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PETROLEUM RESOURCE AND ECONOMIC WELFARE OF FIVE SELECTED LOWER-MIDDLE INCOME OF OIL PRODUCING COUNTRIES (i.e. NIGERIA, PAKISTAN, INDONESIA, EGYPT, INDIA).

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Abstract

Purpose – Economic welfare is one of the macroeconomic goals every country seeks to achieve, be it developed, least-developed or developing one. Some countries with abundant natural resources still suffer from achieving this goal. Based on this reason, this study was carried out to empirically look into the relationship between petroleum resource as measured by oil rent, and official exchange rate, and economic welfare as measured by gross domestic product per capita of five-selected lower-middle-income of oil producing countries (i.e. Nigeria, Pakistan, Indonesia, Egypt and India), using annual time-series data sourced from World Bank for the periods 2010-2020.

Design/methodology/approach – This objective was achieved with the utilization of static panel data method coupled with other linear models such as; Pooled OLS, Fixed effects, and Random effects models.

Findings – The results of the findings of Pooled OLS revealed that petroleum resource as measured by oil rent and official exchange rate had significant bearings on economic welfare as measured by gross domestic product per capita by 103.3 per cent and 0.14 per cent respectively on the average. The result further displayed that fixed effects model was an appropriate model to explain the significant fixed effects oil rent and official exchange rate had on improving gross domestic product per capita, when choice was made between Pooled OLS and fixed effects model. More so, the result further demonstrated that random effects model was the best model to explain the random effects oil rent and official exchange rate had on contributing positively to the gross domestic product per capita, when choice was made between fixed effects and random effects models. Finally, Panel Diagnostic residual test results showed that the series were normally distributed, hence the presence of cross-section dependence was not found in the model.

Conclusion/Policy Implication – The study concluded that for these five-oil producing countries to achieve their economic welfare, they must adopt mixed effects model as portrayed by the findings of this study for policy inference. As this is geared towards enabling these countries to achieve policies that are aimed at pegging their exchange rate to the value of dollars, and increasing the value of crude oil production, so as to improve their economic welfares.

Keywords: *Oil Rent, Official Exchange Rate, Economic Welfare & Static Panel Data Technique*

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1. Introduction

An economy is classified as a fuel exporter if the share of fuel exports in its total merchandise exports is greater than 20 per cent, and the level of fuel exports is at least 20 per cent higher than that of the country's fuel imports. This criterion is drawn from the share of fuel exports in the total value of world merchandise trade. Fuels include coal, oil and natural gas. For other parts of the analysis, countries have been classified by their levels of development as measured by per capita gross national income (GNI). Accordingly, countries have been grouped as highincome, upper middle income, lower middle income and low-income (See table 1 below).

Table 1: World Economic Situation and Prospects, 2020; p.168 (Table E: Economies per capita GNI in June 2019)

High-income		**Upper-middle-income**		**Lower-middle-income**	
Australia	Latvia	Albania	Jamaica	Angola	Morocco
Austria	Lithuania	Algeria	Jordan	Bangladesh	Myanmar
Bahamas	Luxembourg	Argentina	Kazakhstan	Bhutan	Nicaragua
Bahrain	Malta	Armenia	Lebanon	Bolivia	Nigeria
Barbados	Netherlands	Azerbaijan	Libya	Cabo Verde	Pakistan
Belgium	New Zealand	Belarus	Malaysia	Cambodia	Papua New Guinea
Brunei	Norway	Belize	Maldives	Cameroon	Philippines
Darussalam	Oman	Bosnia	Mauritius	Comoros	Republic of Moldova
Canada	Panama	Botswana	Mexico	Congo	Sao Tome and Principe
Chile	Poland	Brazil	Montenegro	Côte d'Ivoire	Senegal
Croatia	Portugal	Bulgaria	Namibia	Djibouti	Solomon Islands
Cyprus	Qatar	China	North Macedonia	Egypt	State of Palestine
Czechia	Republic of Korea	Colombia	Paraguay	El Salvador	Sudan
Denmark	Saudi Arabia	Costa Rica	Peru	Eswatini	Timor-Leste
Estonia	Singapore	Cuba	Romania	Ghana	Tunisia
Finland	Slovak Republic	Dominican R.	Russian	Honduras	Ukraine
France	Slovenia	Ecuador	Samoa	India	Uzbekistan
Germany	Spain	Equatorial Guinea	Serbia	Indonesia	Vanuatu
Greece	Sweden	Fiji	South Africa	Kenya	Viet Nam
Hong Kong	Switzerland	Gabon	Sri Lanka	Kiribati	Zambia
Hungary	Taiwan Province of China	Georgia	Suriname	Kyrgyzstan	Zimbabwe
Iceland	Trinidad and Tobago	Guatemala	Thailand	Lao People's Democratic R.	
Ireland	United Arab Emirates	Guyana	Turkey	Lesotho	
Israel	United Kingdom	Iran	Turkmenistan	Mauritania	
Italy	United States	Iraq	Venezuela	Mongolia	
Japan	Uruguay				
Kuwait					
Low-Income					
Afghanistan				Madagascar	
Benin				Malawi	
Burkina Faso				Mozambique	
Burundi				Nepal	

