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ANALYSIS OF THE EFFECTS OF CRUDE OIL PRICE ON SECTORAL OUTPUTS IN NIGERIA.

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Abstract

This study examined the long-run, short-run and causality relationship between crude oil price and economic sectoral outputs in Nigeria for the period from 1970 to 2014 adopting Integration Stationary Test, Cointegration Test (Johansen and Engle and Granger), Error Correction Model (ECM), and Causality Test (VECM) to examine Five sectors (agriculture; manufacturing; building and construction; wholesale and retail; service) of the Nigerian economy. The long run regression estimate showed that crude oil price is a significant determinant of output growth in the agricultural; manufacturing; Building and Construction; Service sectors of the Nigerian economy with exception to the wholesale and retail sector while the short run error correction estimate showed that only output of the Building and construction; wholesale and Retail; and the Service sectors of the Nigerian economy is affected by crude oil price increase in the short run. Also, the Vector Error Correction Model- Granger causality test shows that, there exists a bi-directional causality running from both the agricultural sector and the service sector to crude oil price. The study recommended among others the need for the government to ensure adequate power supply in order to reduce the over reliance of economics sectors on crude oil products as a prime source of power and also recommends innovation in energy efficient technologies and upgrading existing equipment in order to reduce dependency on crude oil.

Keywords: Oil Price, Economic Sectoral Outputs, VECM, Cointegration, Causality.

1.0 Introduction

One of the world's most strategic natural resources is crude oil and it is required as a crucial input in contemporary economic activities. When Nigeria became politically independent in October 1960, Agriculture was its dominant sector contributing about 70% of the Gross Domestic Product (GDP), employing about the same percentage of the working population, and accounting for about 90% of foreign earnings and Federal Government revenue. The early period of post-independence up until mid-1970s saw a rapid growth of industrial capacity and output, as the contribution of the manufacturing sector to GDP rose from 4.8% to 8.2%. This pattern changed when oil suddenly became of strategic importance to the world economy through its supply-price nexus. (Adedipe 2004). The oil industry is a very important sector to the Nigerian economy as it provides among other things the greatest part of the foreign exchange earnings and total revenue needed for socio-economic and political development. The bulk of Nigerian crude oil is sold unrefined and when refined, the products range from petrol to heavy liquids for road tarring. Government has been the custodian of petroleum and its products in Nigeria. Though, this brought a temporary growth in the economy, the price instability of the crude oil in the world market has led to the downfall of Nigerians economy in various sectors, such as the production, manufacturing and services sectors. (Arinze 2011).

It is no news when one says that the Nigeria economy is beleaguered with epileptic power supply, political crisis, oil bunkering, and consistent vandalism of the oil pipes. This has constituted a major bottleneck to smooth productive activity across various sectors of the Nigerian economy. In order to meet local demand for

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energy, firms have relied heavily on the consumption of diesel and oil petroleum to power their manufacturing plants. With such heavy reliance on these oil products as inputs in the production process, a significant proportion of firms earning which otherwise would have been channeled into investment is used to meet energy shortage in the form of demand for diesel and petroleum. Therefore, such extensive use of crude oil makes the various sectors of the economy prone to unexpected price increase in crude oil (Philips & Aki 2013).

Oil price have been adjusted upward abruptly by different political and economic situations over the years since the early 1970s to date and this has witnessed the outcry of producers and owners of businesses on its implication on production cost and output. Consequently, intense debates and articles on the media have also been frequent on the possible adverse impact of such oil price reviews on firms production cost and output of different sectors of the economy. Analysing the effect of crude oil price on economic output by sector rather than on aggregate output (Gross Domestic Product (GDP)) is pertinent because the effect of changes in crude oil price on aggregate output may be the weighted total of the effects on sectoral output, and simply an aggregate analysis will ignore the individual response of sectoral output to changes in crude oil price. Previous studies in this regard such as Ehinomen & Adeleke (2012), Aigbedion & Iyayi (2007) among others have equally neglected this issue in their analysis. Thus, this study seeks to fill this empirical gap in literature by examining the effect of crude oil price on the various economic sectors of the Nigerian economy for the period 1970 to 2014.

2.0 Literature Review

It is now well documented in both empirical and theoretical literature that oil price has an effect on economic growth and development of an economy.

2.1 Economic Growth Theory

Economic growth is generally regarded as a necessary component of any development strategy. Given population growth, economic growth is necessary just to maintain the material quality of life at existing levels. Harrod-Domar theory is used to explain economic growth which is the main essential feature of an economically growing without a corresponding economic development. The theory shows that there is a positive relationship between saving and growth while there is a negative relationship between growth and capital ratio.

Growth can be mathematically expressed as; $G = s/k$.

Where;

k = incremental capital output,

s = the average propensity to save.

Also, Solow's theory of economic growth shows that growth is based on output, i.e. the combination of labour and capital. When input is doubled, then there will be increase in production too. It is mathematically written as; $Y = Af(L, K)$. The Solow growth model assumes that the marginal product of capital decreases with the amount of capital in the economy. In long run, when an economy accumulates more capital, the capital stock (gk) approaches zero and the growth rate is determined by technical progress and growth of labour force. While in the short-run, an economy that accumulates capital faster will enjoy a higher output. Furthermore, the traditional neoclassical growth theory assumes that output growth occurs from changes in factors namely: first, increase in labour quality and quantity i.e. through population growth and education; Second, increase in capital i.e. through saving and investment; Third, improvement in technology (Cass & Stiglitz 2008).

