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PETROLEUM ENERGY CONSUMPTION, TRADE OPENNESS AND FOREIGN DIRECT INVESTMENT: A TRIPARTITE APPROACH TO ECONOMIC GROWTH IN NIGERIA

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ABSTRACT

Nigeria is an oil-rich country with a significant reliance on petroleum consumption. This study examines the tripartite effects of petrol final energy consumption, trade openness, and foreign direct investment on economic growth in Nigeria over the period 1990-2021. The unit root results and the number of data points at the disposal of this study permit the application of ARDL econometric estimation technique. The short-run and long-run estimated parameters indicate that there are impacts of petroleum consumption, Foreign Direct Investment (FDI) and trade openness on economic growth in both short-run and long-run in Nigeria. In the long run, petroleum consumption (0.3762%), trade openness (0.2272%) and FDI (0.1271%) have a positive and significant impact on economic growth. The coefficient of the error correction term is negative and statistically significant. This implies that the model is mean-reverting, and that the short run model tends to revert to its long-run equilibrium value over time in the event of disequilibrium at the speed of 63% per annum. The model is robust for policy making as it passed diagnostics tests, no evidence of serial correlation, no evidence of heteroskedasticity, no evidence of model misspecification, there is dynamic stability via Cusum and Cusum of Square and the residuals are normally distributed as evidenced from Jarque-Bera statistics. Based on the statistically significant positive impacts of petroleum energy consumption, trade openness and foreign direct investment, this study suggests that policies aimed at increasing petroleum consumption, FDI and trade openness are going to lead to increase in economic growth in Nigeria.

Keywords: Economic growth, Petroleum consumption, Trade openness, Foreign Direct Investment, Time series
JEL Classification: O11, Q43, F11, F21, C22

Introduction

Every country is striving to grow and develop its economy so as to reap the benefits associated with increase in economic prosperity like higher living standard. Meaningful and sustainable economic

progress cannot just drop from heaven without deliberate effort made in an economic setting. Economic growth of any country depends on many variables in the country, some of which are; human and natural resources endowments and the access to energy for execution of the productive activities (Adamu & Mohammed, 2022). Nigeria is a crude oil-rich country with a significant reliance on petroleum energy consumption for its activities. From 1990 to 2020, Nigeria's petroleum final energy consumption shoot from two hundred and sixty five thousand, seven hundred and seventy five tera joules, to eight hundred and eleven thousand, seven hundred and eighty-four tera joules (IEA, 2022).

According to World Bank ranking (World Bank,2022), the top five (5) high ranked economies in terms of millions of dollars GDP as of 2022 were United State of America (25,462,700), China (17,963,171), Japan (4,231,141) Germany (4,072,192) and India (3,385,090). Looking at those economically advanced countries of the world, giant strides have been made by those economies before reaching where they are today. Identification of the pre-requisite economic variables behind the success of such economies is vital for following the footsteps of such prosperous countries. As such, in the course of this study, attempt will be made to identify, and empirically estimate the effects of such variable(s) that can pave way for Nigeria's economic prosperity. In view of the relevance of energy consumption for economic progress, Adamu *et al* (2022) suggested the need for empirical estimation of energy consumption on economic growth and development in Nigeria.

Energy is evidently a livewire of almost all economic activities globally, even though, global energy consumption slowed down in 2022 (+2.1%) due to issues like Covid-19 and Russia-Ukraine war, however, on the average it surpasses the average obtained between 2010 to 2019 growth rate (+1.4%/year). Looking at top global energy consumers in 2022, they were those economies with high records of GDP, precisely the top three energy consumers in the world were: China (3, 801), United States (2, 182) and India (1,005) as reported by Enerdata (2023) in Metric ton of oil equivalent (Mtoe). Additionally, United States and China are the top largest consumers of oil in the world, totaling 19.1 million and 14.3 million barrels per day, respectively (Statista, 2023).

It is evident also that the top global countries are associated with high Foreign Direct Investment (FDI), huge volume of international trade as a ratio of their GDP (Trade openness) all of which were supported by Energy consumption as a pre-requisite livewire of economic activities. As of December, 2022, United States was the World's top destination for Foreign Direct Investment (FDI), with China and Germany among the list of the top ten economies in terms of FDI globally (IMF, 2022). Thus, such variable seems to be vital economic ingredients for the success of a country. The assumption here is FDI flows served as investments into productive activities within the economy, like funds going into new factories and machinery and other growth enhancing ventures. The expectation is, if similar FDI catalyst is applied in other countries, ceteris paribus (holding other things equal), similar economic progress is going to be recorded.