Central African Republic	Niger
Chad	Rwanda
Comoros	Sierra Leone
Democratic People's Republic of Korea	Somalia
Democratic Republic of the Congo	South Sudan
Eritrea	Syrian Arab Republic
Ethiopia	Tajikistan
Gambia	Togo
Guinea	Uganda
Guinea-Bissau	United Republic of Tanzania
Haiti	Yemen
Liberia	

Source: World Bank, Country classification by income (https://datahelpdesk.worldbank.org/knowledgebase/articles/906519).

To maintain compatibility with similar classifications used elsewhere, the threshold levels of GNI per capita are those established by the World Bank. Countries with less than $1,035 GNI per capita are classified as low-income countries, those with between $1,036 and $4,085 as lower-middle-income countries, those with between $4,086 and $12,615 as upper-middle income-countries, and those with incomes of more than $12,615 as high-income countries.

GNI per capita in dollar terms is estimated using the World Bank Atlas method, and the classification of lower middle-income countries is based on data for 2018. Hence, this study decides to focus on five selected countries categorized as lower-middle-income by World Economic Situation and Prospects 2020, which include Pakistan, Nigeria, Indonesia, Egypt and India. Petroleum resource is one of the many of natural resources a specific country is endowed with. It is a God-given resource naturally occurs in deposits under the Earth surface – this resource when tapped and produced it becomes source of wealth to the nation which has it. When it is untapped, it provides a healthy soil for crops and plants to grow.

Every country is predominantly dependent upon this kind of natural resource to develop itself, if it is endowed with, but if it is not endowed with, it can derive gain from it by importing this resource to either develop its economy or citizenry. Petroleum oil is synonymous with crude oil and other hydrocarbons which their existence is in liquid and/or gaseous form in subterranean pools or reservoirs, in tiny spaces within sedimentary rocks. Petroleum resource as one of the natural resources these countries (Pakistan, Nigeria, Indonesia, Egypt and India) are endowed with could have been seen as a trajectory of economic welfare due to enormous financial benefits derived from it. Petroleum resource, with benefits derived from it - it is very important to economic welfare of these countries. Not only that, but also an antidote to unemployment, this is because this sector can eradicate unemployment and funds gotten from it can be used to grow the economies of these countries and thereby would increase their economic welfares.

Despite the fact that petroleum resource gives wealth to these nations, the sector which is responsible for this resource is not performing as expected as its output is not manifesting in the lives of the citizens of these countries. Available record from World Bank shows that in 2010 Nigeria's oil rent contributed 12.85% to the gross domestic product, while a sharp decline of 7.4% was recorded in 2019. Similar record also reveals that Egypt's oil rent contribution to GDP is 7.11% in 2010 and it has a decline of 4.01% in 2019.Whereas, Pakistan oil rent records 0.66% to its GDP and has a low record in 2019 with 0.47%. Similar fluctuation figure of 2.32%

in 2010 and 0.94% is identified with the record of Indonesia. Also, India oil rent contribution to the GDP declines from 0.81% in 2010 to 0.32% in 2019. As a result of the above listed problematic decline and underperformance of this sector in these countries, policies, reforms and strategies have been put in place (such as the Nigeria Development Update Resilience through Reform; Egypt Inclusive growth for Sustainable Recovery; Pakistan Energy Sector Reform; Indonesia Boosting the Development of Digital economy and India economic reforms). Yet, the petroleum sector of these countries, has not performed to the test of time, instead its performance is on a serious decline as the provided figures above show.

The petroleum sector, despite the huge amount of money is producing, most oil refineries of these countries are in dire state, it cannot create job and improve the economic welfare of these countries as they are ranked among lower-middle-income in the World.

