International Journal of Advances in Engineering and Management (IJAEM)
Volume 7, Issue 09 Sept. 2025, pp: 553-566 www.ijaem.net ISSN: 2395-5252

Petroleum Product Prices and Human Development Index in Opec Countries

Attahiru, M.; Oriji, A. B., & ….
Emerald Energy Institute, University of Port Harcourt.

Date of Submission: 15-09-2025 Date of Acceptance: 25-09-2025

ABSTRACT
This study investigates the relationship between refined petroleum product prices—specifically, diesel and petrol—and the Human Development Index (HDI) across selected OPEC countries from 2010 to 2019. Employing a panel data regression framework, the study tested three models: pooled, fixed, and random effects, with diagnostic tests confirming the fixed effect as the most optimal. The fixed effect model revealed that both diesel and petrol prices have statistically insignificant short-run effects on HDI. However, cointegration and error correction analyses affirmed a long-run equilibrium relationship, with both diesel and petrol prices exhibiting statistically significant and positive impacts on HDI. The error correction coefficient (-0.2143) indicates that deviations from the long-run equilibrium are corrected at a rate of 21.43% annually. These findings imply that higher petroleum product prices positively influence human development in the long term. The study recommends that OPEC governments reinvest petroleum revenues into education, healthcare, and infrastructure to sustain improvements in HDI. Additionally, diversifying the economy, investing in a skilled workforce, and promoting cleaner energy alternatives are vital to reducing volatility and ensuring inclusive development. Finally, the study underscores the importance of long-term, strategic petroleum revenue utilization in advancing human development outcomes.

I. INTRODUCTION

Human development refers to the expansion of people's freedoms and capabilities to lead lives they value. The Human Development Index (HDI) is a composite measure including income, education, and life expectancy has increasingly been used to assess a country's overall development beyond traditional economic indicators like GDP. In many oil-exporting developing nations, particularly among OPEC member countries, petroleum product prices significantly influence economic conditions, and by extension, human development outcomes. According to Sen (2011), economic development refers to people's freedom and the removal of obstacles that can hinder it. Freedom allows people to tailor their own destiny and gives them self-confidence. Obstacles that arise in the path of freedom and development, as a result, result in poverty, lack of economic opportunities, corruption, poor governance, lack of education and lack of health".

The prices of petroleum products such as gasoline, diesel, and heating oil are primarily shaped by the dynamics of global crude oil markets. OPEC, controlling a large portion of global oil reserves and production, exerts considerable influence over these prices through supply adjustments. When OPEC restricts crude oil production, it drives up global prices, which directly raises the cost of petroleum products. These fluctuations affect domestic economies in complex ways, particularly in OPEC countries that are heavily reliant on oil revenues for public spending, including investments in health, education, and social infrastructure, which are the key pillars of the HDI.

Despite substantial oil revenues, many OPEC countries still face persistent developmental challenges. According to Nkurunziza and Bates (2003), low investment levels and weak diversification continue to hinder structural transformation in these economies. Such conditions limit improvements in income distribution, education access, and health outcomes, thus dampening HDI progress even amid periods of economic growth driven by oil booms. Furthermore, Liao (2006) examined oil consumption and economic growth in OPEC countries using panel cointegration and error correction models from 1980–2011. He found that energy efficiency improvements had no significant long-term impact on economic growth. This suggests that higher oil prices and increased revenues do not automatically translate into improved human development outcomes. Instead, the volatility in oil markets (marked by fluctuating

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revenues), can disrupt long-term investment in critical human development sectors.

Given these realities, this study focuses on empirically assessing how petroleum product prices impact the Human Development Index in OPEC countries. Using a panel data model for twelve OPEC nations over the period 2010–2019, the analysis estimated the extent to which changes in petroleum prices affect key HDI indicators such as life expectancy, education levels, and per capita income.