Going by the perceived evidenced-based economic relevance of the afore mentioned variables of energy consumption, FDI, and trade openness obtained in top economies of the world, of which the variables were seems to be among if not the key ingredients behind those countries economic prosperity or growth as measured by GDP, this study thus, attempts to evaluate the effects of such variables in the context of Nigeria.

Trade openness is expected to allowed countries to specialize in the production of goods and services that they are good at producing and to import goods and services that they are not good at producing. This has the potential of increasing efficiency and productivity, which will boost economic growth. Furthermore, foreign direct investment (FDI) has the potential of providing countries with access to capital, technology, and expertise, which will helped them to develop new industries, reduce capital flight and to improve the efficiency of existing industries. The success of both trade openness, FDI and other economic activities are expected to be smoothly realized via energy consumption in Nigeria.

As for energy consumption in Nigeria, particular attention is given to the dominant fossil fuel consumed in the country among the fossil fuels. Petroleum consumption has been one of the major sources of energy for economic activities (like transport of labour, raw materials and finish products) for economic growth. For the past three decades, petroleum oil energy consumption has

dominated the other combustible fossil fuel consumed in the country. The trends of major fossil energy consumed from 1990 to 2022 affirmed the dominance of petrol consumption.

IEA (2022) Shows that Nigeria conventional fossil fuel final energy consumption in the last three decades were dominated by petroleum consumption, in 1990, coal consumption was one thousand six hundred and eighteen tera joules (1618 TJ), natural gas (29993 TJ) and petroleum (265775 TJ) final energy consumption. In 2010, coal consumption reduced to nine hundred and eighty tera joules (980 TJ) natural gas increase to (50716 TJ) but less than petroleum (519361 TJ). Petroleum final energy consumption still remain top based on the latest IEA data as of October,2023, for the reported year 2020, with coal appreciating to (1120 TJ), natural gas (158071 TJ) and petroleum reaching all time high of (811784 TJ). On that basis and in order not to over parameterize the model of the study, petroleum is identified as the key energy demanded in the Nigerian economy and hence it's application in this study's analysis.

However, despite the position and magnitude of petroleum consumption in the Nigerian hydrocarbon or fossil fuel energy consumption, the effects of such energy consumption on the economic growth in Nigeria is mixed empirically. Some Studies reported positive effects of petroleum & oil sector on economic growth (Chinedu et al., 2019 & Abubakar, 2017), while others reported negative effects of petroleum on economic growth and productivity (Adebisi *et al.,* 2023). Even findings based on causality were never unanimous, for instance Akinlo (2021) showed causality runs only from economic growth to petroleum consumption. Short-run causality running from oil sector to growth was found to be insignificant in Nigeria (Abubakar, 2017).

Thus, from the reviewed studies, empirical findings on energy consumption and economic growth in Nigeria recorded inconsistent results, thus, it create a gap for more research. Furthermore, based on the pre-liminary review of literature on petroleum energy consumption, none of the studies use final petroleum energy consumption(actual energy use by the end users), and owing to inconsistent results and the need for employing a very relevant but previously un-used petroleum final energy consumption variable, and in generally, with paucity of relevant studies on petroleum

energy and economic growth in Nigeria, there is the need for more research for policy recommendations which this study focus on. This is going by the relevance of energy to economic growth especially when combined with trade and FDI as experienced in many advanced countries of the world like U.S., China, Japan, and so on. This study intends combine and evaluate the effects of all the three variables of petroleum final energy consumption, trade openness and FDI on economic growth in Nigeria over the period of 1990 to 2021, the duration covered is based on data availability.

Subject to empirical verification, the three variables (Petroleum, FDI, and trade openness) are among others expected to positively contribute to economic growth in Nigeria via certain mediums or channels. The effects of petroleum energy consumption, trade openness, and FDI on economic growth can be transmitted through several channels. For instance, petroleum energy consumption can improve productivity by providing inputs for production and enabling technological innovation. With sufficient and affordable energy consumption, trade openness and FDI can facilitate the diffusion of knowledge and technology, which can lead to economic growth. Trade openness can expand the market size for domestic firms, which can lead to economies of scale and higher productivity. FDI can promote investment in human capital, which can lead to higher economic growth.