2.2 Empirical Literature

A couple of empirical studies have worked on the relationship between economic growth and oil price. Some of which includes Selim et al (2007) who wrote on the Oil Price Movements and the Global Economy. They developed a five-region version (the United States, Canada, an oil exporter, emerging Asia and Japan/euro area) of the Global Economy Model (GEM) encompassing production and trade of crude oil, and used it to study the international transmission mechanism of shocks that drive oil prices. In the presence of real adjustment costs that reduce the short-term and medium-term responses of oil supply and demand, their model accounts for large endogenous variations of oil prices with large effects on the terms of trade of oil-exporting versus oil-importing countries (in particular, emerging Asia), and result in significant wealth transfers between them.

This is especially true when considering a sustained increase in productivity growth or a shift in production technology towards more capital-intensive goods in regions such as emerging Asia.

When considering OECD countries, Ibrahim et al (2011) also investigated the effects of crude oil prices on the industrial production of some OECD countries (United State, United Kingdom, Canada, France, Netherlands, Italy and Japan). The relationships between variables are investigated with Johansen Cointegration approach which is based on the methodology of Johansen's VAR model. Their empirical result signifies that there is statistical meaningful short term causality from crude oil price to industrial production in all countries except France. In France however, causality is from industrial production to oil price in short run. Thus, shows that oil prices do affect industrial production index. They found that these results are similar to the results of oil exporting and importing countries such as Saudi Arabia and Iran when observed. Foreseeing that crude oil price is still very crucial for these economies Ibrahim et al (2011) recommended that enhancing oil supply security and guaranteeing oil supply to set up national strategic oil reserve for oil dependent industries is very crucial.

On Asian economies, Hui-Siang et al. (2011) examined the empirical relationship between the domestic fuel prices with the ten disaggregated economic sectors in Malaysia using quarterly data from 1990:Q1 to 2007:Q4. They found that only three sectors (agriculture, trade and other services sectors) are cointegrated with the fuel price and fuel price does Granger cause these sectors. With the evidence of non-cointegrated in most of the economic sectors, fuel price is still able to influence these sectors over a longer period. They recommend the utilization of the renewable energy (RE) as a strategic plan in the long-term due to the high dependency and increasing demand of energy. Also, sufficient government enforcement and support need to be established to facilitate successful renewable energy implementation in Malaysia.

Amaira (2012) also employs an empirical analysis to examine the impacts of oil price fluctuations on economic activity in Tunisia using a sample of observations from 1960 to 2009. The empirical analysis involves testing the time series characteristics of the data series using ADF test and running the pair wise Granger causality test, applying the Johansen cointegration test and the estimation of the long run cointegrating vectors. The analysis was capped with the estimation of short run Vector Error Correction Model (VECM). Even though Tunisian is not oil producing rather oil-importing country, Amaira found that an increase in oil price decrease economic growth of Tunisia. Increasing oil prices are the major concerns for all the developing economies and Tunisian is not exempted. Also, the increase in oil price affects the daily consumption pattern of households badly.

Some authors have also worked on the effect of oil price on African Countries, Some of which includes Nkomo (2006) who examined the impact of higher oil prices on Southern African countries (Angola, Zimbabwe, Tanzania, Zambia, Malawi, Botswana, Mozambique, South Africa, Namibia, Swaziland and Lesotho). In determining the magnitude of oil shocks to the economies of Southern Africa, Nkomo examined the various components of vulnerability as well as the crude oil price movements and the relationship between energy and development. Nkomo found that oil price shocks increase the total import bill for a country largely because of the huge increase in the cost of oil and petroleum products. Also, Low-income countries and poorer households tend to suffer the largest impact from oil price rise. Jerome et al (2007) also appraises the impact of oil on growth in seven major Sub-Saharan African oil exporting countries (Equatorial Guinea, Chad, Angola, Sudan, Nigeria, Congo, Gabon). They used a balanced panel data structure over the period 1987 to 2005 and a constructed Solow growth model using the generalized method of moments (GMM) estimator. The results indicate that initial level of GDP, investment rate and terms of trade have a significant and positive impact of on the growth process while volatility in crude oil price had a negative effect on growth in the sampled countries. According to them, these results are not very robust because the current sample consists of oil exporting countries of SSA but the Solow model accounted for important features of cross-country growth differences in the sampled countries. They recommended that it will be worthwhile to compare this growth process with the non-oil exporting countries of Sub-Saharan African and also to compare the growth process of the oil exporting countries of Sub-Saharan African with those of Latin America, North Africa and the Middle East and even Asian countries. From this, they believe a more definitive pattern may be discerned.

Some Nigerian authors who have also worked on the effect of oil price and economic growth; Nwosa (2012) examined empirically relationship between domestic fuel price and various macroeconomic variables in Nigeria for the period spanning 1986 to 2011. The study adopted both a vector auto-regressive (VAR) and a vector error correction (VEC) models for their analysis. Their variables that are integrated of the same order but are not co-integrated, the VAR model revealed that a unidirectional causation exists from domestic fuel price to short term interest rate while for the pair of variables that are integrated of the same order and are co-integrated

the VEC model revealed the existence of causality from domestic fuel price to inflation rate in the long run; in the short run. They recommended that caution should be taking by the government on domestic fuel price increase especially in an attempt to remove fuel subsidy and deregulate the downstream sector of the industry.