II. LITERATURE REVIEW

The Human Development Index (HDI) stands as a comprehensive and multidimensional tool for evaluating the development status of countries beyond conventional economic indicators. Developed by Mahbub ul Haq and later adopted by the United Nations Development Programme (UNDP), the HDI integrates three essential components, life expectancy, education, and per capita income—to provide a more nuanced picture of societal well-being (Biswas & Caliendo, 2007; Graham, 2010). In contrast to Gross Domestic Product (GDP), which only quantifies economic output, HDI attempts to capture the quality of life and the opportunities available to individuals within a society. Scholars such as Kovacevic (2011) and Graham (2010) emphasize that the HDI's foundational dimensions such as longevity, knowledge, and a decent standard of living represent the most fundamental human aspirations and serve as core indicators of sustainable development. These dimensions resonate deeply with the capabilities approach proposed by Amartya Sen (1999) and further refined by Martha Nussbaum (2000), which argues that development should be about expanding people's capabilities and freedoms to live lives they value. The HDI consequently ranks countries into four broad categories: very high, high, medium, and low human development, emphasizing not only performance but also the efficiency with which nations convert economic resources into human welfare (Barus &Tarmizi, 2021; Lind, 2019).

Importantly, the HDI has proven itself as an effective instrument for revealing development disparities that traditional GDP measures often obscure. Countries with similar levels of income may have vastly different HDI outcomes due to discrepancies in access to education, quality healthcare, and life expectancy (Purba, 2019; Klasen, 2018). These disparities underscore the argument that economic growth, while necessary, is not a sufficient condition for development. The HDI, therefore, functions as both a diagnostic tool and a policy guide for fostering inclusive and equitable development outcomes (Tuba & Pelin, 2022).

Numerous studies have investigated the critical role of fiscal policy in influencing HDI outcomes. For instance, Gupta et al. (1998), Gomanee et al. (2005), and Ali et al. (2012) have shown empirically that targeted government spending on social sectors, particularly health, education, and welfare can significantly elevate HDI indicators. Nwakanma and Nnamdi (2013) argue that a transparent, efficient, and equitable tax system is vital for creating a fiscal environment conducive to human development. In this regard, Kizilkaya et al. (2015) advocate for a tax policy that is not only revenue-generating but also socially responsive and redistributive in nature, aligned with the broader goal of reducing inequality. Sherwani et al. (2017) further elaborate that both direct and indirect tax systems exert substantial influence on HDI levels, particularly when designed with principles of fairness and social accountability. They stress that increased voluntary tax compliance, when matched with visible improvements in public services, creates a virtuous cycle for long-term human development.

The challenges faced by resource-rich but institutionally fragile economies, such as those heavily dependent on oil, introduce another layer of complexity. In these contexts, the volatility of global oil prices can severely affect fiscal planning, particularly in critical sectors such as healthcare, education, and infrastructure. Al Mustanyir (2023) provides a compelling analysis of healthcare expenditure across OPEC countries in the aftermath of the 2014 oil price slump. While some countries like Iran and Venezuela managed to sustain or increase healthcare spending, others like Nigeria and Saudi Arabia faced difficulties due to their over-reliance on oil revenues and limited diversification efforts. This dichotomy underscores the need for resource-dependent nations to stabilize and diversify their revenue base to ensure continued investments in human development.

In Nigeria, several empirical studies have corroborated the inflationary impact of rising petroleum prices. Eregha et al. (2015), Bobai (2012), and Arinze (2011) observed that fuel price increases directly translate into higher transportation costs and broader inflationary pressures. These findings highlight the critical link between petroleum pricing and macroeconomic stability, further emphasizing the need for strategic pricing policies and targeted subsidies. Orgunbodede et al. (2010) and Nwosu (2009) reinforce this view, suggesting that consistent fuel

price hikes raise the cost of living and transportation, which adversely affects lower-income households. These authors advocate for long-term solutions such as domestic refining capacity and broader economic diversification to reduce vulnerability to global oil market fluctuations.