The objective of the study is to assess the effects of petroleum final energy consumption, FDI and trade openness on economic growth in Nigeria from 1990 to 2021. More specifically, the study intends to respectively evaluate, analyze and explore the effects if any of petroleum final energy consumption, FDI, and trade openness on economic Growth in Nigeria. The paper is structured into five sections. Following the introduction section is section two which is the literature review, the methodology is section three, section four is results and discussions, and section five is the conclusion and policy implications of the paper.

Literature Review

Conceptual Review

Under conceptual review, only concepts of final energy consumption related to petroleum final energy used in this study and trade openness will be address. Concept of final energy consumption is not commonly used; previous studies usually employ and

explain total energy or primary energy consumption not final energy. The concept of Trade openness is carrying varied interpretations; this gave rise to different proxies for it. For instance, some use only exports, others used only trade. For instance Omoke and Opuala–Charles (2021) employed total trade, import trade, and export trade as trade openness indicators. Thus economic growth and FDI concepts are common and need no new conceptualization clarification.

Concept of Final Energy

Final energy consumption is "the total energy consumed by end users, such as households, industry and agriculture. It is the energy which reaches the final consumer's door and excludes that which is used by the energy sector itself" (Eurostat, 2018). Final energy is the energy that is actually used (excluding energy own-used by the energy producers, transformation and distributions loses) by final consumers; the energy used in homes, public and private businesses (IEA, 2020).

Concept of Trade Openness

Relying on IMF working paper, Trade openness is conceptualized as the sum of exports and imports as a share of GDP (Lane & Milesi-Ferreti, 2004). OECD (2011) sees trade openness as the frequently used trade to GDP ratio used in measuring the importance of international transactions relative to domestic transactions, it is calculated as the simple average (i.e. the mean) of the total trade (i.e. sum of exports and imports of goods and services) relative to GDP. Thus, trade openness is the share of total international trade out of the country's gross domestic product.

Empirical Review: Energy Consumption and Economic Growth

Abubakar (2017) revealed positive effect of oil sector on economic growth in Nigeria from period from 1981 to 2015. However, short-run causality running from oil sector to growth was found to be insignificant. Narayan *et al.*(2017) revealed that over the period 1985-2013, the wealthier states of India experienced a prevalence of the feedback hypothesis between real gross domestic product growth and petroleum consumption in the short run and the long run. Akinlo (2021) provides evidence in support of cointegration between petroleum consumption and economic growth and causality runs only from economic growth to petroleum consumption in Nigeria from 1981 to 2015.

In general, the relevance of energy utilization in explaining economic activity in Nigeria was also captured by Adamu and Maijama'a (2021), their study revealed that in long-run, the highest forecast variance of unemployment is explained by electricity energy then followed by oil energy consumption in the transport sector by end of short-run period.

A petroleum oil price affects the volume of its consumption which also affects the level of economic productivity in Nigeria, between 1981 and 2019; Adebisi *et al.* (2023) showed that Petrol and Diesel prices negatively and significantly affect manufacturing output in Nigeria. However, prior to this study, Anfofum (2018) used annual data from 1970 to 2016. The study shows evidence of the long run and dynamic relationship for all the variables except industrial oil consumption and oil price variables which has no short run impact on Nigeria's GDP. Also, it was found that capital and labour were more important in affecting output growth compared to energy consumption. Oil prices impacting real GDP negatively in long run but positively in short run. Elsewhere, independent studies in different countries on Petroleum energy consumption nexus with economic growth in countries other than Nigeria (Kenya, South Africa, Pakistan, India) were also recorded, but with divergent results. Wanjiku (2011) investigates the relationship between petroleum consumption and economic growth between 1980 and 2009 in Kenya. The findings indicated that the series were co integrated; petroleum consumption has positive short-run impact on real GDP. The long-run model indicates positive output elasticity with respect to petroleum consumption. Ziramba (2015) evaluates the long-run and causal relationships between oil consumption and economic growth in South Africa over the period 1970 to 2008. The results indicate evidence of unidirectional causality from oil consumption to economic growth.

