POPULATION GROWTH, INVESTMENT, TRADE, ENERGY CONSUMPTION AND ECONOMIC GROWTH IN FIVE OIL-EXPORTING COUNTRIES

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Abstract

The desire to attain increased economic growth has been a major concern for all economies, irrespective of the development status, making it an integral part of global macroeconomics. This study adopts a dynamic panel econometric approach to determine the effects of population growth, foreign direct investment, energy consumption, and foreign trade variables on economic growth in five oil-exporting countries. The individual effects are revealed by t-statistic while the joint effects are shown by F-statistic. In essence, the study unfolds the explanatory power of the underlying variables in respect of economic growth in the affected countries. The study establishes cointegration among the variables and estimation results suggests that population growth, foreign direct investment and import trade have negatively significant effects on economic growth while energy consumption and export trade exhibit a positively significant effect on economic growth in all the estimated models moving from static to dynamic models. The joint effects of these variables are found to be significant indicating that they are strong factors of economic growth. The study therefore recommends a significant reduction in import and excessive population growth in conjunction with raising energy consumption and export trade component to boost economic growth in these oil-exporting economies.

Keywords: Oil-rich developing economies, Static regression, Dynamic model, Foreign trade component, Economic growth
***JEL Classification Codes*: B22; C23; F43; O4**

1. Introduction

In the economic literature, classical macroeconomic growth theory primarily focused on labour and capital. It did not consider the role of government nor energy resources, which have a significant role in economic growth and production (Hodula and Pfeifer, 2018). Energy is a critical factor of production that plays a vital role in developing the business input during the production process (Ahmad and Nu, 2017). Energy products such as oil and gas as well as electricity are very germane in any growth process especially in the modern day world. Their complementary roles in the production process cannot be simply overemphasized. Studies such as Al-Iriani (2006), Karanfil (2009), Adegboye and Babalola (2017), Dada (2019), Ozturk (2010), Magazzino (2016), Mundaca (2017), Onakoya, Jimi-Salami, & Odediran, (2013), Odugbesan & Rjoub, (2020), have also emphasized the role of energy in economic growth. This shows that energy is a strong factor in economic growth. Keynes and the Keynesian economics emphasize the role of government in economic growth. Many variables have been found to affect economic growth rates in country-specific, cross-sectional, and panel studies. For instance, government's roles in the economy may include that of ensuring a very sound energy policy that will positively influence the living condition and overall economic growth. This and many expansive roles of government have implications on her expenditure. Government expenditure therefore has been linked with economic growth variations accross countries of the world (see Abdullah, 2000; Abu & Abdullahi, 2010; Akpan, 2005; All-Usif, 2000; Dada, 2013, 2017; Bose, Hague & Osborn, 2007; Olugbenga & Owoeye, 2007; Peter, 2003, Gregorou & Ghosh 2007). On the other hand, the way government generate revenue to meet her expenditure also matters for economic growth. Government revenue therefore has been linked with economic growth. For example, Aregbeyen & Bashir (2015) confirmed a causal relation between oil revenue and economic growth. Government activities may also may atimes lead inflation which may also have it's own differential impact on different categories of people and economic growth in general. Studies like Hasanov & Omay, (2011); Hayford, (2000); Huang, Yeh, & Wang, (2019); Chang, & He, (2010); Dejan, Jelena & Natasa.(2020); Fountas, (2010); Wilson, (2006); Wu, Chen, & Lee, (2003); Frimpong & Oteng-Abayie, (2010); Eggoh & Khan, (2014); Vinaygathasan, (2013); Attari & Javed, (2013); Ayyoub, (2016); Chimobi, (2010), Ayyoub, Chaudhry, & Farooq (2010), among others, have linked inflation with economic growth. According to Presley, Wesseh & Lin (2018), exchange rate fluctuations, oil price shocks, and consumer prices have been linked with economic growth. In some other studies, money supply has been reported having a link with economic growth, (see, for example., Cheng and Lai, 1997; Fatas & Mihov, 2001; Blanchard and Perotti, 2002; Mohammad, Wasti, Lal & Hussein, 2009; Ogunmuyiwa & Ekone, 2010; Chowdhury, Kundu, Sarkar, 2018, Pintilescu et al., 2014), among others.