At the heart of this debate lies the need for reliable and diverse public revenue sources to finance sustainable development. Edeme et al. (2017) reported a positive correlation between public spending on education, health, agriculture, and village development and HDI improvements in Nigeria. Similarly, Novitasari and Hapitri (2019) documented that local government expenditures in education and healthcare significantly enhanced HDI scores in West Java's districts and cities. Palayukan (2019) reached the same conclusion for Southeast Sulawesi, emphasizing the transformative impact of sustained investment in human capital. Wardhana et al. (2021) also found that spending in the economic, infrastructure, and education sectors significantly boosts Indonesia's HDI. However, not all evidence points in the same direction; Mongan (2019) argued that central government education expenditure had no measurable impact on HDI, though regional spending showed more promising results. This suggests that localized governance and budgetary efficiency may be more effective than centralized interventions in delivering social services.

In Saudi Arabia, Haque and Khan (2019) explored the impact of oil production and government expenditure on HDI using time series data from 1990 to 2016. Their study revealed that a 100-million-barrel increase in oil output could raise HDI by approximately 4 percentage points, while a 1% increase in government spending led to a 10-percentage point rise in HDI. Among all sectors, education expenditure was found to have the most significant positive effect. Interestingly, the study also found a negative correlation between health expenditure and economic growth, suggesting inefficiencies or misallocation in the health sector that warrant structural reform.

Beyond the Middle East, Amakom and Iheoma (2014) found that in Sub-Saharan Africa, only public expenditures in health and tertiary education had statistically significant impacts on human development. Similarly, Qureshi (2009) argued that increased public investment in human development sectors not only improved HDI but also had a catalytic effect on economic growth in Pakistan. Razmi, Abbasian, and Mohammadi (2012) confirmed a strong, positive link between government health spending and HDI in Iran. Their follow-up research also showed that globally, historical government expenditures had predictive power over current HDI values. Mittal (2016) observed similar outcomes in India, where state-level social spending had positive impacts on human development metrics. Also, Haile and Niño-Zarazúa (2018), in their analysis of 55 low- and middle-income countries, concluded that government social spending remains a critical driver of welfare enhancement and human development across the developing world.

Turning to the broader issue of oil revenue and economic growth, Alkhathlan (2013) found that in Saudi Arabia, oil revenue positively influenced economic growth in both short- and long-term horizons. Al Rasasi et al. (2019) echoed this conclusion using data from 1970 to 2017, confirming that oil production and revenue correlate strongly with broader economic development metrics. Sultan and Haque (2018) also demonstrated a long-run relationship between economic growth and oil exports, imports, and government consumption expenditure in Saudi Arabia, further validating the long-term developmental implications of oil revenue management.

In the Nigerian context, Bobai (2012) examined the inflationary consequences of rising petroleum product prices between 1990 and 2011. The study found that petrol (PMS) exerted the strongest influence on inflation compared to diesel (AGO) and kerosene (DPK), the latter having a slight inverse relationship. This evidence supports the argument that domestic price increases in petroleum products significantly affect general price levels, thereby undermining consumer welfare and economic stability. Ehinomeri and Adeleke (2012) studied the petroleum distribution network in Nigeria and identified several systemic inefficiencies, including product outages, inflated prices, and regulatory bottlenecks. They recommended full deregulation of the downstream sector, advocating for greater private sector participation and entrepreneurial engagement to reduce operational costs and improve efficiency. Their findings suggest that improved competition and deregulation could help stabilize prices and ensure better availability of petroleum products across the country. Akinleye and Ekpo (2013) utilized a vector autoregression (VAR) approach to examine the macroeconomic effects of oil price shocks in Nigeria. Their study found that both positive and negative shocks affect government expenditure and GDP, but only in the long term. Positive oil price shocks were more potent, triggering inflationary pressures and leading to