Philip & Akinyemi (2013) examined the long-run and short-run relationship between gasoline price and sectoral output in Nigeria for the period from 1980 to 2010. Six sectors (agriculture; manufacturing; building and construction; wholesale and retail; transportation and communication) of the economy were used. The long run regression estimate showed that gasoline price is a significantly determinant output in all sectors with exception to the building and construction sector while the short run estimate revealed that only output in the agriculture and the manufacturing sectors of the Nigerian economy is affected by gasoline price increase. They recommended that government should ensure adequate power supply in order to reduce the heavy reliance of economics sectors on gasoline as a prime source of power. It is apparent from the above review that there has been neglect among the previous studies on effect of crude oil price on output of the various sectors of Nigerian economy. This study will therefore fill this gap in literature by examining the effect of crude oil price on key sectoral output in Nigeria.

3.0 Methodology and Model Specifications

To examine the causality, short run and the long run relationship between crude oil price and economic output by sector in Nigeria, this study utilizes the Augmented Dickey -Fuller (ADF) and the Philip-Perron test for co-integration (Engle-Granger test and the Johansen Test), the Granger Causality test (VECM), and Error Correction Methodology (ECM). From the theoretical and empirical literature, reviewed on the impact of price on the Nigeria economic growth, the theoretical framework for this research work was established based on the reviews of these authors such as (Odularu 2008), (Odularu, Chinedu 2009), (Debel 2002), (Philip & Akinyemi 2013); the models are specified as follows;

$$\ln Y_{it}(Agr, Man, Wor, Boc, Ser) = f\{\ln(K_t, L_t, P_t)\} \quad (1)$$

where;

P = Crude oil price

Y = Sectoral Outputs (Agr (Agriculture), Man (Manufacturing), Wor (Wholesale and Retail), Boc (Building and Construction), Ser (Service)).

K = capital

L = Labour

Linearizing equation (1), we obtain:

$$\ln Y_{it}(Agr, Man, Wor, Boc, Ser) = \alpha_0 + \alpha_1 \ln K_t + \alpha_2 \ln L_t + \alpha_3 \ln P_t + \varepsilon_t \quad (2)$$

α_0 is the intercept, α_1 to α_3 are the slope of the coefficients of the independent variable to be determined, where ε_t is the error term at time t.

3.1 Testing for Trends and Stationary variables

It is important to know whether a time series is stationary or non-stationary before one embarks on regression analysis due to the danger of obtaining apparently significant regression results from unrelated data when non-stationary series are used in the regression analysis. Such regressions are said to be spurious. The study will commence its empirical analysis by testing the properties of the variables using the Augmented Dickey-Fuller (ADF) and the Philip-Perron tests to examine the stationarity /order of integration of the variables and helps detect the presence or absence of a unit root among the variables and tackle autocorrelation problem by ensuring that the series share the same integration/ unit root properties either at level, at first difference, second difference or at n difference stationary series bearing in mind that the stationarity properties of these variables because the Granger causality test is sensitive to the stationarity of the series. For the test of unit root, both trend and intercept are included to give power to alternative hypothesis of trend stationarity in the series.

3.2 Cointegration in Single Equation: Engle and Granger Approach

The Engle-Granger test is a procedure that involves an OLS estimation of a pre-specified cointegrating regression between the variables. After testing for the unit root of the variable and ensuring that the variables are co-integrated at order one $I(1)$ or at first difference. According to Engle and Granger (1987) the

long-run relationship between the variables can be determined using OLS to estimate a static model such as equation (3) below and the residual of the regression (ECT) will be generated.

$$\ln Y_{it(Agr, Man, Wor, Boc, Ser)} = \alpha_0 + \alpha_1 \ln K_{it} + \alpha_2 \ln L_{it} + \alpha_3 \ln P_{it} + \varepsilon_{it} \quad (3)$$

α_1 , α_2 and α_3 are the long-run output elasticities of Capital, Labour and Crude oil price respectively.

3.3 Johansen Maximum Likelihood Cointegration Approach

Johansen (1988) and Johansen (JJ, 1990) multivariate maximum likelihood approach is one of the alternatives of the Engle and Granger (1987) static model. One advantage of this approach is that the estimation procedure does not depend on the choice of normalization and it is much more robust than Engle-Granger test (see Gonzalo, 1994). Phillips (1991) also documented the desirability of this technique in terms of symmetry, unbiasedness and efficiency. They developed two test statistics to determine the number of cointegrating vectors – the Trace and the Maximal Eigenvalue (M.E) statistics:

$$\begin{aligned} \lambda_{Trace}(r) &= -T \sum_{i=r+1}^k \ln(1 - \lambda_i) \\ \lambda_{Max}(r, r+1) &= -T \ln(1 - \lambda_{r+1}) \end{aligned} \quad (4)$$

$$(5)$$

Where T represents the number of effective observations and λ s are estimated eigenvalues. For real market analysis, with sample size of less than 100, the trace and M.E statistics is adjusted by a factor $(T-np)/T$, where T represents the effective number of observations, n stands for the number of variables and p is the lag order. This allows for correction towards bias finding evidence for cointegration in finite or small sample.