Also, the explanatory power of foreign direct investment in relation to economic growth has been tested (see, for example, De Gregorio, 1992; Lensink & Morrissey, 2006; Ndiaye & Xu, 2016; Vojtovic, Klimaviciene & Pilinkiene, 2019; Simionescu, 2018; Li & Mak, 1994, Akinlo 2004), among others. The experience from the extant literature shows that several factors have been found to influence economic growth across countries of the world. It is also very important to acknowledge the role of population in economic growth. Population as a variable could induce or impede economic growth depending on the population's health status, wellness, and skillfulness. The structure of the population can also matter for economic growth variance. It is a common knowledge to postulate that a vibrant population with a high intelligence quotient is growth-induced while the converse is equally true. Therefore, the game is not that of number but of the physical and mental state of being. So, the population effect on economic growth may be two-sided. It could be harmful or beneficial, the outcome is mutually exclusive. Based on this fact, countries of the world put a varying degree of commitment on the quality of their population. At the same time, some invest so much of their resources in their population to enhance the quality, while others show less concern. The population may only be rising in terms of numbers with little or no effect on productivity. This is a common syndrome in most high populated low-income developing countries. It has also been argued that in the future, the low population characterizing most high-income developed countries of the world today may slowdown economic growth. This implies that there are different dimensions to the relationship between population and economic growth. One key factor is embedded in the endogenous growth theory, which emphasizes human capital and knowledge-driven growth. High population growth might become a blessing to economic growth if a high population is associated with adequate education and training with heavy capacity in human capital development. However, the cost of maintaining quality education and enhanced infrastructure for a high population scenario is very high and may be difficult for low-income countries to attain especially with the high level of corruption in these countries. In this case, we are at a knife-edge.

Concerning foreign direct investment, the ability and political will of countries, particularly less developed countries, to attract environmentally friendly foreign direct investment vary from one country to another. For instance, more foreign direct investment is attracted to countries with political stability, relative peace, and security, while less is attracted to countries with political instability, civil unrest, and insecurity. Investors are less likely to invest in politically unstable or war torn regions. So, the magnitude and productiveness of such investment also vary across countries. The output effect of foreign investment in the host country is also determined by the state of affairs of such country, that is, the state of technology, institutional quality, and business environment. So, the effect of foreign direct investment could be triple-sided (negative, positive or neutral).

Regarding foreign trade, theoretical and empirical literature has justified the growth effect of trade. Foreign trade's effect on economic growth could also be double-sided (negative or positive). When a trade is skewed toward export trade, that is, the export component is greater than the import component, which implies a positive net balance, it will produce a positive growth effect, but when it is skewed toward import trade, that is, the import component is greater than the export component which implies a negative net balance, then the expected growth effect is negative. So, the outcome of engagement in trade is not the same across countries; while it is positive in some countries, it is negative in some other countries. These four variables are very germane in explaining economic growth, especially in the oil-based exporting countries in which oil-revenue represents a significant part of total revenue earnings. The oil and gas sector are characterized with uncertainty due to fluctuations in global prices and demands. The endowment in oil wealth is a common opportunity but the opportunity cost could constitute a major threat to economic progress. Unfolding the explanatory power of these underlying variables will aid effective policies on energy consumption, foreign direct investment, trade and population in relation to economic growth. This study, moving from static to dynamic models, aims at conducting a multivariate analysis by investigating the effect of population growth, foreign direct investment, energy consumption, and foreign trade on economic growth in the oil-exporting and oil revenue-based countries of Saudi-Arabia, Iran, Congo, Sudan and Nigeria. All other growth factors are assumed to be constant while the roles of our underlying variables are captured individually and jointly in our underlying models. The policy implications are based on the result obtained from the analysis. The remainder of this paper is structured with section two providing the literature review. Section three describes the data and econometric methodology meant for the study. Section four presents the empirical results, while section five concludes the paper.

2. Literature Review

A wide range of studies; whether country-specifics, regional or multi-country in nature have used different variables to explain economic growth. The findings of most of these studies are mixed. The extant literature have linked several variables to explain economic growth. Ahmad and Du (2017) used energy production and carbon emissions and additional variables such as domestic and foreign investment, inflation, population density, and agricultural land to explain the economic growth of Iran using annual time series data covering the period (1971-2011). The study found a long-run relationship among all the variables in the models. It also found a direct relationship between carbon emissions and economic growth as well as energy production and economic growth in Iran. Domestic investment was found to make more contribution to Iranian economic growth than foreign investment. Peterson (2017) reported a controversial relationship between population and economic growth. The study identified the various channels through which population growth affects economic growth, such as the age structure of a country's population, international migration, economic inequality, and the size of the labour force.

Wesseh and Lin (2018) used exchange rate fluctuations, oil price shocks, and consumer prices to explain economic growth in Liberia. Consumer prices were found to correlate positively with economic growth in Liberia. Esso and Keho (2016) examined the inter-link among energy consumption, carbon emissions, and economic growth in selected African Countries using cointegration and causality techniques. The result shows that a long-run relationship exists among the variables. Energy consumption and economic growth expansion were found to be associated with an increase in carbon emissions. The result also shows strong evidence of economic growth causing carbon emissions in the short run in Benin, Democratic Republic of Congo, Ghana, Nigeria, and Senegal, implying that economic expansion cannot be achieved without affecting the environment. Unidirectional causality running from economic growth to carbon emissions was found for Benin, Democratic Republic of Congo, Ghana, and Senegal. This suggests that economic expansion cannot be possible in these countries without affecting the environment. It also suggests that carbon emissions reduction policies can be adopted in these countries without harming economic growth in the short run, validating the Environmental Kuznets Curve (EKC) hypothesis. Despite the wide range of studies on factors affecting economic growth in country-specific, regional or multi-country cases, there is this lacuna, the need to investigate the effects by exploring the individual and joint explanatory power of population growth, foreign direct investment, energy consumption, import and export trade in relation to economic growth in these five oil-rich developing countries using a multivariate approach from static to dynamic models. The economies of these five countries namely; Saudi-Arabia, Iran, Congo, Sudan and Nigeria are driven by oil and gas. The bulk of their revenues is based on oil-wealth. It is very important to find out how these underlying explanatory variables individually and jointly affect the growth of the economies of these affected countries. The outcome of the study could provide some policy guides that stimulate economic growth which may eventually translates into meaningful and sustainable economic development in the long-run.