Given this fact, petroleum resource is well known catalyst for economic growth, welfare and development of countries, its underperformance denotes very large-scale danger for the economies of these countries. Although, some studies have been carried out on this topic, and they have also used diverse methods to deal with this problem. Hence, applying this method would make a more important difference from the approach used by previous studies. Therefore, in the light of this, this study is carried out to empirically look into whether funds this petroleum resource generates would increase economic welfare of these five selected lower-middle-income of oil producing countries (such Nigeria, Pakistan, Egypt, Indonesia and India). It is of concern of this study also to carry out an empirical analysis on how to solve this problem.

2. Literature Review

Review of Conceptual Literature

Concept of Petroleum Resources: Petroleum resources are further down the probability tree as far as future production and commerciality is concerned. The quest for petroleum resources begins with play, which can be defined as accumulations of hydrocarbon, either known or postulated, in similar geologic settings with regard to source rock, migration, geologic age, and trapping mechanism, among others. Resources can either be (i) contingent or (ii) prospective. The important distinction between the two subcategories is whether the resource is discovered or not.

Contingent resources are discovered, but the development of such resources is either (i) pending, (ii) on hold, or (iii) not viable under the present circumstances. Prospective resources are yet to be discovered. These are based on exploration and related studies in a prospect, lead, or play. Last but not least, certain petroleum resources are deemed unrecoverable due to technological, economic, or various other impediments. Resources are also categorized on the basis of technical and economic considerations. Technically recoverable resource, referred to as TRR, is the volume of oil and gas that can be extracted by utilizing current technology without any reference to economic feasibility. In contrast, economically recoverable resource, referred to as ERR, refers to the portion of technically recoverable resource that can be extracted economically. With the advancement of technology and favourable economic conditions, the ERR part increases within the TRR. Many unconventional resources cannot be easily converted to the proved reserves category by utilizing the present-day technology. Examples of unconventional oil resources include shale oil, extra heavy oil, tar sands, and bitumen, the commercial extraction of which are difficult and cost intensive (Abdus Satter; Ghulam M Iqbal, 2016).

Concept of Economic Welfare: this measures the level of prosperity and quality of living standards in an economy. This measurement can be seen through a diversity of factors; these

factors include GDP per capita – GDP per capita is obtained by dividing the Gross Domestic Product of a nation by its population, and other indicators which reflect the welfare of the population (i.e. literacy, number of doctors, high level of education, levels of health care, and environmental factors, such as congestion and pollution minimization etc.). These quality of life factors are important in determining economic welfare. This measurement is evaluated based on increase in real output and real incomes which suggest people are better off and therefore there is an increase in economic welfare. It refers to the general welfare of the people within a geographical landscape. Economic welfare tends to identify a person's well-being with the person's command over goods and services. This naturally leads to a focus on income, since a person's income determines how much he or she can consume. Going a step further, this approach often views each person as being endowed with a "utility or welfare function," and the person's income as an important variable that determines the level of utility that the person enjoys. *Social* welfare, according to this approach, is represented by aggregating the utility levels of all individuals in society (Kaushik, Basu & Lòpez-Calva, Luis F., 2011).

Review of Theoretical Literature

The Hotelling's theory of exhaustible resources

The main idea that trails the Harold Hotelling's (1931) theory proceeds in a straight course or manner. According to him, under optimal conditions, the price of an exhaustible resource, the net of extraction costs must be rising at a rate equal to the rate of interest on other assets; otherwise, the present value of the net price which could be received from selling in some periods would be higher than in other periods. In this case, owners of mine would not be indifferent about when to extract and sell their resources. It means that under competitive equilibrium, the rent (price minus cost of extraction) must rise at the rate of interest. As soon as extraction costs fall, the net price (rent) rises, the market price will increase and the quantity demanded will start falling. At the optimal rate of depletion, the resources will be exhausted and the instant demand will fall to zero. Hotelling argued that the socially optimal rate of exploitation of a non-renewable resource over time is achieved in a competitive market equilibrium, provided that the social discount rate equals the interest rate and that there are no sources of market failure such as externalities or incomplete property rights.

Welfare Criterion

Arthur Cecil Pigou **is** the founder of "Welfare Economics" His leading ideas on welfare economics are found in his "Economics of Welfare" (1920). Pigou popularized the word welfare and gave a concrete meaning to it. Pigou gave a clear meaning to the concept of welfare. He defined individual welfare as the sum of satisfactions obtained from the use of goods and services. Social welfare is the summation of all individual welfare in a society. Since general welfare is very wide and complicated, he limited his study to economic welfare. He defined economic welfare as that part of social welfare "that can be brought directly or indirectly into relation with the measuring rod of money."