3.4 Granger Causality - Vector Error Correction Model (VECM)

The detection of cointegration implies that, the Granger causality will be conducted in vector error correction model (VECM) to avoid problems of misspecification (Granger, 1988). VECM is a special case of VAR that imposes cointegration on its variables where it allows us to distinguish between short run and long run Granger causality. The relevant error correction terms (ECTs) must be included in the VAR to avoid misspecification and omission of the important constraints (Granger, 1988). The existence of a cointegrated relationship in the long run indicates that the residuals from the cointegration equation can be formulated as follows:

$$\Delta Y_{it} = \alpha_0 + \sum_{i=1}^m \beta_{1,i} \Delta Y_{t-i} + \sum_{i=1}^n \beta_{2,i} \Delta P_{t-i} + \mu_1 ECT_{t-1} + \zeta_{1t} \quad (6)$$

$$\Delta P_{it} = \delta_0 + \sum_{i=1}^m \phi_{1,i} \Delta P_{t-i} + \sum_{i=1}^n \phi_{2,i} \Delta Y_{t-i} + \mu_2 ECT_{t-1} + \zeta_{2t} \quad (7)$$

Where Δ represents the lag operator, α_0 , δ_0 , ϕ s, and β 's are the estimated coefficients, m and n are the optimal lags of the series Y_{it} and P_{it} , ζ 's represents the serially uncorrelated random error terms while μ_1 and μ_2 measure a single period response of the Y_{it} (P) to a departure from equilibrium. Y_{it} refers to the relevant disaggregate economic sectors in Nigeria while P is the crude oil price. To test whether P does not Granger cause movement in Y_{it} , The null hypothesis is;

$H_0: \beta_{2,i} = 0$ for all i and $\mu_1 = 0$ in Equation (1), The rejection implies that P causes Y_{it} .

Same restrictions and testing procedure will also be applied in testing the hypothesis that Y_{it} does not Granger cause movement in P, where the null hypothesis

$H_0: \phi_{2,i} = 0$ for all i and $\mu_2 = 0$ in Equation (2), The rejection implies that Y_{it} causes P

In the case where cointegration is absent, then the standard first difference vector autoregressive (VAR) model is used. This is done through the elimination of ECT from both equations (6 & 7) above. Thus, contains only the short run causality information.

3.5 Error Correction Model

In order to estimate the short-run relationship among variables in equation (3), the corresponding error correction equation is estimated as follows:

$$\Delta \ln Y_{it(Agr, Man, Wor, Boc, Ser)} = \alpha_0 + \sum \alpha_1 \Delta \ln K_{t-i} + \sum \alpha_2 \Delta \ln L_{t-i} + \sum \alpha_3 \Delta \ln P_{t-i} + \Psi ECT_{t-1} + \varepsilon_t \quad (8)$$

The ECT_{t-1} is the error correction term of the short run equation which will show the difference between the predicted output of the sectors and the actual level of output produced. The Ψ is expected to be negative and less than equal to zero i.e. $-1 \leq \Psi \leq 0$ so that Ψ represents an estimate of the speed of adjustment to

disequilibrium. The higher the absolute value of Ψ , the faster we reach the long-run equilibrium. α_0 is the constant term while $\alpha_1, \alpha_2, \alpha_3$ represents the coefficient of the short-run impact of crude oil price on the various economic sectors. ε_t is error term.

4.0 Presentation and Interpretation of Results

4.1 Unit root test and order of Integration results

Augmented Dickey-Fuller (ADF) Test					Phillip-Perron (PP) Test			
Variables	Level	1st / 2nd Diff	P-Value	Status	Level	1st / 2nd Diff	Status	P-Value
LnY _{Agr}	-2.459	-4.514*	0.0045	I(1), C, T	-2.021	-4.390*	I(1), C, T	0.0062
LnY _{Boc}	-1.111	-5.301*	0.0005	I(1), C, T	-1.568	-5.384*	I(1), C, T	0.0004
LnK	-0.982	-3.821**	0.0271	I(1), C, T	-1.292	-5.598*	I(1), C, T	0.0002
LnL	-3.129	-3.555**	0.0469	I(1), C, T	-1.732	-3.569**	I(1), C, T	0.0454
LnP	-2.518	-6.090*	0.0001	I(1), C, T	-2.518	-6.091*	I(1), C, T	0.0001
LnY _{Ser}	-1.907	-4.435*	0.0010	I(1), C, T	-1.673	-4.343*	I(1), C, T	0.0070
LnY _{Wor}	-3.860	-9.622*	0.0000	I(1), C, T	-3.935	-9.622*	I(1), C, T	0.0000
LnY _{Man}	-2.304	-6.396*	0.0000	I(1), C, T	-2.340	-6.414*	I(1), C, T	0.0000

Note: C and T represents Intercept and linear trend respectively which also implies that the tests at first difference includes both Intercept and trend. * and ** denotes significant level at 1% and 5% significant level respectively.

Using the ADF test on the left hand and PP test on the right hand side of the table, the results for all variables in both level and first difference forms are presented. The null hypothesis for the test is that all variable has a unit root, against the alternative hypothesis that the variable does not have a unit root. It is observed that the variables; Agriculture (LnY_{Agr}), Capital formation (LnK), labour force (LnL), building and construction (LnY_{Boc}), Crude oil price (LnY_{Pri}), Service (LnY_{Ser}), Wholesale and retail (LnY_{Wor}), Manufacturing (LnY_{Man}) are all integrated of order one I(1). The finding of the ADF test also confirmed with that of the Phillip-Perron result on the other column (right hand) of table. Thus, the null hypothesis is rejected meaning that all the variables are stationary/integrated at order one I(1). Therefore, the cointegration test to denote long-run equilibrium relationship among the variables can now be tested.