3. Data and Methodology

This paper adopts a static to dynamic panel econometric approach to investigate the effects of population growth, foreign direct investment, energy consumption and foreign trade on economic growth in five oil-exporting countries. The countries included in the analysis are Saudi-Arabia, Iran, Congo, Sudan and Nigeria. The choice of these countries is based on the endowment of oil wealth as well as the magnitude of oil-export relative to total export. The oil-export constitutes a significant part of total exports of these countries. Hence, they are regarded as oil-driven economies. These countries are endowed in oil wealth which is a unified opportunity while also proved vulnerable to uncertainty due to fluctuations in global oil prices and demand.

Secondary data on key variables from 1981-2019 were sourced mainly from the WDI of the World Bank Group. The variables involved in the analysis include gross domestic products in current US dollar, population, export, and import of goods and services, foreign direct investment, and energy consumption.

3.1 Model Specifications

The study is anchored on the basic Solow growth model, which expresses economic growth as a function of capital and labour input aided with exogenous technology. Technology is said to improve the efficiency of capital and labour input and hence a boost to output. On this note, the functional form of the model is stated as

$$Y = Af(L, K) \quad (1)$$

Where

Y represents economic growth,

K and L stand for capital and labour, respectively, while A is the technological parameter.

By dividing equation (1) by L, the functional form is translated into

$$y = af(1, k) \quad (2)$$

In its intensive form, Equation 2 becomes

$$y = ak^{\mu} \quad (3)$$

where μ is defined as growth elasticity with respect to factor input $'k'$
Linearizing equation (3) produces,

$$lny = lna + \mu lnk \quad (4)$$

By incorporating other key variables into the model, it becomes

$$lny = \Omega_0 + \mu lnk + \beta_1 InP + \beta_2 InF + \beta_3 InE + \beta_4 InX + \beta_5 InT + \varepsilon \quad (5)$$

Where
Ω_0 is lna; P is the population; F is the foreign direct investment, E is the energy consumption, X is the export, T is the net trade balance as percentage of GDP, it is used as foreign trade sub-sector with import component, ε is the error term. $In,$ is the natural logarithm of the affected variables.
The effect is obtained by imposing a restriction on the coefficient of k such that $[\mu = 0]$ and introducing the time path, equation 5 becomes

$$lny_{i,t} = \Omega_0 + \beta_1 InP_{i,t} + \beta_2 InF_{i,t} + \beta_3 InE_{i,t} + \beta_4 InX_{i,t} + \beta_5 InT_{i,t} + \epsilon_{i,t} \quad (6)$$

By introducing the time path and expressing equation (6) in a dynamic form, it becomes

$$lny_{i,t} = \Omega_0 + \partial_* lny_{i,t-p} + \beta_1 InP_{i,t} + \beta_2 InF_{i,t} + \beta_3 InE_{i,t} + \beta_4 InX_{i,t} + \beta_5 InT_{i,t} + e_{i,t} \quad (7)$$

The fixed effect model estimate was carried out on equation (7).

3.2 Variables Coding, Description and Definition

Table 1: Attributes of the Study Variables

VARIABLE	VARIABLE SYMBOL	DESCRIPTION	DEFINITION
Dependent Variable			
Economic Growth	lnGDP	The natural logarithm GDP	An inflation-adjusted measure that reflects the value of all goods and services produced in a given year, expressed in based-year price
Economic Growth	lnGDPPC	The natural logarithm GDPPC	An inflation-adjusted measure that reflects the value of all goods and services produced in a given year, expressed in based-year price
Independent			