Furthermore, Waleed *et al.* (2018) employs annual data covering the period of 1965 to 2015, the results support the existence of bidirectional causality between oil consumption and economic growth in Pakistan. This means that an increase in oil consumption directly affects economic growth. In India, Habib (2019) investigates the relationship between the petroleum consumption and economic growth between 1980 and 2014. The findings revealed that petroleum consumption had a long run

significant impact on the India's economic growth. Unidirectional causality running from petroleum consumption to economic growth in the short run was also found. In summary, the empirical findings recorded from the reviews on energy versus economic growth were not homogenous.

Empirical Review: FDI and Economic growth

Musa *et al.* (2019) were able to show significant effects of variable such as real effective exchange rate, money supply, rate of inflation on economic growth. But, FDI was the only variable that was insignificant in affecting economic growth in Nigeria over the study period of 1981 to 2017. Opoku *et al* (2019) re-examine the impact of FDI on economic growth in Africa, the results reveal that FDI positively and unconditionally spurs economic growth.

Okegbe *et al.* (2019) evaluated the extent to which Foreign Direct Investment (FDI) has contributed to the Gross Domestic Product (GDP) in Nigeria from 2000 to 2017. The study revealed that FDI on financial sector, on oil sector, on non-oil sector has positively and significantly affected Gross Domestic Product in Nigeria. In another study, Giwa *et al.* (2020) found that FDI inflow have insignificant negative effect on the RGDP, but the lag value of FDI were found to have significant positive effect on the RGDP in Nigeria between 1981 and 2017.

Shuaibu *et al.* (2021) studied and discovered that FDI was found to move together with economic growth and specifically having significant negative impact on GDP in Nigeria over the period of 1989 to 2019. In summary, empirical reviews on the connections between FDI and Economic growth were generally conflicting, some studies found positive impact of FDI on Economic growth while others recorded negative, in fact some studies found insignificant impact and absence of even causality.

Empirical Review: Trade Openness and Economic Growth

Ijirshar (2019) assesses the impact of trade openness on economic growth among ECOWAS countries from 1975 to 2017. Results showed that trade openness has positive effects on growth in ECOWAS countries in the long-run but negative and positive (mixed) effects among the countries in the short-run. Elijah and Musa (2019) investigate the dynamic impact of trade openness on the economic growth in Nigerian economy between 1980 to 2016.

The analysis result revealed the trade openness was found to have negatively impacted on the economic growth in both the short run and long run. Guei and Le Roux (2019) Applied ARDL and the pool mean group (PMG) model to assess the link between trade openness and GDP per capita in ECOWAS over the period 1990–2016. The estimation reveals that trade openness has a negative impact on GDP per capita in the long run.

Musa *et al* (2021) studied foreign direct investment and economic growth in Nigeria, the study employed data spanning 1981 to 2018, the findings revealed that trade openness impacted positively on economic growth while domestic investment has a negative impact on economic growth in Nigeria. Omoke and Opuala–Charles (2021) employed total trade, import trade, and export trade as trade openness indicators in Nigeria. Export trade was found to have a significant positive impact on economic growth while the impact of import trade on economic growth is negative and significant

In summary, the literature gaps identified from the above studies reviewed, the connections between petroleum energy consumption and economic growth failed to use final petroleum energy consumed which can better reflect the actual energy used devoid of transmission and distribution losses, or energy sectors owned used of the petroleum, this too much energy is reflected as energy consumed which can give inaccurate real impact of the petroleum energy consumption on economic growth. This study takes a departure by using final petroleum energy consumed in the economy to reveal actual impact of said energy on economic growth. While literature on FDI and trade openness were generally inconsistent, this study contribute to the ongoing debate on their impacts on economic growth in Nigeria especially taking into account their joint contribution with petroleum final energy that happens to be a unique combination of relevant variables. In addition, the study cover time frame gap and ensure avoidance of econometric deficiencies by conducting relevant pre and post estimations checks.

Methodology

The paper investigates the tripartite effects of petroleum energy consumption, trade openness and foreign direct investment on economic growth in Nigeria. Annual data sourced from the World Bank Development indicators and International Energy Agency

websites were utilized and it spans from the period of 1990 to 2021.