Analytical Literature

The present modern welfare economics emerged through an evolution process of aggregating different views of eminent economists of different times. It basically deals with the social and individual welfare status through analysing how the resources of the economy are allocated among the social agents. The period 1939 witnessed the advent of the new welfare economics heralded by Kaldor (1939)-Hicks (1939), though to some extent anticipated by Harold Hotelling and by

Pigou (1920) himself - can be seen today as a movement aimed at dislodging the conventional concept of cardinal utility. This group of economists attempt to expunge inequality, and disallocation of resources etc. among members of the society by propounding different criteria for economic welfare. For instance, Pareto (1894) in his criterion of improvement of economic welfare of the society argued that if a change in resources benefits at least one person while harming no one else, Pareto improvement has been made – this improvement according to him is an action that makes at least one person better off without making anyone worse off. Given an initial allocation of goods or resources for a set of individuals. On the other hand, Kaldor in his welfare criterion postulated that if a certain change in economic organisation or policy makes some people better off and others worse off, then a change will increase social welfare if those who gain from the change could compensate the losers and still be better off than before. Hicks supported Kaldor for employing compensation principle to evaluate the change in social welfare resulting from any economic reorganisation that benefits some people and harms the others. However, Little argued that Kaldor-Hicks compensation principle is merely a definition and not a 'test' of increase in welfare because it ignores income distribution. In fact, the problem of distribution cannot be ignored where the problem of productive efficiency is involved. Scitovsky (1941) in his position maintained that a change is an improvement if the gainers in the changed situation are able to persuade the losers to accept the change and simultaneously losers are not able to persuade the gainers to remain in the original situation. Little does not consider the KaldorHicks criterion and the Scitovsky criterion as satisfactory criteria of welfare. He is in favour of actual rather than potential changes in welfare and proposes his own criterion in these words: "A change is economically desirable if it results in a good redistribution of welfare, and if a policy of redistributing money by lump sum transfers could not make everyone as well-off as they would be if the change were made." Meanwhile, Bergson, Samuelson, Tintner and Arrow are of the view that no meaningful propositions can be made in welfare economics without introducing value judgments. The concept of social welfare is an attempt at providing a scientifically normative study of welfare economics. Thus, the various compensation criteria which led to the so-called New Welfare Economics were attempts at presenting a universally valid criterion for increase in welfare.

Review of Empirical Literature

The important roles petroleum resource play in the development and well-being of many oil producing countries; specifically, India, Egypt, Indonesia, Nigeria and Pakistan have remained one of the vital reasons for this study. Diverse literatures have been empirically reviewed as regards petroleum resource and economic welfare of countries and arrived at conflicting results on the subject matter. This section is dedicated to review some of these studies.

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Review of Empirical Literature Table 2

Author (s)	Countries of study	Purpose of Study	Design / Approaches	Findings	Gaps in Literature
Abbas, Shujaat (2020)	**Pakistan**	Impact of oil prices on remittances to Pakistan from GCC countries, over the period 1980 to 2018	Advanced nonlinear panel Pooled Mean Group (PMG) model	The findings show that oil prices and remittance are asymmetrically associated. The increasing oil prices have a significant positive effect only in the long run.	His study failed provide economic indicator s to measure the purpose for his study; the present study provides economic indicators to measure the purpose of its study like oil rent, exchange rate and GDPpc.
Akeerebari,T.J. and Adesugba, C.N.,(2021)	**Nigeria**	Crude oil dependence and economic development in Nigeria from 1981 to 2019	Augmented Dickey-Fuller test, Johansen co-integration, pair wise Granger causality test and vector error correction model (VECM).	The results of vector error correction (VECM) revealed that government total expenditure, oil revenue, and external reserves have positive and insignificant impact on gross national income per capita. Whereas, exchange rate had negative and significant impact on gross national income per capita.	Their study found mixed results, but failed to explain whether the effect/results happened in long-run or short-run as VECM often provides long-run and shortrun results
Akhmad, A.and Amir, A., (2018)	**Indonesia**	Study of Fuel Oil Supply and Consumption in Indonesia from 1997-2016	The research used econometrics model with simultaneous equation system.	The result of analysis indicated that factors influencing the supply of fuel oil were world oil price and the supply of oil in the previous year.	Their study failed to mention specific method of analysis they applied; but the present study mentions/describes its method of data analysis - panel data technique.
Asagunla,T.M, and Agbede,M.O., (2018)	**Nigeria**	Examined the contribution of the oil revenue to Nigerian output growth for the period of 1981 to 2014	The study employed the fully modified ordinary least squared method (FMOLS)	The study therefore discovered that oil revenue does not have short run impact on the economic activities of Nigeria.	Their study didn't describe the dependent variable used in their study, but the present study describes how it uses GDP per capita as its dependent variable.
Auwal, U. and Mamman, J.A., (2012)	**Nigeria**	Investigated the impact of the petroleum products supply and domestic prices on the domestic distribution from 2005 to 2010	Vector Auto regression (VAR) model and Ordinary Least Square (OLS) estimations	The study found that independent variables are responsible for the variations in petroleum products distributed.	Their study failed to reveal the names of the independent and dependent variables for their study; the present reveals the names of all used variables in its study.