Variable			
Import of goods and services	lnIMPM	The natural logarithm of of IMPM	This is the natural logarithm of the value of all goods and services bought from other countries of the world and consumed at home measured in billions of US dollar
Export of goods and services	lnEXPM	The natural logarithm of of EXPPM	This is the natural logarithm of the value of all goods and services provided and sold to the rest of the world measured in billions of US dollar
Energy consumption per head of population	lnENCPC	The natural logarithm of of lnENCPC	Energy used (kg of oil equivalent per capita). it is the total energy produced and used by human. Typically measured per year, it involves all energy harnessed from every energy source applied towards humanity's endeavours across every single industrial and technological sector, across every country. Energy use has deep implication for humanity's socio-economic-political sphere
Foreign Direct Investment	FDIM_GDP	The ratio of foreign direct investment to GDP	Foreign Direct Investment net inflows as a ratio of GDP
Foreign Direct Investment per head of population	FDIPC	This is the total net inflow of foreign direct investment divided by population	This is the Foreign Direct Investment per head of population
Trade Balance	TBAL_GDP	The ratio of net export to GDP	This is export minus import of goods and services expressed as a percentage of GDP
Population	lnTPOPM	Total population in millions	Natural logarithm of otal population
Note: The pairs (FDIM_GDP and FDIPC); (lnIMPM and TBAL_GDP), and (lnGDP and lnGDPPC) are mutually exclusive in our estimated models			

Source: Authors' compilation

3.3 Unit Root Tests

To account for the stationarity property of each of the variables in the specified model, panel unit root tests proposed by LLC (Levin, Lin, and Chu, 2002) as well as IPS (Im, Pesaran, and Shin, 2003). The null hypothesis of 'serial unit contains root' is tested against an alternative hypothesis of 'serial unit does not contain root. If a serial unit contains root, it means the series is non-stationary. On the other hand, if a serial unit contains no root, the series is stationary. A serial unit that is stationary has zero mean and constant variance. The LLC unit root regression equation having a test statistic with standard normal distribution is of the form

$$\Delta \boldsymbol{W}_{i,t} = \xi^{*} \boldsymbol{W}_{i,t-1} + \sum_{L=1}^{pi} \varphi_{iL} \Delta \boldsymbol{W}_{i,t-L} + \eta_{mi}\, d_{mt} + \varepsilon_{i,t} \qquad (8)$$

where $\boldsymbol{W}$ ***is*** vector of variables in the study; m **is** available models for consideration ranging from Model 1, Model 2 and Model 3; $'pi'$ is unknown lag order that is allowed to vary across individuals; $'i'$ *is* number of cross-sectional units; t *is* time period; Δ ***is*** first difference operator; $\boldsymbol{W}_{i,t}$ *implies the series has* individual-specific mean, linear, and individual-specific time trend; $\xi, \boldsymbol{\varphi}, \boldsymbol{\eta}$ are the estimated parameters; ε *is* white noise error term.

The main task, in this case, is to formally test the null hypothesis of 'unit root' against the alternative hypothesis of 'no unit root. Table 2 provides the tests of hypothesis for the presence of unit root.

Table 2: Testing the Hypothesis of Unit Root (Common Unit Root Test developed by LLC)

Null hypothesis	Alternative Hypothesis
H_0: $\phi^* = 0$, for all i;	H_1: $\phi^* < 0$, for all i.

Source: Authors' Compilation

Following the theoretical exposition, this study considers two models out of $m = 3$;$d_{mt} = d_{3t} = \{1, t\}$. The series $\boldsymbol{W}_{i,t}$ has an individual-specific mean, linear, and individual-specific time trend. Similarly, the IPS unit root regression equation is of the form

$$\Delta \boldsymbol{W}_{i,t} = \lambda^{*}_{i} \boldsymbol{W}_{i,t-1} + \sum_{j=1}^{Pi} \theta_{ij} \Delta \boldsymbol{W}_{i,t-j} + \Phi_{mi}\, d_{mt} + \varepsilon_{i,t}, \qquad (9)$$

where $\boldsymbol{W}$ is the vector of variables in the study; m *is* available models for consideration, m = 1, 2, 3; pi *is* lag order that is allowed to vary across individuals; i *is* number of cross-sectional units; t ***is*** time period; Δ ***is*** first difference operator; λ, θ, Φ *are* parameters to be estimated; ε is the white noise error term. From Table 3, the null hypothesis (H_0) of 'unit root' is tested against the alternate hypothesis (H_1) of 'no unit root.'

Table 3: Testing the Hypothesis of Unit Root (Individual Unit Root Test developed by IPS)

Null hypothesis	Alternative Hypothesis
H_0: $\lambda^*_i = 0$, for all i;	H_1: $\lambda^*_i < 0$, for all $i = 1, \dots, N_1$;
$\lambda_i = 0$ for $i = N_1 + 1, \dots, N$	

