230
	(0.05732)	(0.03863)
9	0.146127	0.017306
	(0.06727)	(0.04114)
10	0.155812	0.018453
	(0.07849)	(0.04384)
11	0.166138	0.019676
	(0.09107)	(0.04673)
12	0.177150	0.020980
	(0.10510)	(0.04984)
13	0.188891	0.022371
	(0.12071)	(0.05317)
14	0.201410	0.023853
	(0.13803)	(0.05676)
15	0.214759	0.025434
	(0.15719)	(0.06061)
16	0.228993	0.027120
	(0.17837)	(0.06474)
17	0.244170	0.028918
	(0.20173)	(0.06919)
18	0.260353	0.030834
	(0.22746)	(0.07398)
19	0.277609	0.032878
	(0.25576)	(0.07913)
20	0.296008	0.035057
	(0.28687)	(0.08467)

4.10.2 Response Functions (IRFs) for lncp

Response of LNCP:

Period	LNGDP	LNCP
1	0.065240	0.127996
	(0.04302)	(0.02862)
2	0.080509	0.021384
	(0.02125)	(0.03963)
3	0.086923	0.011462
	(0.02316)	(0.02559)
4	0.092790	0.011104
	(0.02680)	(0.02641)
5	0.098951	0.011730
	(0.03146)	(0.02807)
6	0.105510	0.012497
	(0.03711)	(0.02986)
7	0.112503	0.013324
	(0.04374)	(0.03178)
8	0.119960	0.014207
	(0.05138)	(0.03383)
9	0.127910	0.015149
	(0.06008)	(0.03604)
10	0.136388	0.016153
	(0.06990)	(0.03840)
11	0.145427	0.017223
	(0.08091)	(0.04093)
12	0.155066	0.018365
	(0.09321)	(0.04365)
13	0.165344	0.019582
	(0.10689)	(0.04658)
14	0.176302	0.020880
	(0.12207)	(0.04971)
15	0.187987	0.022264
	(0.13887)	(0.05309)
16	0.200446	0.023739
	(0.15743)	(0.05671)
17	0.213732	0.025313
	(0.17791)	(0.06061)
18	0.227897	0.026990
	(0.20047)	(0.06480)
19	0.243002	0.028779
	(0.22529)	(0.06932)
20	0.259108	0.030687
	(0.25257)	(0.07417)

Cholesky One S.D. (d.f. adjusted)
Cholesky ordering: LNGDP LNCP
Standard errors: Analytic

5.0 References

1. Omoregie, Uyiosa (2018). *Nigeria's Petroleum Sector and GDP - The Missing Oil Refining Link*. Retrieved from https://ideas.repec.org/p/osf/socarx/5raqk.html
2. Mikalauskiene, Ciegis, Nakciunaite (2013). *Dependence between Labor Market and Economic Cycles*. Retrieved from https://www.researchgate.net/publication/277417941_Dependence_between_Labour_Market_and_Economic_Cycles
3. Žalgirytė, Gižienė (2014). *The analysis of trends in GDP and cyclical nature of GDP changes in Baltic states*. Retrieved from https://cyberleninka.org/article/n/1355134/viewer
4. Gylych, Jibrin, Celik, Isik (2020). *Impact of Oil Price Fluctuation on the Economy of Nigeria, the Core Analysis for Energy Producing Countries*. Retrieved from https://www.intechopen.com/online-first/73798DOI: 10.5772/intechopen.94055
5. Corden WM, Neary JP (1982). *Booming sector and De-industrialization in a small open economy*. 825-848. Retrieved from https://academic.oup.com/ej/article/92/368/825/5220457.
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6.0 Author

Siddhant Jhawar, the author of this research paper, is at the moment a rising junior in Daly College, Indore. He is highly fervent about disciplines involving mathematics, psychology, and economics. He plans on continuing the existing research for his future endeavors.