COVID-19: DYNAMICS OF SOCIOECONOMIC SHOCKS ON ENERGY SECTOR PERFORMANCE IN AFRICA

By

Ajeigbe, Omowumi Monisola (Ph. D)
Department of Economics, Faculty of Social Sciences, Redeemer's University, Ede, Nigeria
Phone No.: 08036151959 Email: ajeigbeo@run.edu.ng, amonisla@yahoo.com

&

Adesina, Olumide Sunday (Ph. D)
Department of Mathematics, Faculty of Natural Sciences, Redeemer's University, Ede, Nigeria
Phone No.: 08034809642 Email: adesinas@run.edu.ng, olumidestats@gmail.com

Abstract

The resistance of the energy sector in recent time has been tried by COVID-19 as the occurrence has added to the dampening down demand for crude oil which has resulted in volatility in prices and dwindling production of crude oil at the global crude oil market. Dwindling demand and price decline can also be perceived as a trend in the electricity sector, the electricity price and consumption. The consequences of individual policy response by countries in relation to the socioeconomic impact of COVID-19 is yet to be known and recent studies conducted in the continent are yet to document the impact of the pandemic on the oil-producing African countries. It is in the light of this that this study determined the effect of socio-economic shocks activated through the COVID-19 pandemic on the energy sector performance and economic development of Africa. Monthly data were sourced from the United States Energy Information Administration, COVID-19 geographic distribution worldwide, World Development Indicator and Trading Economics from 2019 (m12) to 2020 (m10). Seventeen oil-producing African countries were selected across the region based on data availability. The structural panel vector auto regression (SPVAR) analytical technique was used in estimating COVID-19 pandemic and socioeconomic shocks on the energy sector performance proxied by oil production (OILP), Electricity price (ELECTP) and Economic Development proxied by Gross Domestic Product per capita (GDPPC) of the countries. Findings revealed that the COVID-19 pandemic transmits a negative shock to oil production and GDP per capita while a positive shock is transmitted to electricity price. The socioeconomic variables also transmitted both the positive and negative shocks to OILP, ELECTP and GDPPC. Therefore, the study recommended that policies should be directed towards putting in place a shock-absorbing mechanism so as to cushion the effect of the identified shocks on the performance of the energy sector and the economic development of the countries.

Keywords: COVID-19, Energy sector, Socio-Economic, Structural PVAR, Shock, Performance

JEL Classification: B55 C23 E66

Introduction

The origin of the COVID-19 pandemic can be traced to the Province of Wuhan in China in the month of December 2019 where the aforementioned started spreading without control to every province in China to other nations of the World as people move from one place to another (Ozili, 2020; Nicola et al, 2020, Gossling, Scott & Hall, 2020). In Africa, the discovery of the first case of COVID-19 originated from Egypt on February 14th, 2020 which in recent time, 52 countries in Africa have confirmed cases. As the time of writing this article, the confirmed cases have risen to 1,685,503 with death cases of 40,546. The African countries recorded to have the highest cases were South Africa, Egypt, Nigeria, Ghana, Kenya and Morocco. Based on the records, the continent is yet to ascertain the number of cases reported as cases are underreported giving a doubt on the accuracy of data collection which can assist countries in the continent in policy response to the pandemic (OECD, 2020). The transmission of the pandemic to Africa has been traced to the existing trade relation between Africa and China as most countries in the continent are major importer of commodities from China. This has a spillover effect for most African countries as it has an adverse effect on African trades especially the businesses that depend solely on China for the stream of major and immediate raw materials (Ozili, 2020). The spread of COVID-19 to Africa created the need for urgent action in relation to universal reaction to end the pandemic, relieve the situation and put in place the base for lengthy period recovery (Ufua et al, 2021).

The disruption of the socioeconomic system of any economy can trigger a minute or great effect which can bring about various repercussions that can affect negatively both the social and economic welfare and invariable place an embargo on sustainable socioeconomic development (Bruneckiene, et al. 2019). The consequences of individual policy response by countries in relation to socioeconomic impact of COVID-19 is yet to be known and recent studies conducted in the continent are yet to fully document the impact of the coronavirus endemic on African countries. Studies available have been able to explore the impact of COVID-19 with specific focus on sectors and single country analysis through the use of various data collection techniques (Gossling et al. 2020; Laing 2020, Ozili, 2020, Ozili and Arun, 2020, Fernandes, 2020; Ather, et al. 2020; Fornaro and Wolf, 2020). Despite this, there is still dearth of literatures on the socioeconomic impact of COVID-19 with emphasis placed on empirical and cross-country analysis in Africa which according to World Health Organisation on 17th April, 2020 have identified Africa as the next epicentre of COVID-19.

The resistance of the energy sector in recent time has been tried by COVID-19 as the occurrence has added to the dampening down of demand for crude oil which has resulted in volatility of crude oil prices and decline in production at the global crude oil market. According to a report by the IEA oil market in April, 2020, it is expected that oil demand globally will experience a short fall of 9.3mb/d in the year 2020, which COVID-19 has fast-tracked the descent especially in the price of gas. Decreasing demand and reduction in price can also be identified as a trend in the electricity sector, basically the electricity price and consumption. A negative impact has been felt of COVID-19 on the renewable sector through the distribution of equipment to power plants, as China stands as the main manufacturer of several clean energy technologies (Global Energy Review, 2020, RES4Africa, 2019). Based on this, there is the need to study the impact of the pandemic on the sector given that consistent and sustainable energy is a fundamental need and more importantly, the sector has been noted for playing supportive and crucial services during the global crisis (United Nations Economic Commission for Africa, 2020).