Source: Authors' Compilation

4. Results and Discussion of Findings

Table 4: Result of Descriptive Analysis

Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis

GDP	1.97E+11	9.53E+10	3.97E+12	4.71E+09	4.24E+11	7.124773	62.37272
GDPPC	3922.681	1657.17	24577.98	1.93E-08	5552.9	2.078268	6.766518
IMPM	3.63E+10	1.59E+10	2.55E+11	929475.9	5.13E+10	2.294856	8.233427
EXPM	4.79E+10	1.60E+10	3.99E+11	3.69E+08	7.56E+10	2.616686	10.31779
ENCPC	1701.529	715.4378	6937.231	295.2242	1891.072	1.377897	3.652109
FDIM	2.47E+09	7.13E+08	3.95E+10	-1.88E+09	5.43E+09	4.295626	24.76689
FDIM_GDP	1.824531	0.818201	43.4385	-1.751567	3.79714	7.176584	75.68742
FDIPC	70.08738	10.44459	1520.998	-100.0578	214.0372	4.508611	24.97072
TBAL_GDP	0.148969	5.48E-08	29.04884	2.77E-11	2.080231	13.85659	193.0052
TPOPM	58705223	43827180	2.01E+08	10366661	42866791	1.385155	4.47886

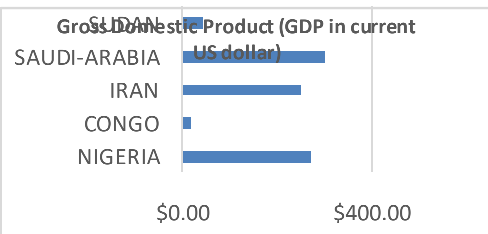
Source: Authors' Compilation

4.1: Descriptive Summary of Key Variables in the study

The result of descriptive analysis of the data for this study is as shown in Table 4: The average GDP for the study sample was estimated to be about $197 billion, while the average GDPPC was revealed to be about $3,923. The total foreign direct investment attracted during the analysis period was about $2.47billion on average for the entire sample, while the average foreign investment per capita was about $70. The total export value of the foreign trade sector is estimated at $47.9billion, while the average export value of the foreign trade sector per capita is estimated at $1,397. The total import value of the foreign trade sector is estimated at $36.3billion, while the average import value of the foreign trade sector per capita is estimated at $1,026. The average energy consumed by the entire sample during the period is estimated as 1702kg of oil equivalent. The trade balance is about (0.149% of GDP) on average, while the total population of the entire sample is estimated as (59millions) on average. Table 4 also reveals that all the variables are positively skewed while the Kurtosis for each variable is greater than 3; hence, they are said to be leptokurtic.

4.2 **Graphical Analysis of key variables in each of the countries in the panel**

4.2.1 Gross domestic product and population



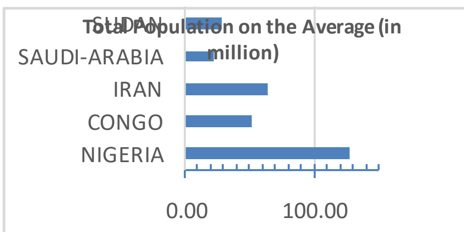
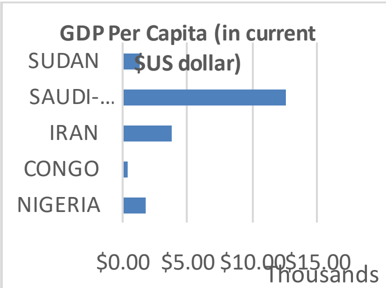


Fig. 1: Gross Domestic Product (GDP in billions of US dollar) **Fig. 2: Total Population on the Average (in million**

Figures 1-7 present the result of graphical analysis of key variables involved for each of the countries in the panel. From Figures 1 and 2, Saudi Arabia tops in overall GDP follows suit by Nigeria and Iran while Sudan and Congo rank fourth and fifth respectively. Considering the population in these oil-rich developing countries, Nigeria is top the list, Iran ranks second, Congo ranks third, and Sudan and Saudi Arabia rank fourth and fifth respectively. However, it is worth mentioning that Saudi Arabia with the lowest population appears to be the biggest in terms of GDP. So it is not a game of number but that of productivity attached to the population. Figure 8 presents the growth rate of each of the variables involved across countries.

1.2.2 Gross domestic product and energy consumption per head of population



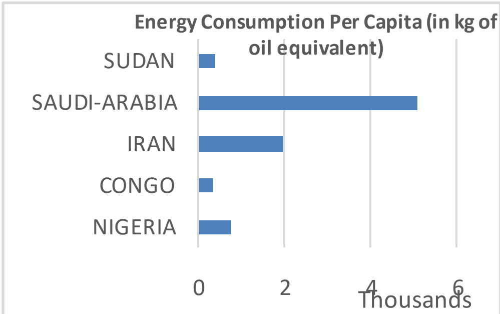


Fig. 3: GDP Per Capita (in thousands of $US dollar) **Fig. 4: Energy Consumption Per Capita (in kg of oil equivalent)**

The result in Figures 3 and 4 shows the GDP per capita and energy consumption per capita. Saudi Arabia also tops the list in both GDP per capita and energy consumption per capita. This is empirically sound as income determines consumption as in a simple Keynesian consumption function, which expresses consumption as a function of income. The GDP per capita is otherwise known as per capita income. Consumption is expected to be low where per capita income is low. Iran ranks second in terms of GPD per capita, Nigeria ranks third, while Sudan and Congo rank fourth and fifth. However, in terms of energy consumption, Iran ranks next to Saudi Arabia. Nigeria ranks third while Sudan and Congo are almost in a tie.