Model Specification and Theoretical Framework

This study follows and modifies the framework of Aminu, & Aminu, (2015) in the study that re-examine the relationship between energy consumption (petrol in metric tons) and economic growth using Nigeria's data. Their original model capture only energy variables (petrol, liquefied natural gas and electricity consumption) as determinants of economic growth in Nigeria, ignoring important variables like FDI and trade openness which are recognized growth contributors in advance countries like U.S. and China. The Endogenous Growth Model provides a theoretical framework and basis for model modification specification in this study. Lucas argues that economic growth is driven by technological innovation, which is accumulated through investment in human capital and research and development (Lucas, 1988). Petroleum consumption can support economic growth by providing the resources needed to invest in human capital and research and development.

Thus, the modified model for this study is represented in a functional form below:

YPC = F (PET, FDI, TOP)

Where,

YPC = Gross Domestic Product Per Capita (Dependent variable)

PET = Petroleum oil final energy consumption (Independent variable)

FDI = Foreign Direct Investment inflows (Independent variable)

TOP = Trade Openness (Independent variable)

The linear specification of the model is as follows:

$YPC = \beta_0 + \beta_1 PET + \beta_2 FDI + \beta_3 TOP + \varepsilon_t$ …… (1)

Where: β_0 = Constant term, β_1 to β_3 = coefficient of independent variables and ε_t = Error Term.

ARDL Model Specification

Auto Regressive Distributed Lagged (ARDL)

The time span of the data points series is small (1990 to 2021), and considering the possibility of the data to be stationary at; first difference I (1), at level I(0) or combination both I(0) and I(1) series. Therefore, the Pesaran *et al*. (2001) bounds testing approach is considered appropriate. It deem fit to help in achieving the research objectives of this study. Other ARDL advantages are the avoidance of problem of endogeneity as the approach corrects for residual serial correlation, it also allows for the use of

different lags of variables in the data generating process (Pesaran and shin, 1999).

The unrestricted ARDL model specification is as follows

$$\Delta YPC = \beta_0 + \sum_{t=1}^{N} \Delta\beta_{1i} YPC_{t-i} + \sum_{t=0}^{N} \Delta\beta_{2i} PET_{t-i} + \sum_{t=0}^{N} \Delta\beta_{3i} FDI_{t-i} + \sum_{t=0}^{N} \Delta\beta_{4i} TOP_{t-i} + \alpha_{0i} YPC_{t-i} + \alpha_{2i} PET_{t-i} + \alpha_{3i} FDI_{t-i} + \alpha_{4i} TOP_{t-i} + \varepsilon_t$$

……(2)

Δ is short run change parameter, β's are coefficients of short run parameters, α's are coefficients of long run parameters. t-i represents lag values of the parameters, ε_t

The short run error correction model is as follows:

$$\Delta YPC_t = \beta_0 + \sum_{t=1}^{N} \Delta\beta_{1i} YPC_{t-i} + \sum_{t=0}^{N} \Delta\beta_{2i} PET_{t-i} + \sum_{t=0}^{N} \Delta\beta_{3i} FDI_{t-i} + \sum_{t=0}^{N} \Delta\beta_{4i} TOP_{t-i} + \lambda ECT_{t-i} + \varepsilon_t$$

……(3)

Δ is short run change parameter, β's are coefficients of short run parameters, t-i represents lag values of the parameters, ε_t error term, λ is the coefficient of error correction term that signifies the speed of adjustment back to long run equilibrium in the event of short run disturbances.

Results and Discussions

Time series secondary data spanning 32 years covering 1990 to 2021 were used for this study. For verification and replication of the estimate and for future studies, below is the data, unit of measurement and sources. GDP per capita (in constant U.S. $ 2015), FDI (Inflows) and Trade Openness (TOP) which is the sum of export and imports as a ration of GDP (in constant U.S. $ 2015) all were sourced from world bank development indicators data base (www.data.worldbank.og). Petroleum oil (PET) final energy consumption was sourced from International Energy Agency (IEA) website (www.iea.org).

Table 1
Results for the Variables used in the Study

Statistical measures	YPC	TOP	PET	FDI
Mean	2002.065	51703002	530127.7	3.09E+09
Median	1981.699	45835524	488309.0	2.16E+09
Maximum	2679.555	98608076	915402.0	8.84E+09
Minimum	1429.012	31417061	265775.0	3.00E+08
Std. Dev.	464.1733	17460383	200856.3	2.61E+09
Skewness	0.066417	1.112227	0.577873	0.868488
Kurtosis	1.354537	3.587685	1.921405	2.555125

Jarque-Bera	3.633593	7.058095	3.332152	4.286667
Probability	0.162546	0.029333	0.188987	0.117263
Observations	**32**	**32**	**32**	**32**

Source: Authors' Estimation using E-Views version 10.