The need to examine the impact of socioeconomic shocks on the performance of the energy sector can be justified as energy remains an essential commodity that enables socioeconomic development and fuels global economic activity. More so, in relation to economic development, the price of energy is fundamental to satisfying and enhancing the living standards of billions of people. In recent times, the energy sector has started a transition to renewable energy, which can only be studied through the hoop of social and economic factors (Liko, 2019). It is in the light of the above that this study looks at the effect of socio-economic shocks caused by the COVID-19 pandemic on the energy sector performance and economic development in Africa.

Methodology

Data Sources and Measurement of Variables

Monthly data were sourced from the United States Energy Information Administration, COVID-19 geographic distribution worldwide, World Development Indicator and Trading Economics from 2019 (m12) to 2020 (m10). Seventeen oil producing African countries were selected across the region based on data availability. The countries selected were Angola, Algeria, Nigeria, Libya, Gabon, Egypt, the Republic of Congo, Equatorial Guinea, South Sudan, Chad, Sudan, Tunisia, Cameroon, Ivory Coast, Niger, Morocco and Mauritania. Energy sector performance was proxied by oil production and electricity price. Economic development was proxied by Gross Domestic Product per capita income. The list of sources of socioeconomic determinants of the COVID-19 pandemic was adopted and modified from the study of (Stojkoski et al, 2020) namely Inflation, unemployment, balance of trade, and government debt. The energy sector (oil production and electricity price) and economic development are determined by the shocks in the above socioeconomic determinants. In the bid to measure the shocks from the COVID-19 pandemic, cases of COVID-19 on monthly basis were used starting from the first month when the virus was discovered in Africa and this was bring into line with monthly data of other variables in order to make sure there is consistency.

Variables	**Measurement**
Oil Production	Measuring oil production is based on barrels produced in a country.
Electricity Price	Electricity prices can be measured such that it reflects the cost to construct, fund, sustain and control power plants and the electricity grid.
Gross Domestic Product Per capita	The GDP per capita is measured by dividing a country’s economic output by its total population. This measurement reveals the standard of living and how thriving a country impression to each of its citizen.
Inflation	This is measured through the use of consumer price index (CPI). This is calculated using the percentage in the price of a basket of goods and services consumed by households.

Unemployment	This is measured by dividing the number of unemployed individual or persons by the number of persons presently employed in the labour force.
Balance of Trade	This is measured by subtracting the value of export from the value its import.
Government Debt	This is measured by the gross debt of the general government as a percentage of GDP.

Estimation Technique

The study made use of the Structural Panel Vector Autoregressive (SPVAR) model by Pedroni (2013) taking into justification reactions to factors based on eccentric in addition to collective structural shocks allowing complete cross member heterogeneity of the reaction dynamic forces. In other words, the structural panel VAR (SPVAR) has its foundation on structural decomposition of shocks into collective types of shocks against the eccentric types of shocks, taking into consideration the constituent shocks with every single of the identified categories of shocks (Amu, et al, 2021, Amisano & Giannini, 1997). The technique is usually preferred when analysing structural shocks and dynamics. SPVAR can be convenient to a wide-ranging of panel data types, as well as the composition of panels on multi-country or multi-regional data. Finally, the technique is applicable for unbalanced panels based on the data length which be at variance by a panel member. The SVAR panel method is suitable in the bid to improve inference for properties of the same distribution and for changing aspects of discrete members of the panel which is based on lack of adequate data especially for a predictable time series SVAR estimation.

The transmission of socioeconomic shocks triggered by the COVID-19 pandemic on the energy sector performance and economic development can be derived through the use of a reduced form of the Structural PVAR model for 11 months lags.

$$\mathrm{A}_0\Upsilon_{m,it} = \mathcal{L}_{m,io} + \sum_{i}^{k} \mathrm{B}_{m,i}\,\Upsilon_{m,it-1} + \mathrm{B}_{m,2}\Upsilon_{m,it-2} + \cdots \ldots .\,\mathrm{B}_n\Upsilon_{m,it-n} + \phi\mathrm{X}_{m,i} + \varepsilon_{m,it} \ldots\ldots\ldots\ldots\ldots (1)$$