Awujola, et al. (2015)	**Nigeria**	Examined the economic impact of oil exportation on Nigerian economy covering a period of 1970 to 2012	Vector Error Correction Model (VECM)	Empirical analysis shows that there exists a long run relationship between the crude oil exports and the economic growth.	Their study covered the period 2005-2010, but there have been recent developments in macroeconomic studies, the present is recent and covers the period 2010-2020.
Ifeoluwa, et al. (2020)	**Selected oilproducing African countries**	Investigated the relationship between sustainable development and crude oil revenue (COR) in selected oil-producing African countries from 1992–2017	Pooled Mean Group (PMG) estimators on panel autoregressive distributed lag model (ARDL)	This study was significant for Africa to break away from fiscal over-dependence on natural resource revenue, especially crude oil due to its high volatility and to correct porous institutional outlook	Their study only stated the purpose for the study without provided robust empirical framework; the present study provides robust empirical framework and reveals its findings.
Ikechukwu, K. and Omotayo, M., (2019)	**Oilproducing countries in Africa**	The Impact of Changes in Oil Price on Stock Market from Q1:2010 to Q4:2018	Dynamic panel analysis technique	From the findings, an adverse effect of oil prices existed on stock markets in Africa, attributable to fragmented and underdeveloped capital markets	The data used in their study was Quarterly, but the present study uses annual time-series data for cross sectional units.
Mamdouh, A. and Mohamed, A., (2020)	**Egypt**	Explore the extreme effect of crude oil price fluctuations and its volatility on the economic growth of Middle East and North Africa (MENA) countries	Panel quantile regression approach with other linear models such as fixed effects, random effects and panel generalized method of moments	The findings summarize that changes in oil price and its volatility have an opposite effect for each oil-export and oil-import countries.	Their study failed to explain a specific variable it used as dependent variable, and also failed to reveal the period of its study; the present study is specific about its dependent variable GDPpc., and the periods are 2010-2020.
Mustag, et al., (2021)	**Pakistan**	Explored the dependence between changes in world crude oil prices and the performance of the Pakistan Stock	Quantile regression approach	The findings depicted that the dependence between changes in crude oil price and the sectoral stock returns is heterogeneous across industries and it	Their study adopted a better technique to analyse the relationship between crude oil prices and sectoral stock return, but didn't explain the result of their finding in details, the present study
		Exchange, at the aggregate as well as sectoral levels for the period from July 1997 to December 2016.		exists in both bullish and bearish market trends.	explains detail of it finding and makes recommendation for policy inference.

Qudah, et al., (2016)	**Egypt**	The Impact of Oil Sector on the Global Competitiveness of the GCC Countries: Panel Data Approach	The study uses panel data techniques	The results showed that the relation between rent and GCI found to be negative and highly significant whereas the oil prices and contribution of the mining sector in GDP found to have positive relation with GCI at 90% significance level.	Their study found negative relationship between study variables, but the present study finds positive and significant relationship between the study variables.
Rashmi, et al. (2019)	**India**	Crude Oil Import Elasticity Of Demand In India An Empirical Analysis 19872016	Auto Regressive Distributed Lag (ARDL) co-integration technique	It was revealed that the long-run income elasticity coefficient was found to be statistically significant with expected sign.	Their study failed to relate its finding between variables, the present study relates its finding between variables understudy.
Suleiman Sa'ad, (2009).	**Indonesia**	An empirical analysis of petroleum demand for Indonesia	The bounds testing approach to cointegration	The results suggest that both total products and gasoline share estimates are more responsive to changes in income than changes in the real price of petroleum products	The bounds testing approach used for analysis is associated with long-run while its analysis talked about responsive as if it was Impulse Response Function it used. The present study uses corresponding method in its study.
Sultan, et al. (2020)	**India**	Empirical Investigation of Relationship between Oil Price and Inflation from 1970-2017	Johansen cointegration method	It is found that oil price does affect the inflation level in India both in the short run as well as in the long run	Their study used not accurate variables that have direct relationship between them in the model, but present study variables have direct link between them.
Yadav., et al. (2020)	**India**	A dynamic relationship between crude oil price and Indian equity market for the periods 2002018.	Augmented Dickey–Fuller test, Johansen co-integration test, the vector auto-regression (VAR) model, Granger causality/Wald test	The study found that both the variables, crude oil prices and Sensex are integrated of order 1, no co-integration between them, VAR model unfold the marked effect of previous month crude oil prices (lag 1) on the movement of Indian stock market.	Their study analysed the results of its finding, but failed to provide analytical framework analysis which is basis for empirical research. The present study discusses the analytical framework and anchors its study on a recent study, and concludes its study with critical policies' recommendation.