The descriptive statistics from Table 1 suggests that the four variables have the following characteristics YPC (GDP per capita), the mean is 2002.065, but the median is 1981.699, suggesting that the distribution is skewed to the right. The standard deviation is also relatively high, at 464.1733, which suggests that the data is spread out. TOP (trade openness), the mean is 51703002, and the median is 45835524, suggesting that the distribution is also skewed to the right. The standard deviation is also relatively high, at 17460383. PET (petroleum final energy consumption), the mean is 530127.7, and the median is 488309.0, suggesting that the distribution is slightly skewed to the right. The standard deviation is relatively low, at 200856.3. FDI (foreign direct investment inflows), the mean is 3.09E+09, and the median is 2.16E+09, suggesting that the distribution is also skewed to the right. The standard deviation is very high, at 2.61E+09. The descriptive statistics also suggest that the four variables are normally distributed, with exception of trade openness having Jarque-Bera probability value of less than 5%. A kurtosis greater than 3 for same trade openness indicates that the existence of heavy tail than a normal distribution. The skewness are positive, this indicate that the distribution is skewed to the right.

Table 2
Unit Root Test Result

Variable at level	ADF Test Statistic	ADF Prob. Value	PP Test Statistic	PP Prob. Value	Stationarity Status
YPC	-2.29	0.17	-2.31	0.17	Non-Stationary
TOP	-2.12	0.2	-2.14	0.2	Non-Stationary
PET	-2.56	0.09	-2.58	0.09	Stationary
FDI	-2.01	0.23	-2.03	0.23	Non-Stationary
Variable at first difference					
ΔYPC	-2.99	0.005	-3	0.005	Stationary

ΔTOP	-2.83	0.008	-2.84	0.008	Stationary
ΔPET	-3.16	0.003	-3.18	0.003	Stationary
ΔFDI	-2.7	0.011	-2.71	0.011	Stationary

***Source*:** *Authors' Estimation using E-Views version 10.*

From Table 2, only petroleum oil final energy consumption (PET) became stationary at level, the rest of the variables namely: gross domestic product, foreign direct investment inflows and trade openness were stationary at first difference, this result allows for the application of ARDL estimation technique. This is also coupled with small data handling capability of the technique and its ability to reveal both short and long run estimated results that this study aimed at.

Table 3
Co-integration Test and Lag Selection Result

Null Hypothesis	Test Statistic	Critical Value (1%)	Critical Value (5%)	Critical Value (10%)	Decision
No levels relationship	24.48135	3.65	2.79	2.37	Reject the null hypothesis

Source: Authors' Estimation using E-Views version 10.

From Table 3, the test statistic is 24.48135. The critical values at the 1%, 5%, and 10% significance levels are 3.65, 2.79, and 2.37, respectively. Since the test statistic is greater than all three critical values, we can reject the null hypothesis of no cointegration at the 1%, 5%, and 10% significance levels. This means that there is a long-run relationship between gross domestic product per capita (YPC), trade openness (TOP), petroleum oil final energy consumption (PET), and foreign direct investment inflows (FDI). In other words, the four variables move together in the long run. This means that a change in one variable is likely to lead to a change in the other variables, even if there is a delay. This is a strong result, as it suggests that the variables are closely interconnected in the long run. This could have important implications for policymakers, who may be able to use this information to design more effective policies. This implies that, if policymakers are interested in increasing YPC, they may want to focus on policies that increase TOP, PET, and FDI. For model estimation, Akaike Information Criteria (AIC) is used and lag 3 is indicated as the appropriate lag for the model.