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Volume 7, Issue 09 Sept. 2025, pp: 553-566 www.ijaem.net ISSN: 2395-5252

depreciation of the domestic currency due to increased importation. The study concluded that oil price shocks have the potential to derail economic progress by exacerbating inflation and exchange rate volatility. Abdul-Mumuni et al. (2023) extended this analysis to Ghana and investigated the impact of crude oil price fluctuations on HDI indicators using structural equation modeling. Their findings revealed a significant negative effect of oil price changes on school enrolment and GDP per capita. Although a negative relationship was also found between oil price volatility and life expectancy at birth, it was statistically insignificant. The study called for investment in alternative energy sources such as natural gas, solar, and biofuels to reduce overdependence on oil and insulate human development outcomes from market volatility.

Lastly, Okoro (2021) conducted a comparative study of oil-exporting and oil-importing African countries to explore the dynamic relationship between oil prices and macroeconomic indicators. The findings indicated that GDP in oil-exporting countries responded positively to oil price changes, while in oil-importing countries, the response was negative. Interest rates and exchange rates were significantly influenced by oil prices in both groups. Granger-causality tests further confirmed that oil prices have a causal effect on key macroeconomic variables, affirming the central role of oil in shaping fiscal and monetary outcomes across Africa.

The literature consistently underscores the complex yet critical relationship between petroleum economics, public expenditure, and human development. While oil revenues offer significant opportunities for boosting HDI through increased public investment, the real challenge lies in the effective, transparent, and equitable allocation of those resources. For countries to truly benefit from their natural endowments, they must adopt stable fiscal frameworks, strengthen institutional capacity, and prioritize human capital development through investments in education, health, and infrastructure. Diversifying the economy and reducing dependency on oil revenues will be vital for achieving long-term, sustainable, and inclusive development.

III. METHODOLOGY

This study adopts a quantitative research approach to examine the impact of petrol and diesel prices on GDP and the Human Development Index (HDI) across 12 OPEC countries. The research design is descriptive, aimed at providing specific insights into the nature of the relationship between fuel prices and development indicators over a ten-year period from 2010 to 2019. Descriptive research is appropriate when the researcher already has some understanding of the problem and seeks to provide a clearer explanation (Zikmund, 2000; Sekaran, 2003).

The population of the study includes all 12 member countries of the Organization of Petroleum Exporting Countries (OPEC). The study focuses on these countries due to their shared dependence on petroleum markets and their strategic role in global oil pricing and supply. Secondary data forms the basis of this study and was collected from reliable international sources, including the World Bank Statistical Bulletin, OPEC Oil Market Reports, the World Governance Indicators, and the International Monetary Fund (IMF). Data was collected for the following variables: petrol price, diesel price, gross domestic product (GDP), and the Human Development Index (HDI).

A cross-sectional and panel data design was used. Cross-sectional data refers to data collected at a single point in time, while panel data allows the researcher to observe multiple variables across time and space. The combination of both enables more robust analysis and identification of trends across the 10-year study period. The use of secondary annual time-series data is appropriate for evaluating long-term patterns and relationships between economic indicators. The data was analyzed using both descriptive and inferential statistical techniques. Descriptive statistics helped summarize and describe the characteristics of the dataset, while inferential statistics allowed for hypothesis testing and generalization of findings across the population of interest.

The study's empirical model draws from well-established literature, including works by Gavin and Perotti (1997), and Alesina and Tabellini (2005), ensuring methodological rigor and relevance.

This study adopts a log-linear econometric model to examine the relationship between fuel prices and two key development indicators: Gross Domestic Product (GDP) and the Human Development Index (HDI) in OPEC countries. The model is specified using panel data over a 10-year period (2010–2019) and estimated using E-Views statistical software.