From equation 1, the matrix specifying contemporaneous relationship among the variables is represented by $\mathrm{A}_0\Upsilon_{m,it}$ which is a $(Kx1)$ vector of three endogenous variables in such a way that $\Upsilon_{m,it} = \Upsilon_{m,it-1}, \Upsilon_{m,it-2}, \Upsilon_{m,it-3 \ldots\ldots\ldots} \Upsilon_{m,it-n}$ (oil production, Electricity price and GDP per capita). $\mathcal{L}_{m,io}$ represent $(Kx1)$ vector of constants constituting country-specific intercept terms. The coefficients of Matrix with lagged endogenous variables (for every $i = 1 - P$). $\mathrm{B}_{m,i}$ is represented by ϕ. The lag operator also captures $\mathrm{B}_{m,i}$ as a polynomial with restrictions typically imposed on the coefficient matrices. The stated model in this study imposes restrictions on the endogenous variables of energy sector and economic development. Vector of coefficients is represented by $\mathrm{X}_t.K$ with $\varepsilon_{m,it}$ representing the vector of uncorrelated error terms. $\varepsilon_{m,it}$ consists of socioeconomic shocks and COVID-19 cases in the selected African Countries. Therefore, error term $(\varepsilon_{m,it})$ consists of socioeconomic shocks triggered by COVID-19 pandemic. Any shocks arising from COVID-19 pandemic and socioeconomic activities are employed to record innovations based on the performance of the energy sector and the economic development of the selected countries in Africa. In the bid to capture socio-economic shocks, residual shock was considered based on the error term as shown below;

$$\Upsilon_{m,it} = z_i + \mathrm{A}(P)\Upsilon_{m,it} + H(P)\mathrm{X}_{m,t} + \nu_{m,it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where specifications for $\Upsilon_{m,it}$ and $\mathrm{X}_{m,t}$ is given as

$$\Upsilon_{m,it} = (oilp, electp\ and\ gdppc) \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots . (2a)$$
$$\mathrm{X}_{m,t} = (COVID\ 19\ and\ socioeconomic\ shocks) \ldots \ldots \ldots \ldots \ldots \ldots \ldots .. (2b)$$

Specification of the endogenous variables is shown in equation 2a. $\mathrm{X}_{m,t}$ in equation 2b explains the vector of the crude oil price, electricity consumption and economic development for each of the selected countries (endogenous variables) used in the study. Equation 2b explains the vector of the exogenous variable that reflects shocks. Zi stands for vector of constants representing country intercept terms. $\mathrm{A}(P)$ and $H(P)$ specify the matrices of polynomial lags which capture the interaction between the endogenous variables and their lags.
$\nu_{m,it.} = \mathrm{I}^{-I}\, \mu_{\varepsilon it}$ stands as vector of the error term.

The restrictions were imposed based on economic theory to discuss how each variable is placed for identification purpose. The assumptions show that the outbreak of COVID-19 triggered socioeconomic shocks thus impacting the performance of the energy sectors and the economic development of the selected countries in Africa. The study also assumes that COVID-19 cases and all the sources of socio-economic shocks affect the performance of the energy sector and the economic developments of the selected countries in Africa. Therefore, the study examined the effect of COVID-19 shocks and all the sources of socio-economics shock on the energy sector performance and economic development of African countries. The restriction imposed on the three endogenous variables are shown in equation 3. The dependent variables are listed in the first-row left-hand side of the matrix (crude oil price, electricity consumption and economic development).

$$\begin{bmatrix} OILP \\ ELECTP \\ GDPPC \end{bmatrix} = \begin{bmatrix} COVID & INFL & UNEMP & BOT & GOVTD \\ 1 & V & V & V & V \\ V & 1 & V & V & V \\ V & V & 1 & V & V \end{bmatrix} \qquad (3)$$

All the Vs explained the variables to be estimated. For illustration, OILP can be determined by COVID-19 shock and shock from inflation, unemployment, balance of trade and government debt. This takes the same process for electricity price and gross domestic product per capita.

Results and Discussion

Descriptive Statistics

The descriptive statistics made available the facts surrounding the sample statistics such as the mean, median, maximum and minimum value and also revealed the measurement of the sample distribution such as the kurtosis, skewness and the Jarque-Bera statistic. The study made use of 11 monthly data from December 2019 to October 2020. From the result, the maximum values for oil production, electricity price, GDP per capita, COVID-19, inflation, unemployment, balance of trade, and government debt were at 18%, 24%, 89%, 69%, 26%, 35%, 70%, and 15% while the minimum values were at 0.2%, 2.1%, 37%, 0, -19% 1% -19% and 40%. There is a high level of stability of the data as revealed by the mean and median values which lies inside the series of minimum and maximum value. The extent of the variation or degrees of dispersion of each series from its mean is calculated through the use of standard deviation (SD) revealing low values and giving the implication that there is a small deviations of the actual data from their mean. The result from the descriptive statistics also revealed 75% (6 of 8) positive skewness and 25% (2 of 8) negative skewness of the series distribution which by implication shows that the variables are skewed leftward and rightward. Based on the expectation of a perfectly symmetrical distribution such as normal distribution, it is expected that the coefficient of skewness measuring the degree of asymmetry or departure from symmetry of a distribution should be zero. From the result, most of the variables have their coefficient of skewness tends towards zero, signifying that the series used for the study are normally distributed.

Similar to skewness is the kurtosis, providing information about the degree of peakedness of distributions and the result from the descriptive statistics showed that 87.5% (7 of 8) of the variables have a platykurtic distribution (relatively flat-topped distribution) while the remaining have leptokurtic distribution series (relatively high peaked distribution). Nevertheless, skewness and kurtosis are not the complete statistics used for testing the normality of a probability distribution of a series. The statistics used to test normality or the asymptotic property of a series is the Jarque-Bera statistic which is calculated using the skewness and kurtosis coefficient of the series being studied. The basis for the analysis of normality or asymptotic property of a series is shaped by the postulation of series normality distribution which can be estimated using further test statistics like χ, t and F amongst others which are generally used in the appraisal of econometric model. Based on the estimated result from the descriptive statistics, the probability value of Jarque Bera statistics has the normally distribution assumption which is accepted at 1% or 5% for all the series. The result of the descriptive statistics is presented in Table 1.