Table 4
Short and Long-Run Estimated Results

Variable	Short-Run ARDL	Long-Run ARDL
Dependent variable: YPC		
DLOG(YPC(-1))	-0.553843***	-0.628345***
DLOG(YPC(-2))	0.185382**	-
DLOG(TOP)	0.047783***	0.227223***
DLOG(TOP(-1))	-0.093967***	-
DLOG(PET)	0.091756***	0.376229***
DLOG(PET(-1))	0.046407**	-
DLOG(PET(-2))	0.072281***	-
DLOG(FDI)	-0.006738*	0.127151***
DLOG(FDI(-1))	-0.067988***	-
DLOG(FDI(-2))	-0.030234***	-
ECT (-1)	-0.628345***	-
R-Square & Adj.R-Square	0.96 & 0.94	
Durbin-Watson	2.38	
F-Stats (Prob.)	1214.38 (0.00)***	

The asterisks ***,** and * are 1%, 5% and 10% levels of significance. **Source:** Authors' Estimation using E-Views version 10.

From Table 4, the short and long-run ARDL models suggest that the independent variables trade openness (TOP), petroleum oil final energy consumption (PET), and foreign direct investment inflows (FDI), have a significant impact on economic growth (YPC) in Nigeria. In the short run, DLOG(YPC) is negatively correlated with its own lagged values, but positively correlated with DLOG(TOP), DLOG(PET), but negatively impacted by DLOG(FDI). The coefficient on the error correction term (ECT (-1)) is negative (-0.6283) and statistically significant, or the model has speed of adjustment of approximately 63%. This suggests that the model is mean-reverting over time.

In the long run, Economic growth (YPC) variable is positively correlated with all independent variables. Precisely, 1% increase in petroleum final energy

consumption brings about 0.3763% increase in economic growth, followed by trade openness with 0.2272% and finally FDI with 0.1272%. In both short and long-run trade openness (TOP) have significant positive impacts on economic growth at 1% significance level, this agree with the findings of Musa *et al* (2021), Ijirshar (2019), but contradict the work of Elijah and Musa (2019) where trade openness was found to have negatively impacted on the economic growth in both the short run and long run. Short and long-run petroleum (energy) consumption (PET) enhances economic growth at 1% levels of significance, this corroborates with the findings of Wanjiku (2011) and Ziramba (2015). The result of foreign direct investment (FDI) in the short run is weak and negative at 10% indicating that at early stage of FDI, Nigeria may not instantly start reaping its benefits on economic growth. The long-run result is positive and significant at 1%, this agrees with Opoku *et al* (2019) that FDI positively spurs economic growth.

By and large, the short-run and long-run ARDL models suggest that all the three independent variables in this model are important determinants of economic growth in Nigeria, both in the short and in the long run respectively. Holding other things constant, policies aimed at increasing petroleum energy consumption, trade openness and foreign direct investment inflows are going to increase economic growth in the long run.

Table 5
Post-Estimation Diagnostics Results

Test	Result	Interpretation
Breusch-Godfrey Serial Correlation LM Test	F-statistic = 0.959350, p-value = 0.3452	No evidence of serial correlation
Heteroskedasticity Test: Breusch-Pagan-Godfrey	F-statistic = 1.188485, p-value = 0.3756	No evidence of heteroskedasticity
Heteroskedasticity Test: ARCH	F-statistic = 0.900868, p-value = 0.3513	No evidence of heteroskedasticity
Ramsey RESET Test	F-statistic = 0.765461, p-value = 0.3975	No evidence of model misspecification

Source: Authors' Estimation using E-Views version 10.

From Table 5, the F-statistic is 0.959350 and the p-value is 0.3452 for Breusch-Godfrey serial correlation LM test. This means that there is no evidence of serial correlation in

the residuals. Also, Heteroskedasticity and Ramsey RESET Test for misspecification revealed that the F-statistic value of 1.188 and p-value of 0.3756, f-statistic value of 0.765461 and p-value of 0.765461 and p-value of 0.3975 respectively implying desirable results of homoskedasticity and correct specification of the model. This means the model is good for policy making.