Model Specification

$HDI = f(POP, POD)$

$HDI_{it} = \alpha + \beta_1 POP_{it} + \beta_2 POD_{it} + \varepsilon_{it}$

$LogHDI_{it} = \alpha + \beta_1 logPOP_{it} + \beta_2 logPODit + u_{it}$

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where:
log(HDI)) represents the log of human development index as the second dependent variable
log(POP)represents the log of price of petrol
log(POD)represents the log of price of diesel
iand t denotes the country and the time period
u_{it}represents shocks that have effects on policy variables not captured specifically in the equation

Dependent Variable

The study adopted Human Development Index (HDI) of the OPEC member states for ten years as the dependent variables for testing.

Independent Variable

The Independent variables adopted are the price of petrol and price of diesel of the OPEC member states for the same period. Since the study is on refined petroleum product prices, it is important to see its effects on the said dependent variables

IV. RESULTS AND DISCUSSION

Table 1: Descriptive Statistics

	HUMAN_DEVELOPMENT_INDEX__HDI_	PRICE_OF_DIESEL__POD__US$	PRICE_OF_PETROL__POP__US$
Mean	0.720650	4.1346	4.4979
Median	0.743500	0.220000	0.370000
Maximum	0.933000	1.090000	1.270000
Minimum	0.488000	0.010000	8.00E-05
Std. Dev.	0.102776	0.334023	0.341340
Skewness	-0.3871	0.357105	0.797040
Kurtosis	2.430115	1.583345	2.623822
Jarque-Bera	4.620128	11.53628	12.29525
Probability	0.000000	0.000000	0.000000
Sum	86.47800	45.48000	49.47632
Sum Sq. Dev.	1.256977	12.16129	12.69991
Observations	120	110	110

Source: Author's computation (2025)

This analysis examines the Human Development Index (HDI) and fuel pricing (diesel and petrol) trends across OPEC countries from 2010 to 2019. The average HDI of 0.720650 indicates a medium-to-high level of development among OPEC nations, with a relatively small standard deviation (0.102776), suggesting most countries cluster near the mean. However, a negative skew (-0.387059) reveals a few countries with significantly lower HDI scores, likely due to challenges like political instability and weak investment in health and education. Kurtosis near 2.43 implies the HDI distribution is close to normal, though the normality test suggests the data is not perfectly normally distributed. The diesel price across OPEC countries averaged $4.13455 per gallon, with a small standard deviation of $0.334023, indicating minimal variation in prices. A positive skew (0.357105) points to a few countries with significantly higher diesel prices, often due to limited refining capacity, reduced subsidies, or higher import dependency. The kurtosis of 1.583345 suggests the distribution is close to normal but slightly flatter.

Similarly, petrol prices averaged $4.49785, with a low standard deviation of $0.341340. The higher positive skew (0.797040) indicates more countries had petrol prices above the mean, driven by subsidy cuts or import reliance. The kurtosis of 2.623822 shows a distribution near normal but with heavier tails. In both diesel and petrol pricing, the data failed normality tests, confirming non-normal distributions.

Unit Root Test (ADF)

Unit root test is used to evaluate the behaviour of refined petroleum product prices and economic development. In addition, to examine how the data is trending; upward or downward, stabile or capable of predicting the future. If the data has unit root, that means the data is unstable or unpredictable and therefore may not be valid for prediction or forecasting. Using Augmented Dickey Fuller test, the following present the unit

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root test (long run analysis) of human development index (HDI), Price of Diesel (POD), Price of Petrol (POP) in the table below:

Table 2: Unit Root Test Results

Variables	At Level	Remark	1st Difference	Remark	Order of Integration
HDI	ADF = -2.534217 10% critical value = -3.486064	Presence of unit root	ADF = -10.56278 10% critical value = -3.486551	Presence of unit root	I(1)
POD	ADF = -2.014121 10% critical value = -3.506484	Presence of unit root	ADF = -8.015653 10% critical value = -3.506484	Presence of unit root	I(1)
POP	ADF = -2.554802 10% critical value = -3.491928	Presence of unit root	ADF = -10.20632 10% critical value = -3.493129	Presence of unit root	I(1)