4.2.3 Foreign direct investment and export trade

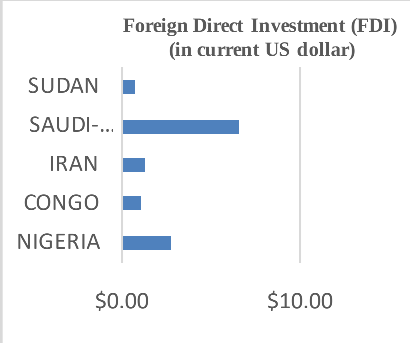


Fig. 5: Foreign Direct Investment (FDI in current US dollar)

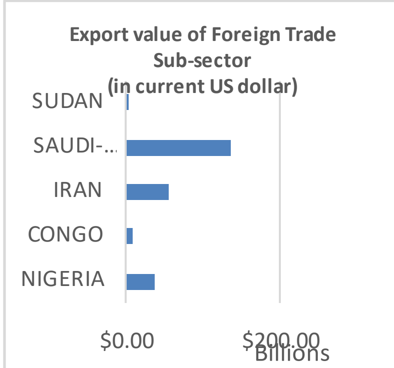


Fig. 6: The export value of Foreign Trade Sub-sector (in current US

4.2.4 The import trade and macroeconomic variables across countries

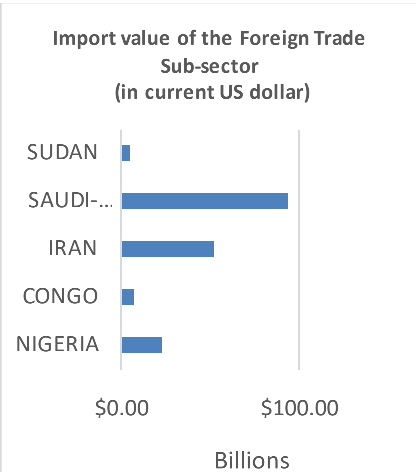


Fig.7: The import value of Foreign Trade Sub-sector (in current US

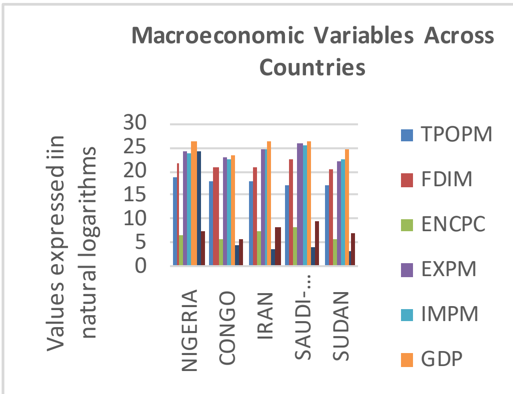


Fig. 8: Graphical display of the growth rate of each of the variables in the analysis across the five countries

The result in Figures 5, 6, and 7 shows the FDI attracted in current US dollar, the export value of the foreign trade sub-sector, and the import component of foreign trade. Saudi ranks first in the list in terms of foreign direct investment attracted, the export value of foreign trade sub-sector, and the import component of foreign trade. In terms of the export trade value of the foreign trade sub-sector and import component, Iran ranks second, Nigeria ranks third, Congo ranks fourth, and Sudan ranks fifth. Nigeria ranks higher than Iran, Congo in the fourth position, while Sudan ranks fifth in foreign direct investment. In Figure 8, the growth rate of each of the variables are shown visually for all the countries. It is important to consider not only the growth in the level of the variable but also its growth rate. The natural logarithm of each of the variables are taken as the approximate growth rate of the variable.