Source: Authors' Computation

3. Methodology and Table Presentation of Data Analysis Nature and Data Source

The study on the relationship between Petroleum Resource and economic welfare of five selected lower-middle income of oil producing countries (such as Nigeria, India, Egypt, Pakistan and Indonesia) employs static (balanced) panel data analysis to investigate annual time-series data for the periods 2010-2020 that cut across 5 countries with 50 observations.

Gross domestic product per capita (GDPpc) is used as a proxy for economic welfare of these 5 countries and its data are sourced from World bank and in Billions of U.S Dollars; Oil rent (O-R) is in percentage, and Official exchange rate (OEXCHR) is the value of these study countries' currencies versus U.S Dollars, they are both used as indicators for petroleum resource and their data are sourced from World Bank respectively.

Model Specification

Following the research work of Mamdouh & Mohamed (2020) in exploring the extreme effect of crude oil price fluctuations and its volatility on the economic growth using Panel quantile regression approach with other linear models such as fixed effects, random effects and panel generalized method of moments. The adapted form of the model is expressed in a multivariate regression and modified with the incorporation of exogenous indicators considered include: oil rent (O-R), and official exchange rate (OEXGHR). Thus, a functional form of the relationship between petroleum resource and economic welfare of Nigeria, India, Egypt, Pakistan and Indonesia is illustrated as;

GDPpc = f (O-R, OEXCHR) ……..... (1)

Where;

GDPpc= Gross Domestic Product Per Capita (Target variable)

O-R = Oil Rent (Predictor Variable)

OEXCHR = Official Exchange Rate (Predictor Variable)

From the functional relationship above, it can be represented in Panel Data Model as follows:

$Y_{ìt} = \alpha + \sum_{k=1}^{j} \beta\kappa\, X\kappa\, ìt + \mu_{ìt}$; k = 1, J …… (2)

Where Y is the Target variable; α represents an intercept and it is constant across all individuals and time periods; β measures the effect of independent variable on dependent variable and X_k are predictor variables. The subscripts ì and t refer to cross-sectional dimension and time series dimension respectively. $\mu_{ìt}$ explains individual-specific variation in Target variable GDPpc which stays constant across time for each individual. Hence, ì refer to as individual observations which of course used to represent, countries in this study.

From the above equation, it can be further broken down to illustrate Pooled Least Square, Fixed Effects Model and Random Effects model.

3.1 Panel Data Estimation Techniques

Basically, in this study, the static panel data models together with other linear methods; such as Pooled Ordinary Least Square (Pooled OLS), Fixed Effects Model (FEM) and Random Effects Model (REM) are employed with the help of E-view 10 Software for data analysis. Each of these methods has its underlying assumptions which must necessarily be satisfied to obtain unbiased and efficient estimates. Each is considered in turn of these methods with the underlying assumptions.

Common Effect Model or Pooled Least Square (Pooled OLS)

Pooled least square technique simply combines only time series and cross section data. In this model time and individual dimensions are considered, therefore it is assumed that the behaviour of data that cut across these countries are the same in various periods. This Pooled least square

technique uses the Ordinary Least Square approach to estimate the panel data model. In this method, Pooled Least Square model equation can be expressed as follows;

$GDPpc_{it} = \alpha + \beta_1 O\text{-}R_{it} + \beta_2 OEXCHR_{it} + \mu_{it}$ ..... (3)

Where: GDPpc is target variable; α is the intercept; β_1 and β_2 are the coefficients for the respective predictor variables; OR_{it} and $OEXCHR_{it}$ are the predictor variables; μ_{it} is the error term

Fixed Effects or LSDV Model

This model assumes that differences between individuals can be accommodated from different intercept. This estimation model is also called the technique of Least Square Dummy Variable (LSDV). The fixed effects model is different from the Pooled least square or common effect, though still uses some Ordinary Least Square properties. It is considered unrealistic, the assumption of modelling that produces a constant intercept for each cross section and time. Hence, it assumes that differences between individuals/cross sections can be accommodated from difference intercept between individuals, the dummy variable technique is used. Thus the Fixed Effect Model equation can be illustrated as follows;

$GDPpc_{it} = \alpha + \beta_1 O\text{-}R_{it} + \beta_2 OEXCHR_{it} + \varepsilon_{it}$..... (4)

Where: GDPpc is target variable; α is the intercept; β_1 and β_2 are the coefficients for the respective predictor variables; $O\text{-}R_{it}$ and $OEXCHR_{it}$ are the predictor variables; ε_{it} is the error term.