4.2 Johansen Maximum Likelihood Cointegration Approach

According to the procedure, we must first determine the lag length of the VAR which must be small enough to allow estimation and high enough to ensure that errors are approximately white noise. Using different information criteria viz: Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), Hannan-Quinn Information Criterion (HQ), Final Prediction Error (FPE) and Sequential Modified LR Statistic (LR), thus can be conclude that the optimal lag length for the variables is three. The lag length selection criteria result is presented in the table below.

4.2.1 Lag Length Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-53.142	NA	3.18e-09	3.135	3.476	3.257
1	254.887	473.891	1.25e-14	-9.378	-6.307	-8.276
2	313.468	66.091	2.54e-14	-9.100	-3.299	-7.019
3	427.625	81.958*	7.88e-15*	-11.673*	-3.142*	-8.612*

* 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

	Trace Test					Maximum Eigen value Test				
	Null	Alternative	Statistics	95% critical values	P-value	Null	Alternative	Statistics	95% critical values	P-value
Y _{AGR}	$r=0$	$r \geq 1$	104.835*	47.856	0.000	$r=0$	$r \geq 1$	58.344*	27.584	0.000
	$r \leq 1$	$r \geq 2$	46.491*	29.797	0.003	$r \leq 1$	$r \geq 2$	24.236*	21.131	0.018
	$r \leq 2$	$r \geq 3$	22.255*	15.495	0.004	$r \leq 2$	$r \geq 3$	18.393*	14.265	0.011
	$r \leq 3$	$r \geq 4$	3.862*	3.842	0.049	$r \leq 3$	$r \geq 4$	3.862*	3.842	0.049
Y _{MAN}	$r=0$	$r \geq 1$	93.914*	47.856	0.000	$r=0$	$r \geq 1$	43.043*	27.584	0.000
	$r \leq 1$	$r \geq 2$	50.870*	29.797	0.000	$r \leq 1$	$r \geq 2$	23.408*	21.131	0.024
	$r \leq 2$	$r \geq 3$	27.462*	15.495	0.001	$r \leq 2$	$r \geq 3$	18.024*	14.265	0.012
	$r \leq 3$	$r \geq 4$	9.437*	3.842	0.002	$r \leq 3$	$r \geq 4$	9.437*	3.842	0.002
Y _{BOC}	$r=0$	$r \geq 1$	91.559*	47.856	0.000	$r=0$	$r \geq 1$	53.326*	27.584	0.000
	$r \leq 1$	$r \geq 2$	38.232*	29.797	0.004	$r \leq 1$	$r \geq 2$	21.116	21.132	0.050
	$r \leq 2$	$r \geq 3$	17.117*	15.495	0.028	$r \leq 2$	$r \geq 3$	10.709	14.265	0.169
	$r \leq 3$	$r \geq 4$	6.407*	3.842	0.011	$r \leq 3$	$r \geq 4$	6.407*	3.842	0.011
Y _{SER}	$r=0$	$r \geq 1$	123.307*	47.856	0.000	$r=0$	$r \geq 1$	75.962*	27.584	0.000
	$r \leq 1$	$r \geq 2$	47.345*	29.797	0.000	$r \leq 1$	$r \geq 2$	26.170*	21.132	0.009
	$r \leq 2$	$r \geq 3$	21.175*	15.495	0.006	$r \leq 2$	$r \geq 3$	14.847*	14.265	0.040
	$r \leq 3$	$r \geq 4$	6.328*	3.842	0.011	$r \leq 3$	$r \geq 4$	6.328*	3.842	0.012
Y _{WOR}	$r=0$	$r \geq 1$	85.287*	47.856	0.000	$r=0$	$r \geq 1$	39.248*	27.584	0.001
	$r \leq 1$	$r \geq 2$	46.039*	29.797	0.000	$r \leq 1$	$r \geq 2$	23.869*	21.132	0.020
	$r \leq 2$	$r \geq 3$	22.171*	15.495	0.004	$r \leq 2$	$r \geq 3$	14.573*	14.265	0.044
	$r \leq 3$	$r \geq 4$	7.598*	3.842	0.006	$r \leq 3$	$r \geq 4$	7.597*	3.842	0.005

4.2.2 The Result of Unrestricted Cointegration rank test

Note: * denotes the rejection of the null hypothesis at a 5% significant level

To determine the number of the cointegrating vectors, both the Trace test and the Maximum Eigen-value test were used, using the more recent critical values of MacKinnon-Haug-Michelis (1999).

Using the co-integration estimate in the table above, it is observed that the null hypothesis of no co-integration at $r = 0$, $r \leq 1$, $r \leq 2$, and $r \leq 3$ were rejected by the trace statistic in all the models. Thus, confirming the existence of four cointegrating relationships in all the models for the different sectors while null hypothesis of no co-integration at $r = 0$, $r \leq 1$, $r \leq 2$, and $r \leq 3$ were rejected by the maximum-eigen statistic in all the models with exception to the Building and Construction sector model which the maximum-eigen test indicates one cointegration between the variables while the trace test indicates four cointegration between the variables. Since both the Trace test and the maximum eigen statistic test are eligible tests for cointegration. Thus, for the purpose of this study and with respect to the Building and Construction sector, the cointegration estimate by the trace statistic is adopted. This implies that there exist four co-integrating equations in all the models and suggests the existence of a long run relationship among the variables in the models and thus the null hypothesis of no cointegration can be rejected.

4.3 Engle and Granger Cointegration Approach and Estimation of Long-run Elasticities

The first step of the Engle and Granger approach which shows the long-run elasticities of our model presented in table below.