4.3 Unit Root and Cointegration Results

Table 5: Result of Panel Unit Root Tests

Model: Tests conducted with intercept and time trend					
Variables	**LLC Test**	**IPS Test**	**ADF-FISHER χ^2Test**	**PP-FISHER χ^2_Test**	**I(d)**
InGDP	*LV: -1.826** FD: -14.255****	*LV: -0.101 FD: -15.669****	*LV: 9.647 FD: 187.737****	*LV: 10.283 FD: 275.406****	- *I(1)*
InGDPPC	*LV: 0.225 FD: -7.391****	*LV: -0.899 FD: -18.355****	*LV: 13.635 FD: 293.064****	*LV: 67.186 FD: 489.855****	- *I(1)*
InENCPC	*LV: -0.156 FD: -6.816****	*LV: -1.118 FD: -11.345****	*LV: 28.206*** FD: 122.734****	*LV: 60.342*** FD: 479.797****	- *I(1)*
InEXPM	*LV: -0.067 FD: -10.846****	*LV: -0.187 FD: -10.878****	*LV: 8.980 FD: 99.381****	*LV: 9.335 FD: 99.291****	- *I(1)*
InIMPM	*LV: 0.314 FD: -10.020****	*LV: 1.482 FD: -8.222****	*LV: 5.364 FD: 72.894****	*LV: 2.919 FD: 75.723****	- *I(1)*
FDIM	*LV: 7.292 FD: 7.292*	*LV: -1.948 FD: -1.948***	*LV: 27.309 FD: 27.309****	*LV: 87.330 FD: 87.330**8*	- *I(1)*
FDIPC	*LV: -3.662 FD: -4.359****	*LV: -0.546 FD: -5.970****	*LV: 12.038 FD: 70.001****	*LV: 4.608 FD: 98.885****	- *I(1)*
TBAL	*LV: 0.239 FD LV: -10.353****	*LV: -0.740 FD: -10.018****	*LV: 14.249 FD: 84.900****	*LV: 14.341 FD: 91.004****	- *I(1)*
InTPOPM	*LV: -2.711 FD: -*	*LV: 0.426 FD: -*	*LV: 16.772** FD: -*	*LV: 45.638*** FD: -*	*I(0)* -
LV = Level; FD = First Difference					

**** (**) [*] denote 1% (5%) [10%] significance level*

Source: Authors' Compilation

The unit root test is conducted to account for the stationarity property of the series and the need to test for cointegration if the individual series are non-stationary. According to Engle and Granger (1987), a set of individually non-stationary variables can be modeled together if they are found to be cointegrated. Once any of their linear combinations are stationary, they are collectively stable and can be modeled together. The presence of cointegration implies that variables relate over the long run; that is, they converge to long-run equilibrium. The result of the panel unit root tests is presented in Table 5. Four panel unit root tests, namely LLC, IPS, ADF-Fisher, and PP-Fisher, jointly agree that variables are stationary at I(1) with only one variable in exception.

Panel Cointegration Tests

Table 6: Pedroni Cointegration Test

	Statistic	**P-value**

Panel v-Statistic	1.461*	0.072
Panel rho-Statistic	-2.014**	0.022
Panel PP-Statistic	-13.716***	0.000
Panel ADF-Statistic	-10.818***	0.000
	Statistic	**P-value**
Group rho-Statistic	-1.227	0.890
Group PP-Statistic	-2.368**	0.009
Group ADF-Statistic	-0.791**	0.215

**** (**) [*] denote 1% (5%) [10%] significance level*

Source: Authors' Compilation

The cointegration test becomes necessary after confirming variables to be non-stationary I(1. If the variables are found to be cointegrated, then it means their linear combination is stationary. The result in Table 6 confirms that the variables, though individually non-stationary but as a group, are stationary. Having confirmed cointegration among the group of I(1) variables, this study proceeds to estimate the static and, finally, the dynamic models. The results of the panel cointegration test in Table 6 reveals that both individual and group statistic confirmed the presence of cointegration among the variables included in the study. The coefficients and the probability values of the various panel and group statistics are clearly shown in the table.

4.4 The Static and Dynamic Models

Table 7: Result of Static POLS and Dynamic POLS Estimate

Dependent Variable= InGDPPC									
Ind.Variables	**Panel Least Square (PLS)**			**Result of Panel Dynamic OLS (PDOLS) with lead and lag time (1, 1)**			**Result of Panel Dynamic OLS (PDOLS) with lead and lag time (3, 1)**		
	Coefficient	**t-stat**	**P--value**	**Coefficient**	**t-stat**	**P--value**	**Coefficient**	**t-stat**	**P--value**
FDIM%GDP	-0.0224	-1.830	0.0689	-0.0325	-2.331	0.0219	-0.0811	-4.457	0.0001
InEXPM	0.4163	6.712	0.0000	0.4312	7.251	0.0000	0.5085	6.550	0.0000
InENCPC	0.5844	5.831	0.0000	1.1343	5.409	0.0000	1.5063	6.045	0.0000
TBAL%GDP	-0.8567	-40.101	0.0000	-81.096	-5.467	0.0000	-12.2071	-7.253	0.0000
InTPOPM	-0.4256	-4.792	0.0000	-0.4171	-2.483	0.014	-0.6429	-2.691	0.0109

						8			
C	1.1238	0.887	0.3764	-	-	-	-	-	-
R-square	**0.930**			**0.994**			**0.999**		
Adj.R-square	**0.928**			**0.989**			**0.996**		
F-stat(p-value)	**505.342(0.000)**			-			-		
Long-run Variance	-			**0.019**			**0.002**		
Diagnostic tests	**Residuals Cross-section Dependence Test** *Breusch-Pagan LM Test-stat=74.02(0.000)* *Pesaran scaled LM Test-stat=13.20(0.000)* *Pesaran CD Test-stat=7.33(0.000)* **Residuals Normality Test** *JB-stat(p-value) = 161.772(0.000)*			**Residuals autocorrelation Test** *Q-stat(p-value) = 4.905(0.054)* **Residuals Normality Test** *JB-stat(p-value) = 1.416(0.493)*			**Residual autocorrelation Test** *Q-stat(p-value) = 4.905(0.067)* **Residuals Normality Test** *JB-stat(p-value) =0.021(0.990)*		