Random Effects Model

This model is used to estimate panel data where interference variables may be interconnected between time and between individuals. The difference between intercepts is accommodated by error term of each country in the Random Effects model. One of the advantages of using this model is that is to expunge Heteroscedasticity Generally speaking, the Random Effects model differs from Pooled Least Square and fixed effects model – it doesn't use the principle of common effect, but uses the principle of maximum likelihood or generalized least square technique. Hence, Random Effects Model (REM) equation is specified as follows;

$GDPpc_{it} = \alpha + \beta\kappa O\text{-}R_{it} + \beta\kappa OEXCHR_{it} + \mu_i + \varepsilon_{it}$ ..... (5)

Where: GDPpc is target variable; α is the intercept; β_κ and β_κ are the coefficients for the respective predictor variables; $O\text{-}R_{it}$ and $OEXCHR_{it}$ are the predictor variables; μ_{it} is the individual impact of i^{th} entity, is not measurable variables; ε_{it} is the error term; i = entity(country) and t = time (such as years from 2010 to 2020).

4. Results and Discussion

Table 3: Pooled OLS, Fixed Effects model and Random Effects Model.

Pooled OLS Results				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1684.433	124.5209	13.52731	0.0000
O-R	103.3912	20.85086	4.958606	0.0000
OEXCHR	0.148705	0.017489	8.502690	0.0000
Fixed Effects Model Results				
C	2258.990	157.3709	14.35456	0.0000
O-R	2.313151	20.56760	0.112466	0.9110
OEXCHR	0.061343	0.049175	1.247436	0.2190
Random Effects Model Results				
C	2150.458	299.3400	7.184001	0.0000
O-R	11.40445	19.96276	0.571288	0.5705
OEXCHR	0.092514	0.037743	2.451171	0.0180

Period included: 10; Cross-sections included: 5; Total panel (balanced) observations 50
Source: Authors' Computation with E-view 10 Software

From the result of panel least square above, it is revealed that the absolute value of the coefficients of oil rent (O-R) and official exchange rate (OEXCHR) are positive and their probability values are statistically significant at 5% level respectively. Since, oil rent variable in the model is in percentage, hence it is estimated that 1% increase in the value of oil rent (OR) would lead to a significant rise of 103.39 units in the value of gross domestic growth per capita (GDPpc) as a proxy for economic welfare on the average. Similarly, it is estimated that one unit increase in the value of official exchange rate (OEXCHR) would also generate a significant unit of 0.14 increase in the value of gross domestic growth per capita (GDPpc) as a proxy for economic welfare on the average in the pooled OLS model. This result is a clear indication that an increase in demand for goods and services translates into increased demand for these five selected lower-middle income oils producing countries' currencies.

5. Choice of a Model

Likelihood Ratio test

Choice between Pooled OLS and Fixed Effect Model

In this case, the decision criterion is based on the results of Null and Alternative hypotheses with the application of Likelihood Redundant test; suggesting that Pooled OLS is an appropriate regression model, if Null hypothesis is accepted ($p > 0.05$). Conversely, Fixed

Effect model will be chosen as an appropriate model, if and only if, Null hypothesis is rejected ($p < 0.05$).

Hausman Test

Choice between Fixed Effects and Random Effects Model

Here, making choice of a better model between Fixed Effects Model and Random Effects Model is made - Hausman tests is utilised to run the test as the decision criterion is also based on the outcomes of Null hypothesis and Alternative hypothesis. Implying that Fixed Effects Model is a better model, if the Null hypothesis is rejected (i.e. $P < 0.05$). On the contrary, Random Effects Model is better, if we accept Alternative hypothesis (i.e. $P > 0.05$). Table 5a below presents the results respectively

Table 4: Choice of a Model Test Results

Likelihood Ratio Tests Results			
Effects Test	Statistic	d.f.	Prob.
Cross-section	27.290654	(4,43)	0.0000
Cross-section Chi-square	63.187484	4	0.0000
Housman Test Results			
Test summary	Chi-Sq. Statistic	Chi-Sq. d,f.	Prob.
Cross-section Random	3.632187	2	0.1627
Variable	Fixed	Random	Var(Diff) Prob.
O-R	2.313151	11.404451	24.514226 0.0663
OEXCHR	0.061343	0.092514	0.000994 0.3227