Table 1: Descriptive Statistics

	OILP	ELECTP	GDPPC	COVID	INFL	UNEMP	BOT	GOVTD
Mean	312.2316	13.82727	3118.575	18584.28	4.088717	12.58289	-5861.596	75.09893
Median	102.0000	12.70000	2900.000	862.8710	3.200000	11.20000	-597.0000	70.20000
Maximum	1841.900	23.90000	8900.400	693739.4	25.80000	34.80000	700000.0	150.4000
Minimum	0.200000	2.100000	370.0000	0.000000	-18.50000	1.000000	-191428.3	40.00000
Std. Dev.	501.6687	6.006516	2403.177	84014.12	7.998155	9.011864	86214.94	29.88362
Skewness	2.143988	-0.279787	0.983391	6.897257	-0.057863	0.832896	5.325727	0.986564
Kurtosis	6.370824	2.204303	2.997168	51.14638	6.740164	3.066645	49.84901	3.350087
Jarque-Bera	231.7959	7.372928	30.14003	19544.32	109.1006	21.65544	17985.37	31.28973
Probability	0.000000***	0.025060**	0.000000***	0.000000***	0.000000***	0.000020***	0.000000***	0.000000***
Sum	58387.30	2585.700	583173.6	3475260.	764.5900	2353.000	-1096119.	14043.50
Sum Sq. Dev.	46810905	6710.551	1.07E+09	1.31E+12	11898.51	15105.75	1.38E+12	166103.7
Observations	187	187	187	187	187	187	187	187

*Note: ***, **, * denotes level of significance at 1%, 5% and 10%*

Source: Authors' Computation

Lag length selection criteria

Lag length selection criteria is the second estimation to be carried out in order to check if sufficient lags have been included in the VAR as too many lags have been known to result in a waste of the degrees of freedom while the inclusion of too few lags is expected to lead to autocorrelation in the residuals thereby resulting in misspecification of the equation. The result on the Lag Length selection criterion or appropriate lag length is presented in Table 2 where the selection criterion (LR, FPE, AIC, SIC & HQ) selected three, six and seven lags.

Table 2: Lag Length Test

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-941.7461	NA	4.46e+12	37.63710	38.31892	37.89765
1	55.07555	1641.824	6.75e-05	-1.101002	-0.078271	-0.710186
2	144.9961	137.5256	2.87e-06	-4.274357	-2.910715	-3.753269
3	176.8860	45.02108*	1.20e-06	-5.172001	-3.467449*	-4.520642*
4	184.9340	10.41505	1.30e-06	-5.134668	-3.089205	-4.353036
5	198.0921	15.48006	1.17e-06	-5.297729	-2.911356	-4.385825
6	209.4589	12.03547	1.17e-06*	-5.390546	-2.663263	-4.348370
7	219.6011	9.545551	1.25e-06	-5.435336*	-2.367142	-4.262888
8	225.2902	4.685183	1.68e-06	-5.305499	-1.896395	-4.002779

*Note: ***, **, * denotes level of significance at 1%, 5% and 10%*

Source: Authors' Computation

* specifies 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

The panel unit root test was carried out on all variables through the use of Levin Lin Chu (LLC) and Im Pesaran Shin (IPS). The variables were found to be stationary at levels for both LLC and IPS except COVID which was stationary at levels under the LLC alone. The result of the unit root is presented in Table 3.

Table 3: Unit Root Test Results for Stationarity of Variables

Variables	LLC	Levels	IPS	Levels	Remark
OILP	-1282.47***	I(0)	-754.141***	I(0)	Stationary
ELECTP	-287.673***	I(0)	-193.931***	I(0)	Stationary
GDPPC	-21341.1***	I(0)	-15241.6***	I(0)	Stationary
COVID	-243168**	I(0)	----	I(0)	Stationary
INFL	-394.820***	I(0)	-170.271***	I(0)	Stationary
UNEMP	-384.2541***	I(0)	-234.286***	I(0)	Stationary
BOT	-47.3576***	I(0)	-12520.9***	I(0)	Stationary
GOVTD	-1075.83***	I(0)	-783.212***	I(0)	Stationary

*Note: ***, **, * denotes level of significance at 1%, 5% and 10%*

Source: Authors' Computation

Kao Residual Cointegration Result

The Kao cointegration test showed that the probability value is at 1%, which implies that the Null Hypothesis of no cointegration cannot be rejected, thus, the result showed that there is the existence of no cointegration among the variables (Kao & Chiang, 2000). Table 4 presented the result.

Table 4: Kao Residual Cointegration

			t-Statistic	Prob.
ADF			-25.20910	0.0000***
Residual variance			9277.068	
HAC variance			5732.375	

*Note: *** denotes level of significance at 1%*

Source: Authors' Computation

The result of the stability test which revealed that the Eigen values lie inside the unit circle which by implication suggest that the VAR satisfies the stability condition. Table 5 presented the result.