Source: Author's computation with E-View 10

From table 2 above, the unit root test showed that all the variables are non-stationary at levels and at first difference. This simply means that, the employed variable at their natural values and form do not possess smooth trend that can lead to a reliable estimation. This also means that, the use of these variables at their natural form will lead to an unreliable estimation and result. In light of this, the study therefore needs to proceed to the evaluation of the stationarity of the underlying variables at level. The result was tested at 1st difference and the result shows that all variables attained stationarity immediately they were differenced as a result of their probability values all being below the threshold level of 0.05 (5%), which shows the absence of unit root. This shows that, all variables performed better in terms of internal consistencies and trend when they were differenced. This similarly means that, the employed variables can be used for subsequent test and will produce results that are reliable. In light of the observation of stationarity at first difference, the study proceeds to the panel trend of Cointegration test.

Pooled Effect Model

To evaluate the nature of short run relationship between employed variables using a single constant parameter across the various cross-section in the second model, the pooled effect is presented as follows.

Table 3: Pooled Effects Regression Output

Dependent Variable: HUMAN_DEVELOPMENT_INDEX__HDI_
Method: Panel Least Squares
Date: 06/28/24 Time: 14:19
Sample: 2010 2019
Periods included: 10
Cross-sections included: 11
Total panel (balanced) observations: 110

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.806504	0.012812	62.94749	0.0000
PRICE_OF_DIESEL__POD__US$	-0.242345	0.051175	-4.735620	0.0000
PRICE_OF_PETROL__POP__US$	0.048596	0.050078	0.970410	0.3340

R-squared	0.409366	Mean dependent var	0.728164
Adjusted R-squared	0.398326	S.D. dependent var	0.104059
S.E. of regression	0.080716	Akaike info criterion	-2.168864
Sum squared resid	0.697114	Schwarz criterion	-2.095214
Log likelihood	122.2875	Hannan-Quinn criter.	-2.138991
F-statistic	37.08060	Durbin-Watson stat	0.036319
Prob(F-statistic)	0.000000		

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Source: Extract from E-view version 10 Output

Table 3 above shows the pooled effect of the second model (human development index). The R-Square value of 0.409366 shows that, in this effect, all employed predictor variables such as Price of Diesel (POD), Price of Petrol (POP) jointly account for only 40.93% of variations in the dependent variable i.e. human development index (HDI) of the sampled 12 OPEC countries. The Durbin-Watson Statistics value of 0.036319 is seen to be very low and shows positive serial correlation which is bad and shows overlap between the trends of the employed predictor variables. The F-statistics value of 37.08060 at a probability value of 0.000000 which is less than the 0.05 significance level shows a strong model. From the coefficients and significance level, the study observes that; POD shows a negative (-0.242345) and significant (0.0000 < 0.05) influence on the HDI of sampled OPEC countries over the study period, which means that, a unit increase in POD is likely to have a significant unit increase in HDI. Price of petrol (POP) shows a positive (0.048596) and insignificant (0.3340 > 0.05) influence on the HDI of sampled OPEC countries, which shows that, a unit increase in POP is likely to have an insignificant 0.3340-unit increase in HDI. Overall, the employed dimensions of refined petroleum product prices are insignificant in the short-run.

For this model, the study cannot accept the result of this effect until we employ our diagnosis test to know if it is the optimal model. This therefore makes us proceed to the next effect (Fixed Effect).

Fixed Effect Model

In this model, effects are fixed if they are interested in themselves or random if there is interest in the underlying population. Therefore, the fixed effect seeks to evaluate the model considering each case (OPEC countries individual effect). This is therefore presented as follows;

Table 4: Fixed Effects Regression Output for Human Development Index (HDI).