4.3.1 Long-run Regression Cointegrating Equation

INDEPENDENT VARIABLES	DEPENDENT VARIABLES				
	LN _Y _{AGR}	LN _Y _{MAN}	LN _Y _{BOC}	LN _Y _{WOR}	LN _Y _{SER}
LNP	-0.174 (0.0002)*	-0.100 (0.0179)**	-0.464 (0.0000)*	-0.155 (0.1381)	-0.160 (0.0008)*
LNL	7.915 (0.0000)*	7.230 (0.0000)*	1.951 (0.0000)*	6.394 (0.0000)*	6.177 (0.0000)*
LNK	0.251 (0.0000)*	0.334 (0.0000)*	0.637 (0.0000)*	0.357 (0.0000)*	0.325 (0.0000)*
R ²	0.996	0.989	0.990	0.977	0.995
S.E of Reg.	0.177	0.311	0.212	0.433	0.186
F-Stat.	3418.71	1195.85	1294.67	542.969	2694.90
Prob.(F-stat)	0.000	0.000	0.000	0.000	0.000
D.W	1.0808	0.855	1.433	1.660	0.831

Notes: numbers above parentheses are coefficient values while numbers in the parentheses () are Probable values. */** denotes significance level at 1% and 5% respectively

Table 4.3.1 above shows that with respect to the variable of interest (Crude oil price (lnP)) exception to the Wholesale and retail sector (lnY_{WOR}) model, The result revealed that crude oil price is a determinant of output in the Agriculture (lnY_{AGR}), Manufacturing (lnY_{MAN}), Building and Construction (lnY_{BOC}) and Service (lnY_{SER}) sectors of the Nigerian economy in the long-run. A one percent increase in gasoline would result in a decline in Agricultural, Building and Construction and Service sectors by 17.4%, 46.4%, 16% respectively at one percent significant level. Also an increase in Crude oil price by one percent would culminate in a decline in Manufacturing (lnY_{MAN}) outputs by 10% at five percent significant level. The implication of the above result is that Crude oil price plays an important role in the productivity of most sectors of the Nigerian economy in the long run. This impact however differed among the sectors with the Building and Construction sector having the most adverse impact of any increase in Crude oil price in Nigeria. The stationarity properties of the residuals from the long run estimates were then examined and the results presented on the table below.

4.3.2 ADF Residual (ECT) Stationarity Test

Augmented Dickey-Fuller (ADF) Test		
Variables	Level	Status
Resid-Agr (ECTA)	-3.859*	I(1)
Resid-Man (ECTM)	-3.454**	I(1)
Resid-Boc (ECTB)	-4.680*	I(1)
Resid-Wor (ECTW)	-5.274*	I(1)
Resid-Ser (ECTS)	-3.287**	I(1)

Note: */** denotes 1% and 5% significance level respectively. The critical values of the residual are -3.6009, -2.935001 and -2.605836 at 1%, 5% and 10% significant levels respectively.

Table 4.3.2 above shows that using the Augmented Dickey Fuller test, it is revealed that the residuals from individual models are stationary at levels (that is integrated of order one) with Agriculture (ECTA), Building and Construction (ECTB), Wholesale and Retail (ECTW) at one percent significant level while Manufacturing and Service sectors are significant at five percent significant level. Thus, the ADF test on the residuals indicates that cointegration exists between the models variables and a long-run relationship between the economic variables can be expected.

Error Correction Model and the Estimation of Short-Run Elasticities

In addition to the long run estimate discussed above, this study also examined the short run relationship between the oil price and sectoral output by utilizing the short run error correction model of equation presented below.

$$\Delta \ln Y_{it} = \alpha_0 + \sum \alpha_1 \Delta \ln K_{it} + \sum \alpha_2 \Delta \ln L_{it} + \sum \alpha_3 \Delta \ln P_{it} + \psi ECT_{t-1} + \varepsilon_t$$

The ECT_{t-1} is the error correction term of the short run equation which will show the difference between the predicted output of the sectors and the actual level of output produced. The ψ is expected to be negative and less than equal to zero i.e. $-1 \leq \psi \leq 0$ so that ψ represents an estimate of the speed of adjustment to equilibrium. The result of the short run estimate is presented on table below. It shows that with respect to the parsimonious regression estimate capturing the short run analysis, it is observed from that there is significant improvement in the parsimonious model of the over parameterized model.