Table 5: Stability Test
Eigen value Stability Condition

Eigen value	Modulus
0.999975	0.999975
0.999866	0.999866
0.986450	0.986450
-0.008714	-0.008714
-0.002387	-0.002387
-8.17e-05	-8.17e-05

Note: All the Eigen values lies inside the unit circle. VAR satisfies the stability condition

Source: Author's Computation

Table 6 present the result of autocorrelation where it was observed that the LRE*stat is statistically significant at 1% at Lag of 1, 2 and 3. Hence the Null hypothesis is rejected of No serial correlation. Therefore, we conclude that no autocorrelation exists in the residuals.

Table 6: VAR Residual Serial Correlation LM Tests

Lag	LRE*Stat	Df	Prob
1	405.1984	25	0.0000***
2	171.8029	25	0.0000***
3	81.48028	25	0.0000***

H_0: No serial correlation at lag order

*Note: *** denotes level of significance at 1%*

Source: Authors' Computation

The estimation of the Structural Panel VAR model and the contemporaneous relationship among the endogenous variables is presented in Table 7. The values were estimated in their natural forms at levels in order to prevent loss of information as a result of variables differencing. The negative shock from the COVID-19 pandemic to the energy sector and economic development of the selected countries in Africa is an indication of the danger which the pandemic is set to pose to the performance of the energy sector through oil production (-0.08), electricity price (-0.10) and economic development (-0.13) which invariably suggests that the countries should prepare to work towards how to rectify the damage that will be done to their energy sector and the economic development (used to measure the extent of the standard of living of the people). The negative shock from the pandemic more so causes a contemporaneous marginal increase in the cost of production of crude oil and electricity price which invariably will trigger an increase in the cost of living thereby causing a decline in economic development which is used to measure the standard of living of the people. A decline in the standard of living of the people in the selected African countries is expected to push more people into extreme poverty.

On the other hand, the sources of socioeconomic shocks triggered by COVID-19 pandemic used in the study also revealed a long-run relationship with energy sector performance and economic development of the selected African countries. A major socioeconomic shock triggered by COVID-19 is inflation (-0.03) which is used in measuring the macroeconomic stability of an economy. Inflation revealed a positive shock to oil production (0.48) while a negative shock is revealed for electricity production (-0.43) and economic development (0.29). This suggest that inflation can cause a contemporaneous marginal decline in oil production which can triggered further crises in the economy as oil has been seen to be the lifeblood of all human being. Invariably, the negative shock to electricity price and economic development implies that inflation can trigger a contemporaneous marginal increase in the price of electricity and increase in the general price level thus causing a decline in economic development through a decrease in the standard of living of people in Africa. Another socioeconomic shock triggered by COVID-19 pandemic is unemployment which transmits a positive shock to oil production (0.50) and economic development (0.66) which implies that unemployment can cause a contemporaneous marginal decline in the performance of the energy sector in the oil producing African countries and also a decline in the economic development of the countries. Unemployment also revealed a negative (-0.43) shock to the price of electricity which by implication unemployment can trigger a contemporaneous marginal increase in the price of electricity due to increased demand of electricity in unemployed households. Balance of trade (BOT) and Government Debt (GOVTD) are two socioeconomic activities triggered by COVID-19 pandemic as the result from table 6 revealed a positive shock from BOT to oil production and economic development. This suggested a contemporaneous marginal decline in the performance of the energy sector and economic development. In other words, a positive shock from exports and imports of goods and services causes a decrease in oil production, decrease in the standard of living of the people in the selected African country. On the other hand, BOT revealed a negative shock to electricity price which implies a contemporaneous marginal increase in electricity price. Finally, GOVTD revealed a positive shock which implies a contemporaneous marginal decline in the energy sector performance and economic development of the selected African countries

Table 7: Estimated coefficients of the short-run variables

	OILP	ELECTP	GDPPC	COVID	INFL	UNEMP	BOT	GOVTD
OILP	1	0	0	0	0	0	0	0
ELECTP	-0.68	1	0	0	0	0	0	0
GDPPC	0.12	-0.10	1	0	0	0	0	0
COVID	-0.08	-0.10	-0.13	1	0	0	0	0
INFL	0.48	-0.43	-0.29	-0.03	1	0	0	0
UNEMP	0.50	-0.43	0.66	-0.17	0.33	1	0	0
BOT	0.04	0.19	0.11	-0.02	0.00	0.36	1	0
GOVTD	0.46	0.46	0.04	-0.18	0.24	0.27	-0.04	1

Source: Author's Computation

Impulse Response Functions (IRFs) and Forecast Error Variance Decomposition (FEVD)
The IRFs functions revealed the interaction of responses of every single variable in the model to structural shocks on one standard deviation to other variables over time. On the other hand, measurement of the fraction of the forecast error variance of an endogenous variable that can be connected to orthogonalized shocks to itself or to another variable can be estimated through the use of forecast error variance decomposition. For the purpose of this study, response of the energy sector and economic development to shocks (innovation) is shown in Figure 1.