Source: Authors' Computation with E-view 10 Software

From the results of the test above, it shows when making choice of the appropriate model between Pooled OLS and Fixed Effects Model with the application of redundant likelihood ratio test; it can be concluded that Fixed Effects model is an appropriate Model to use in this study, this is because the Prob. value is less than 5% level of significance. According to Fixed Effects Model, the predictor variables (i.e. O-R and OEXCHR) contribute significantly to the gross domestic growth per capita as a proxy for economic welfare of these five countries by 27.29% and 63.18% respectively. While, the result of Hausman tests shows that the best model to use is Random Effects as its Probability value is greater than 5% level of significance. Hence, according to Random Effects Model the predictor variables (i.e. O-R and OEXCHR) improve

the economic welfare measured by gross domestic growth per capita (GDPpc) of these fiveselected lower-middle income of oils producing countries by 11.40% and 0.09% respectively.

Panel Residual Diagnostic Tests

Some diagnostic tests are run to ascertain the economic welfare of the model; namely normality test and cross-sectional dependence test. The table below displays the results.

Table 5: Panel Diagnostic Tests Results

Test	Hypothesis		Prob. value
Jarque-Bera	Normally Distributed		0.322435
Test	Statistic	d.f.	Prob. value
Breusch-Pagan LM	18.08209	10	0.0536
Pesaran Scaled LM	1.807209		0.0707
Pesaran CD	-0.126090		0.8997
Result: No cross-section dependence (correlation) in Residuals			

Source: Authors' Computation with E-view 10 Software

From the results of residual tests above, it can be concluded that the series are normally distributed and that there is no cross-section dependence in the model.

6. Conclusion and Policy Implications

Economic welfare of every country in the world cannot be overemphasized. Countries seek to achieve this macroeconomic objective, so that welfare of their citizens will be in a good and acceptable state or condition. Based on this reason, this study was carried out to empirically look into the relationship between petroleum resource and economic welfare of five-selected lower-middle income oil producing countries (i.e. Nigeria, Pakistan, Indonesia, Egypt and India), using static panel data together with Pooled OLS, Fixed Effects Model and Random Effects Model analysis for the periods 2010-2020. In the course of carrying out this investigation, the findings of the empirical results of Pooled OLS revealed that oil rent and official exchange rate positively and significantly improve the gross domestic growth per capita (GDPpc as a proxy for economic welfare of these countries by 103.3% and 0.14% respectively on the average. To ascertain the economic effect the importance of petroleum resource cause on economic welfare of these five-selected lower-middle income oil producing countries. The study resorted to run analysis of choosing an appropriate model between Pooled OLs and Fixed effects Model with the application of Redundant likelihood ratio Test. Based on the result of hypothesis, it was displayed that Fixed Effect Model was chosen over Pooled OLS, implying that Fixed Effects model was appropriate to explain these effects. After making the choice of fixed effects; the results showed that oil rent (O-R) and official exchange rate (OEXCHR)

significantly had fixed and constant effects on gross domestic growth per capita (GDPpc) as a proxy for economic welfare of these countries by 27.29% and 63.18% on the average. In the same vein, the study as well, run analysis to making the best choice between Fixed Effects and Random Effects models utilising Hausman Test. Based on the result of hypothesis, it clearly displayed that Random Effects model was chosen over Fixed Effects Model, suggesting that Random Effects Model was the best chosen model to explain random effects of relationship these variables (O-R and OEXCHR) had with economic welfare of these countries as measured by gross domestic growth per capita GDPpc as it improved their economic welfare by 11.40% and 0.09% respectively. Furthermore, to verify the reliability and economic health of the model, the study was subjected to residual diagnostic tests – the results of the findings of Jarque-Bera test proved that the series were normally distributed at 5% level of significance. Whereas, the results of Breusch-Pagan LM, Pesaran LM and Pesaran CD tests respectively reported that there was no cross-section dependence in the model. The policy implication here is that, for these five-oil producing countries to tap into the effects petroleum resource as measured by oil rent and official exchange rate had on their gross domestic growth per capita (GDPpc) as a proxy for economic welfare, they must adopt mixed effects model as revealed by the findings of this study. As this is geared towards enabling these countries to achieve policies that are aimed at pegging their exchange rate to the value of dollars, and increasing the value of crude oil production, so as to improve their economic welfare.

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