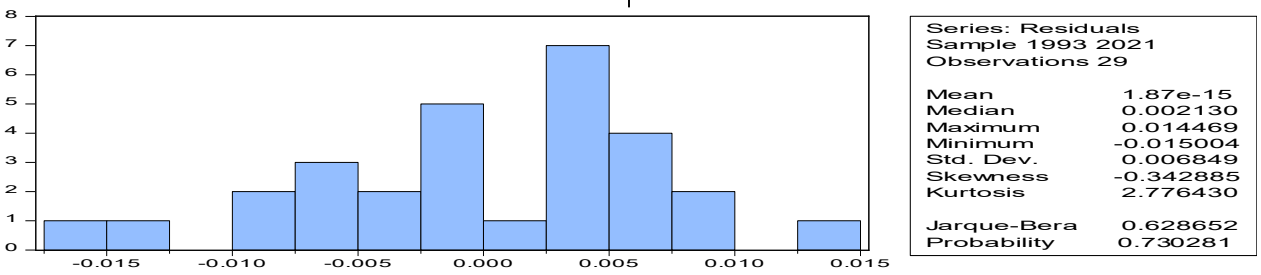


Fig 2: Histogram of Jarque-Bera Normality Test

From figure 2, the Jarque-Bera probability of 73% (0.73) indicates that the model has normal distribution and the cusum and cusum of squares in figure 3 and 4 is dynamically stable because the blue lines were in-between the red lines or ranges.

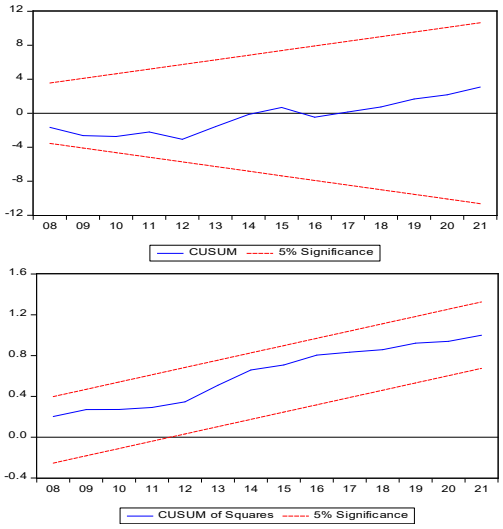


Fig 3: Cusum Stability Bounds
Fig 4: Cusum of squares Stability Bounds

The model passed all the post estimation diagnostics: serial correlation, heteroskedasticity, linear specification, normality and stability test. Serial correlation, the Breusch-Godfrey Serial Correlation LM Test is a test for serial correlation in the residuals of a regression model.

Conclusions and Recommendations

This study examines the effects of petroleum final energy consumption, FDI, and Trade openness on economic growth in Nigeria over the period 1990-2021. The unit root properties of the series were mixture of level and first difference stationary from both ADF and PP tests.

In the short run, petroleum energy consumption and trade openness have positive impacts on economic growth, while short run FDI negatively but weakly impacts on GDP in Nigeria, FDI and trade openness were having positive impacts on economic growth in Nigeria in the long run, the variable with biggest long run positive magnitude on economic growth is petroleum energy consumption, followed by trade openness and finally FDI. Based on the revealed empirical findings, this study concludes that all the three variables of petroleum final energy consumption, trade openness and foreign direct investment spur economic growth in Nigeria. Thus, attention on long run policy recommendation should be on all the three variables in their order.

The study recommends that there should be affordable consistent and sustained increase in petroleum energy supply for consumption in Nigeria to reap the positive contribution of petroleum on the economy, the existing but faulty Nigerian refineries should be repaired to be supplying cheap refined petroleum to Nigerian economy without any landing cost of importation. The petroleum refineries can also give other important by-products from crude oil like insecticides chemicals, fertilizer chemical, jet fuel, diesel, kerosene, lubricants, solvents, plastics and so on, which can contribute to economic growth of Nigeria .

In the short run effort should be made to correct the negative effects of FDI on Nigeria's GDP by providing the enabling environment for investment like tax concessions, addressing all form of distortions (like kick-backs, bribery, corruptions, insecurity) and improve infrastructures (such as power supply and road) that will entice good foreign direct investment. With trade openness having both short run and long run statistically significant positive impact on economic growth, more liberal trade relations are to be encourage to help expand the market size for domestic firms, more competition that will result in efficiency which can lead to economies of scale and higher productivity, as no country can live in isolation in today's world.

Interaction with the rest of the world is inevitable, but it should be fair enough to bring positive result to Nigeria. As an exporter of mainly primary products (raw materials like crude oil) and importer of finished products and technology, steady transition effort should be made at import substitution whereby production of sophisticated machines, equipment and

finished product that Nigeria use to import are produced in Nigeria. Future studies should use other methodologies and variables that may be relevant in the future determination of economic growth and development of Nigeria.

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