As part of the robustness check, the long run effects of the model response to shocks in addition to the extent of the effect among the variables. Additional analyses were employed using the Impulse Response Function and Variance Decomposition grounded on SPVAR. The result was presented for 10 periods. The impulse response function was presented in a diagram showing the generalized impulses one SD innovations which draw more meaningful interpretations for the short run and long run responses to shocks. Therefore, based on the impulse estimations, it is assumed that the first variable to appear explains the other variables but not vice versa. OILP, INFL and GOVTD indicates a negative short run correlation from the first to the eighth period and a positive long run correlation from the ninth to the tenth period while on the other hand, ELECTP, GDPPC, COVID, UNEMP and BOT revealed a positive correlation in the first to eighth period and a negative correlation in the ninth to tenth period. In the broad sense, oil production, inflation and government debt displayed a non-responsive to the outbreak of COVID-19 pandemic shock in the short run in which as more cases of COVID is discovered, there was a response to the shock from the pandemic. On the other hand, electricity price, gross domestic product per capita, COVID-19 pandemic, unemployment and balance of trade reacted immediately to shock from the pandemic both at the beginning of the period to the end. This implies that a minute shock from the pandemic has a long-lasting effect on the variables. The result showed that the pandemic triggered shock as it was revealed that it has a positive effect on itself from the beginning of when the case of COVID was first discovered in December, 2019 till date. The result is presented as Figure 1

Variance Decomposition
The impulse response function revealed the effect of shock of a structure with emphasis on an internal variable while the variance decomposition was conducted to influence individual variable's information based on the other variables showing the comparative effect. The estimated result predicted high variance contribution of COVID-19 pandemic shocks in the first and second period to oil production, electricity price, GDP per capita, inflation, unemployment, balance of

trade and government debt with the variance contribution gradually slowing down from the third to the tenth period. The result is presented in Figure 2.