1.1 Parsimonious Short-run Regression Estimate

INDEPENDENT VARIABLES	DEPENDENT VARIABLES				
	$\Delta \ln Y_{AGR}$	$\Delta \ln Y_{MAN}$	$\Delta \ln Y_{BOC}$	$\Delta \ln Y_{WOR}$	$\Delta \ln Y_{SER}$
ECM(-1)	-0.549 (0.001)*	-0.417 (0.015)*	-0.614 (0.004)*	-0.901 (0.000)*	-0.380 (0.005)*
$\Delta Y(-1)$	0.533 (0.005)*	-	-	-	0.443 (0.001)*
$\Delta Y(-2)$	-	-	-	-	-
$\Delta Y(-3)$	-	-	-	-	-
$\Delta \ln P$	-	0.597 (0.000)*	-0.413 (0.000)*	-0.338 (0.100)***	-0.164 (0.003)*
$\Delta \ln P(-1)$	-	-	-	-	-
$\Delta \ln P(-2)$	-	-	-	-	-
$\Delta \ln P(-3)$	-	-0.169 (0.097)***	-	-	-
$\Delta \ln K$	-	0.416 (0.004)*	0.385 (0.005)*	0.624 (0.007)*	-
$\Delta \ln K(-1)$	-	-	-	-	-
$\Delta \ln K(-2)$	-	-	-	-	-
$\Delta \ln K(-3)$	-	-	-	-	-
$\Delta \ln L$	-	10.873 (0.030)**	-	17.722 (0.069)***	-
$\Delta \ln L(-1)$	-	-	-	-	-
$\Delta \ln L(-2)$	-	-	-	-	-
$\Delta \ln L(-3)$	-	-	-	-	-
Adjusted-R ²	0.557	0.618	0.538	0.555	0.544
S.E of Reg.	0.125	0.200	0.187	0.418	0.108
F-Stat.	11.861	13.009	11.412	9.373	11.393
Prob.(F-stat)	0.000	0.000	0.000	0.000	0.000
D.W	1.951	1.758	1.758	2.042	1.986

Notes: numbers above parentheses are coefficient values while numbers in the parentheses are Probability values. */**/** denotes significance level at 1%, 5% and 10% respectively. Y refers to output of the various sectors (that is Agriculture (AGR), Manufacturing (MAN), Building and Construction (BOC), Wholesale and Retail (WOR) and Service (SER))

From table 4.4.1 above, it was observed that the various models were fit and appropriate for the analysis. The adjusted R-squared of the model ranged from about 0.54 percent (Service sector) to 0.61 percent (Manufacturing sector); suggesting that a relatively high proportion of variations in output across the sectors

was explained by the explanatory variables in the models. The high and significant value of the F-Statistic further confirmed the fitness of the model. The Durbin Watson Statistics in all the models were close to 2 (ranging from 1.75 (Manufacturing and Building sector) to 2.04 Wholesale and Retail sector)). The coefficients of error correction term (ECM(-1)) in each model were both statistically significant at one percent and negative. The negative sign of the error correction term indicates a backward movement toward long run equilibrium from short run disequilibrium. This feedback movement ranged from about 38% (Service sector) to 90% (Wholesale and Retail sector) across the five models. With regard to the variable of interest (that is crude oil price ($\ln pri$)), it was observed that in all the models (with exception to the manufacturing sector model), the current value of crude oil price had a significant negative effect on their outputs. Thus, a one percent increase in current crude oil price would result in a decline in current building and construction, wholesale and retail, service sectors output by 41%, 34%, 16% respectively in the short run. With respect to the manufacturing output, it is revealed that in the short run the current value of crude oil price had significant and positive effect on current manufacturing output. Therefore, a one percent increase in current crude oil price would result in an increase in current manufacturing output by 59% while a one percent increase in the third lagged value of crude oil price would bring about a decline in manufacturing output by 17%. With respect to the remaining sectoral model (that is Agriculture) both current and the lagged values of crude oil price were observed to have insignificant effects on output. This implies that crude oil price does not have a significant impact on the output of the Agriculture sector in the short run.

4.5 Residual Diagnostic Tests

The robustness of the models estimate were further ascertained by carrying out various diagnostic tests on the residual of the ECM model; namely the histogram and normality test, the serial correlation LM test and the ARCH LM test. The Jarque-Bera statistics from the histogram and normality test on all the models were insignificant, implying that the residual from the error correction model is normally distributed. More so, both the Serial Correlation and ARCH LM test confirmed that there is no serial correlation in the residuals of ECM regression. This is because the F-statistics of both tests on all the five models were insignificant. In other words, the errors are conditionally normally distributed and can be used for inference (Nwachukwu & Odi, 2009). The results of the diagnostic test on the residuals are presented in table below.

4.5.1 Residual Diagnostic Tests

Agricultural sector		
Diagnostic Tests	F-statistics	Probability
Serial Correlation LM (3)	0.217	0.805**
ARCH (3)	3.230	0.080**
Normality	Jarque-Bera3.534	0.170**
Manufacturing sector		
Diagnostic Tests	F-statistics	Probability
Serial Correlation LM(3)	0.844	0.439**
ARCH (3)	0.015	0.902**
Normality	Jarque-Bera46.215	0.237**
Building and Construction sector		
Diagnostic Tests	F-statistics	Probability
Serial Correlation LM(3)	1.345	0.273**
ARCH (3)	2.272	0.139**
Normality	Jarque-Bera15.115	0.436**
Wholesale and Retail sector		
Diagnostic Tests	F-statistics	Probability
Serial Correlation (3)	0.178	0.837**
ARCH (3)	0.010	0.919**
Normality	Jarque-Bera388.61	0.324**
Service sector		
Diagnostic Tests	F-statistics	Probability
Serial Correlation LM(3)	0.068	0.934**
ARCH (3)	0.156	0.695**
Normality	Jarque-Bera9.161	0.210**

** denotes fail to reject the null hypothesis; there is no problem evident in diagnostic test. () denotes number of lags used in test.

The import from the above findings is that the impact of a change in crude oil price has a long run effect on the output on most sectors of the Nigerian economy than a short run effect. This could result from rigidities of adjustment to price changes in the short run, however in the long run such price change would be absorbed in the production decision of firms, thereby resulting in a decline in output of firms.

4.6 Granger Causality Test- VECM Long-run and Short-run Causality

When cointegration is detected, then the Granger causality will be conducted in vector error correction model (VECM) to avoid problems of misspecification (Granger, 1988). Table presented below shows the long-run and short-run causality estimate between crude oil price and the various economic sectors used in the study.