**** (**) [*] denote 1% (5%) [10%] significance level*

Source: Authors' Compilation

The analysis begins with the estimation of the static model to determine the effect of population growth, foreign direct investment, energy consumption, and foreign trade on economic growth in five oil-rich developing countries. The result presented in Table 7 shows that population, foreign investment, and foreign trade with import components have a negative and significant effect on economic growth with little exception to foreign investment, which is not significant at 5 percent. On the contrary, energy consumption and export trade component of foreign trade has a positive and significant effect on economic growth. However, there are challenges encountered with the use of this model; though the associated adjusted R-square of about 93 percent with an F-statistic of 505.342 significant at 1 percent shows a very significant joint effect of these selected variables in explaining economic growth variance in these economies, there are issues with residuals cross-section dependence and residuals normality. The three statistics, namely, Breusch Pagan LM Pesaran scaled LM, and Pesaran CD, all reject the null hypothesis of no cross-section dependence in residuals which implies that the residuals of the model are correlated. The Jarque-Bera statistic of 161.772 rejects the null hypothesis of residuals normality, breaking down the assumption of residual normality. This calls for the use of dynamic models, specifically dynamic ordinary least squares popularly known as panel DOLS. This estimation technique is robust in handling problems associated with the stationarity of variables once there is existence of at least one cointegrating vector by the way it endogenously introduces lags and leads time.

Table 7 also contains the two dynamic models with different lead and lag time. The first dynamic model used lead and lag time (1, 1), while the second used lead and lag time (3, 1). The result in the table shows that the second dynamic model is more robust than the first in all measures of statistical performance. It is the lead and lag time that minimizes the long-run variance. For instance, there is a complete absence of serial correlation. Also, the null hypothesis of normality cannot be rejected, meaning that the residuals of the model are normally distributed. It also has the highest adjusted R-square of about

99.6% and a long-run variance of about 0.002, lower relative to the first dynamic models. On the strength of this, the second dynamic model, as shown in the table, is the basis for the policy recommendation. From the table, all the selected explanatory variables significantly affect economic growth in these economies. For instance, while population, foreign direct investment, and foreign trade with import component have a negative and significant effect, energy consumption and export component of foreign trade sub-sector have a positive and significant effect on economic growth. This result agrees with some empirical studies particularly Dada (2013; 2019) for Nigeria, Topolewski (2021) for a significant number of EU countries as per energy-growth nexus; Upreti (2015) for a large number of developing countries as regards export-economic growth nexus.

5. Conclusion and Policy Recommendations

Economic growth has been an inspiring and most interesting topic in macroeconomic discourse. Macroeconomists of different ages, ranging from those focusing on short-run economic growth like Lord Maynard Keynes and those whose works are centered on long-run economic growth like Robert Solow, have isolated which variables are responsible for economic growth variance across countries of the world. Why economic growth is faster in some countries and regions and why it is slower in the others. The issues of convergence and how long and when such a convergence will likely take place are all contending issues. Owing to this fact, researchers across the globe are inspired to conduct research on various factors that determine the economic growth of a particular country or region. There have been several studies, such as country-specific, regional or multi-country studies exploring different variables that can explain the notable variations in economic growth across countries and regions of our world. This study contributes to this discourse by investigating the effect of population growth, foreign direct investment, import component of foreign trade sub-sector, export component of foreign trade, and energy consumption to explain economic growth variance in five oil-exporting open economies using a panel approach. Both static and dynamic models were formulated and estimated after the unit root tests. Cointegration tests were carried out to account for the long-run property of the variables by finding out if the group of individually non-stationary I(1) variables could be found to be cointegrated. The static models failed to meet up with some underlying assumptions and hence, the need to move from static to dynamic models that are robust enough in the achievement of the objective of this study. The result shows that the individually non-stationary I(1) variables are cointegrated which indicate that they converge to a long-run equilibrium. All the variables are found to exhibit a significant effect on economic growth of these oil-exporting economies. Particularly, foreign trade with import component, foreign direct investment, and population growth have a significantly negative effect on economic growth while energy consumption and export component of the foreign trade sub-sector have a significantly positive effect on economic growth.

The study concluded that foreign trade with import component, foreign direct investment, and population growth retarded economic growth. In contrast, energy consumption and export component of foreign trade positively and significantly influenced economic growth in these countries. The study recommends that population and import component of foreign trade sub-sector should be reduced to enhance higher economic growth. Only foreign direct investment that are friendly to physical, social, and economic environment should be attracted to avoid growth illusion in these countries. Also, energy consumption and export component of foreign trade should be increased in order to raise the level of economic growth in these affected oil-exporting countries.

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