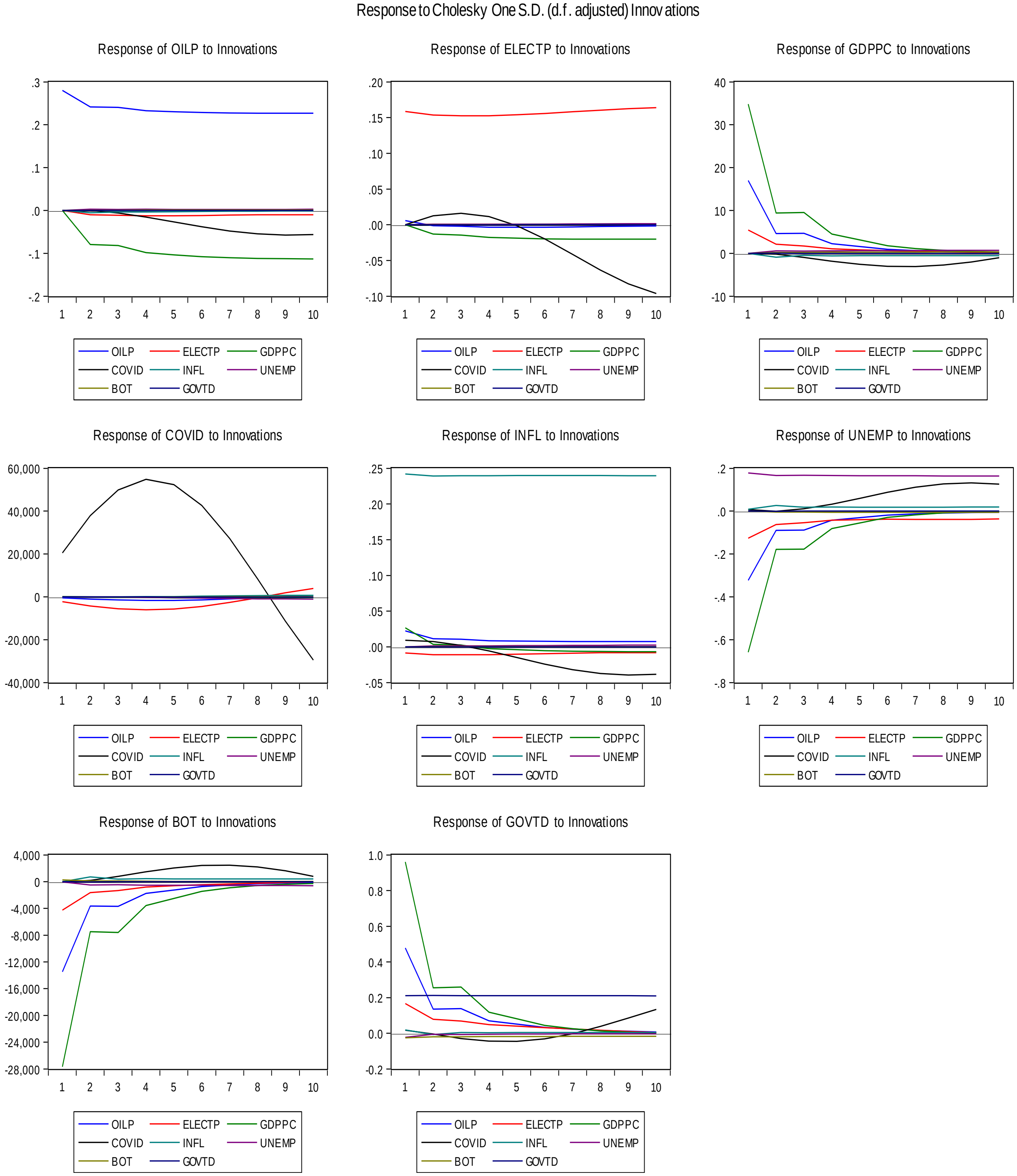

Figure 1: Impulse Response Functions (IRFs)
Source: Authors' Computation

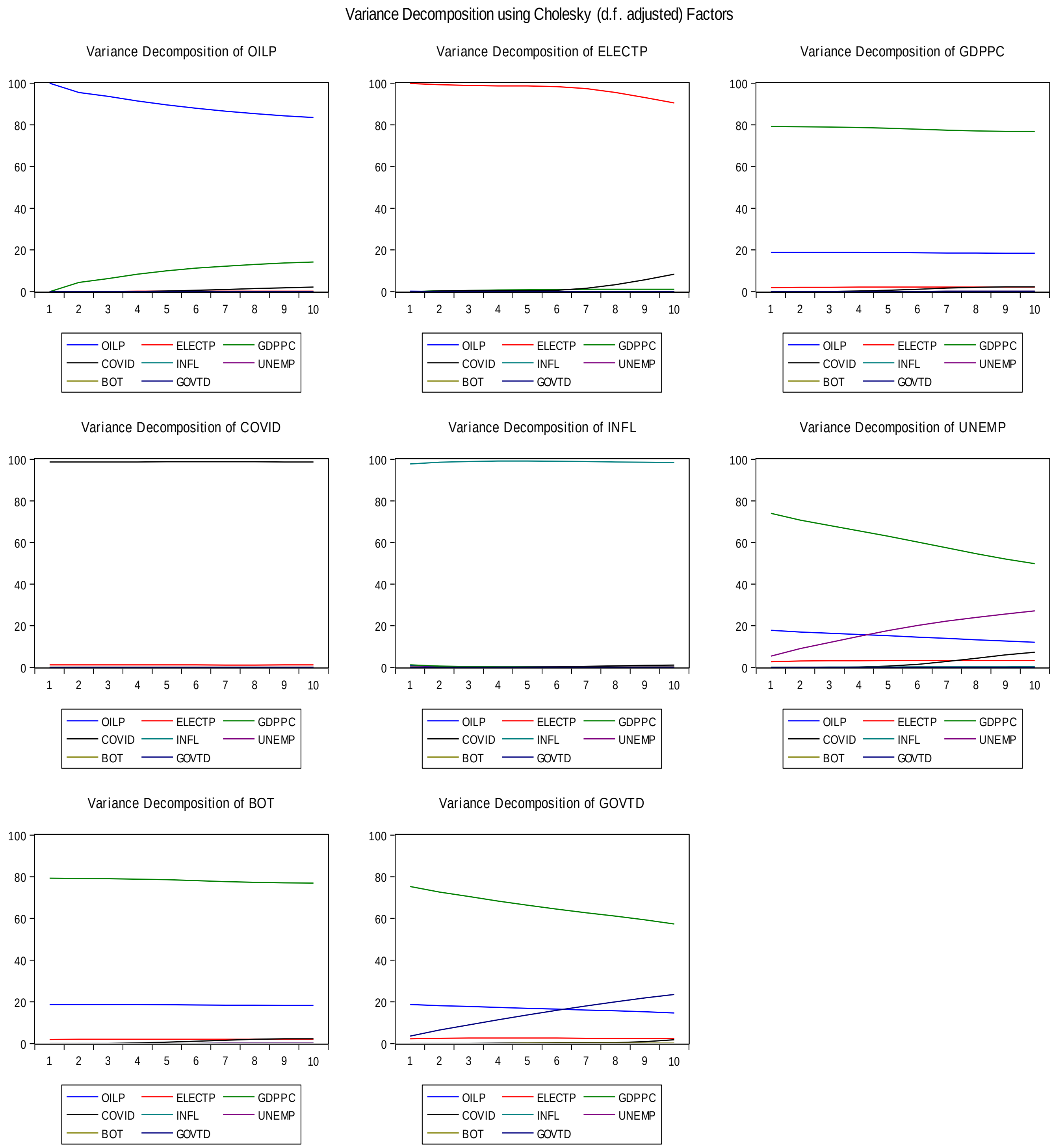

Figure 2: Forecast Error Variance Decomposition (FEVD)
Source: Author's Computation

Conclusion and Recommendation

The study examined the effect of socioeconomic shocks triggered by COVID-19 pandemic on the performance of the energy sector and economic development of oil producing countries in Africa. Seventeen countries were selected based on data availability. The socioeconomic variables used were selected based on a study which identified potentials socioeconomic determinants of COVID-19 pandemic namely inflation, unemployment, balance of trade and government debt. The energy sector was proxied by oil production and electricity price while economic development was measured by Gross domestic product per capita which measures the standard of living of the people.

The study made use of Structural Panel Vector Auto regression in estimating the variables considered for the study. It engaged various techniques such as the descriptive statistics, the unit root for stationarity test, the lag length selection criterion, the cointegration test, the stability test through the use of eigen value, the VAR residual serial correlation LM test, the coefficients of the short run variables, impulse response function and the variance decomposition. The impulse response function and variance decomposition techniques were employed to explain the response of the energy sector, economic development to socioeconomic shocks triggered by COVID-19 pandemic. This has policy implication as the findings from the impulse response function and variance decomposition revealed a large impact on the short run to shocks from COVID-19 and a mild impact on the long run.