4.6.1 Estimated Long-Run and Short-Run Causalities

Causality between Crude oil price and Economic sectors Outputs

	LONG RUN CAUSALITY					Chi-square	SHORT RUN CAUSALITY			
	AGR	MAN	WOR	BOC	SER		AGR	MAN	WOR	BOC
ECT(-1)	-0.9138*	-0.4669*	-0.3679*	-0.4472	-0.4905*		9.4104*	7.3797	5.1952	0.3682
Prob	0.0000	0.0000	0.0004	0.2105	0.0001		0.0243	0.0607	0.1580	0.9467
Std-Error	0.1581	0.0922	0.0886	0.3466	0.1036	F-stat	3.1367	2.4599	1.73173	0.1227
T-Stat	-5.7792	-5.0603	-4.1495	-1.2899	-4.7344					

Causality between Economic Sectors Outputs and Crude oil Price

	LONG RUN CAUSALITY					Chi-square	SHORT RUN CAUSALITY			
	AGR	MAN	WOR	BOC	SER		AGR	MAN	WOR	BOC
ECT(-1)	-0.8012*	-0.2873	-0.3802	-0.7637	-0.7818*		2.8448	0.8773	3.6973	1.0902
Prob	0.0036	0.2702	0.3154	0.1266	0.0000		0.4162	0.8309	0.2961	0.7794
Std-Error	0.2461	0.2539	0.3700	0.4810	0.1254	F-stat	0.9483	0.2924	1.2324	0.3634
T-Stat	-3.2563	-1.1311	-1.0273	-1.5878	-6.2302					

Note; * denotes significant at 5% and the existence of a causality.

The results presented in the table above are the causality estimates in vector error correction model (VECM). With respect to the causality between Crude oil price and Economic sectors Outputs, we see that the *ect(-1)* is negative and statistically significant at one percent level in all the economic sectors model (with exception to the Building and Construction sector) suggesting that Agricultural, Manufacturing, Wholesale & Retail and Service sector all granger causes crude oil price in the long-run. Also, the statistical significance of the *ect* also suggest that crude oil price bears the brunt of short run adjustment to bring about the long run equilibrium.

Estimating a Wald test on the coefficients of the different economic sectors, we were able to get the short run causality between crude oil price and economic sectors. From the table we see that all the economic sectors (with exception to the Agricultural sectors) does not granger causes crude oil price in the short run because the probability value for the chi-square are all significantly different from five percent. But the Agricultural sector model shows that agricultural output granger causes crude oil price in the in the short run with it chi-square probability value to significant at five percent. While with respect to the causality between Economic Sectors output and crude oil price, we see that the *ect(-1)* is negative and statistically not significant at five percent level in all the economic sectors model (with exception to the Agricultural and the Service sector) suggesting that crude oil price does not granger cause the outputs of these sectors but only granger causes outputs of the Agricultural and Service sector. Estimating a Wald test on the coefficients of the different economic sectors, we were able to get the short run causality between economic sectors and crude oil price. From the table we see that there exist no causality between economic output and crude oil price, thus crude oil price does not granger causes economic sectors output due to the chi-square probability value not being significant at 5 percent level.

The import from the above findings is that there exist a bi-directional causality between crude oil price and both the agricultural sector and the Service sector output. This could be as a result of the component that makes up the service sector such as the transportation and Communication sector which has a very crucial need for petroleum products and are thus very sensitive to fluctuations in crude oil price.

5.0 Conclusion

Different econometric approaches such as the Johansen cointegration test, the Engle and Granger test, the Error Correction Model and the Vector Error Correction Model were all used in achieving the effects of crude oil price on the economic sectoral output. The long run regression estimate showed that crude oil price is a significant determinant of output growth in the agricultural; manufacturing; Building and Construction; Service sectors of the Nigerian economy with exception to the wholesale and retail sector. In addition, the short run error correction estimate showed that only output of the Building and construction; wholesale and Retail; and the Service sectors of the Nigerian economy is affect by crude oil price increase in the short run. This could result from rigidities of adjustment to price changes in the short run, however in the long run such price change would be absorbed in the production decision of firms, thereby resulting in a decline in output of firms. The significant coefficient for *ect* in the sectoral equations imply that that crude oil price is the leading variable for these three economic sectors in the long run. All the economic sectors in Nigeria are cointegrated with crude oil price from the Johansen test rest and through the Vector Error Correction Model- Granger causality test. There exists a bi-directional causality running from both the agricultural sector and the service sector to crude oil price. This could be as a result of the component that makes up the service sector, such as the transportation and Communication sector which has a very crucial need for petroleum products and are thus very sensitive to fluctuations in crude oil price.

5.1 Recommendation

Based on these findings, the study recommends that paramount care should be taken on future changes in crude oil price given the harmful effect on the various sectors of the Nigerian economy. Apart from the above, there is also the need for the government to stabilize power supply to reduce the over reliance of the sectors on oil products such as gasoline as a prime source of power. This would reduce the cost incurred on gasoline as an input in the production process and also aggregate production cost. Finally, fluctuation of crude oil prices has a challenge ahead for Nigeria in attaining sustainable economic growth which is very crucial. Thus, proactive agenda should be formulated to ensure efficient coordination in the future scenario of the oil prices. Among which includes the innovation in energy efficient technologies and upgrading existing equipment in order to reduce dependency on crude oil.

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