The findings revealed that COVID-19 pandemic transmit a negative shock to oil production and GDP per capita causing a contemporaneous marginal increase in the cost of production of crude oil and increase in the cost of living thereby reducing the economic development (standard of living) in the selected country. On the other hand, a positive shock is transmitted to electricity price which implies a contemporaneous marginal decline in the production of electricity which the resultant effect can trigger increase in electricity price. The socioeconomic variables also transmitted both the positive and negative shocks to OILP, ELECTP and GDPPC. Therefore, the study recommended that policies should be directed towards putting in place shock absorbing mechanism so as to cushion the effect of the identified shocks on the performance of the energy sector and the economic development of the countries.

References

Amisano, G., & Giannini, C. (1997). Topics in Structural VAR Econometrics. 2nd Edition Berlin, Springer-Verlag.

Amu, B., Osabuohien, E., Alege, P. & Ejemeyovwi, J. O. (2021). Impact of Real Shocks on Business Cycles in Selected Sub-Saharan African Countries. *Cogent Business and Management*, *8*(1), 1875548.DOI: http://dx.doi.org/10.1080/23311975.2021.1875548

Ather, A., Patel, B., Ruparel, N.B., Diogenes, A. & Hargreaves, K.M. (2020). Coronavirus Disease 19(COVID-19): implications for clinical dental care; *Journal of Endodontics*, 46(5): 584-595.

Bruneckiene, J., Pekarskiene, I., Palekiene, O. & Simanaviciene, Z., (2019). An Assessment of Socio Economic Systems Resilience to Economic Shocks: The case of Lithuanian Regions; *Journal of Sustainability*; 11(566): 1-24

Fernandes, N. (2020). Economic effects of coronavirus outbreak (COVID-19) on the World Economy. Available at SSRN 3557504.

Fornaro, L. & Wolf, M. (2020). Covid-19 Coronavirus and Macroeconomic Policy, Working Paper, available at: SSRN:https://ssrn.com/abstract=3560337.

Global Energy Review (2020). The impacts of the Covid-19 crisis on global energy demand and CO2 emissions. www.iea.org/corrigenda

Gossling, S., Scott, D. & Hall, C.M. (2020). Pandemics, tourism and global change: a rapid

Assessment of COVID-19; *Journal of Sustainable Tourism*, pp. 1-20.
Kao, C. and Chiang, M.-H. (2000). 'On the estimation and inference of a cointegrated regression in panel data', in Baltagi B. H. (ed.), Advances in Econometrics: Non stationary Panels, Panel Cointegration and Dynamic Panels, Vol. 15, pp. 179–222.
Laing, T. (2020). The economic impact of the Coronavirus 2019 (Covid-2019): implications for the mining industry. The Extractive Industries and Society, in press.
Liko, G., (2019). Impacts of Energy Sector on the Economy, Social and Political Landscape and Sustainable Development: http://doi.org 10.13140/RG.2.2.12626.
Nicola, M., Alsafi, Z., Sohrabi, C., Kerwan, A., Al-Jabir, A., Losifidis, C., Agha, M., & Agha, R., (2020). The socio economic implications of the coronavirus pandemic (COVID-19): A review; *Int J. Surg*, 78: 185-193.
OECD (2020), "Supporting people and companies to deal with the Covid-19 virus: Options for an immediate employment and social-policy response", OECD briefs on the policy response to the COVID-19 crsis, OECD, Paris, https://oecd.dam-broadcast.com/pm_7379_119_119686- 962r78x4do.pdf.
Ozili, P.K. & Arun, T. (2020). Spill over of COVID-19: impact on the global economy, Available at SSRN 3562570.
Ozili, P.K. (2020). Covid-19 pandemic and economic crisis: the Nigerian experience and structural causes, Available at SSRN 3567419.
Pedroni, P., (2013). Structural Panel VARs, Journal of Econometrics; 2: 180-206:
The impact of COVID-19 on Africa Energy sector COVID-19 and Africa-socio-economic implications and policy responses.
RES4Africa Foundation, (2019). "Africa future's counts". Available [Online] at https://www.res4africa.org/wp-content/uploads/2019/06/ RES4Africa_flagship_2019.pdf
Stojkoski, V., Utkovcki, Z., Jolakoski, P. & Kocarev, L. (2020).The Socio-Economic determinants of the Coronavirus Disease (COVID-19) Pandemic. https://www.researchgate.net/publication/340712025.
Ufua, D., Osabuohien, E., Ogbari, M, Falola, H., Okoh, E. & Lakhani, A (2021). Re-Strategizing Government Palliative Support Systems in Tackling the Challenges of COVID-19 Lockdown in Lagos State, Nigeria. *Global Journal of Flexible Systems Management*. DOI: https://doi.org/10.1007/s40171-021-00263-z
United Nations Economic Commission for Africa, 2020a. Policy brief: Impact of COVID-19 in Africa. Retrieved from: https://www.uneca.org/sites/default/files/PublicationFiles/sg_policy_brief_on_covid-19_impact_on_africa_may_2020.pdf