Dependent Variable: HUMAN_DEVELOPMENT_INDEX__HDI_
Method: Panel Least Squares
Date: 06/28/24 Time: 14:35
Sample: 2010 2019
Periods included: 10
Cross-sections included: 11
Total panel (balanced) observations: 110

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.743822	0.011909	62.45792	0.0000
PRICE_OF_DIESEL__POD__US$	-0.041661	0.026274	-1.585638	0.1161
PRICE_OF_PETROL__POP__US$	0.003483	0.024116	0.144422	0.8855
	Effects Specification			
Cross-section fixed (dummy variables)				
R-squared	0.975802	Mean dependent var		0.728164
Adjusted R-squared	0.972808	S.D. dependent var		0.104059
S.E. of regression	0.017159	Akaike info criterion		-5.181956
Sum squared resid	0.028561	Schwarz criterion		-4.862809
Log likelihood	298.0076	Hannan-Quinn criter.		-5.052508
F-statistic	325.9609	Durbin-Watson stat		0.365694
Prob(F-statistic)	0.000000			

Source: Extract from E-view version 10 Output

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Table 4 above shows the fixed effect of the second model (HDI). The R-Square value of 0.975802 shows that, in this effect, all employed independent variables i.e. the Price of Diesel (POD), Price of Petrol (POP) jointly account for only 97.58% of variations in the dependent variable i.e. human development index of the sampled 12 OPEC countries. The Durbin-Watson Statistics value of 0.365694 is seen to be within the relevant range and therefore shows the presence of negative serial correlation which is acceptable. The F-statistics value of 325.96 at a probability value of 0.0000 which is less than the 0.05 significance level and therefore shows a viable model. From the coefficients and significance level, the study observes that; Price of Diesel (POD) shows a negative (-0.041661) but insignificant (0.1161 > 0.05) influence on the human development index (HDI) of sampled OPEC countries over the study period, which means that, a unit increase in price of diesel (POD) is likely to have an insignificant 0.1161-unit increase in HDI. Price of petrol (POP) shows a positive (0.003483) and insignificant (0.8855 > 0.05) influence on the Human Development Index of sampled OPEC countries, which shows that, a unit increase in Price of petrol (POP) is likely to have a 0.003483-unit increase in HDI.

The nature of these relationships show that the refined petroleum product prices have insignificant influence on economic development in the short-run. The fixed effect results cannot be accepted without the diagnosis test, which will enable the determination of the optimal effect. We therefore proceed to the next effect (Random Effect).

Random Effect Model

Random effects models will estimate the effects of time-invariant variables.

Table 5: Random Effects Regression Output for Human Development Index (HDI).

Dependent Variable: HUMAN_DEVELOPMENT_INDEX__HDI_
Method: Panel EGLS (Cross-section random effects)
Date: 06/28/24 Time: 14:59
Sample: 2010 2019
Periods included: 10
Cross-sections included: 11
Total panel (balanced) observations: 110
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.750322	0.029360	25.55601	0.0000
PRICE_OF_DIESEL__POD__US$	-0.051980	0.025734	-2.019910	0.0459
PRICE_OF_PETROL__POP__US$	-0.001482	0.023734	-0.062441	0.9503
	Effects Specification			
			S.D.	Rho
Cross-section random			0.089819	0.9648
Idiosyncratic random			0.017159	0.0352
	Weighted Statistics			
R-squared	0.045921	Mean dependent var		0.043911
Adjusted R-squared	0.028088	S.D. dependent var		0.017551
S.E. of regression	0.017303	Sum squared resid		0.032035
F-statistic	2.575042	Durbin-Watson stat		0.337369
Prob(F-statistic)	0.080864			
	Unweighted Statistics			
R-squared	0.188036	Mean dependent var		0.728164
Sum squared resid	0.958346	Durbin-Watson stat		0.011277

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Source: Extract from E-view version 10 Output

Table 5 above shows the random effect of the second model (Human Development Index). The R-Square value of 0.045921 shows that, in this effect, all employed predictor variables such as Price of Diesel (POD), Price of Petrol (POP) jointly account for only 4.59% of variations in the dependent variable i.e., human development index of the sampled 12 OPEC countries. The Durbin-Watson Statistics value of 0.337369 is seen to be very low and shows positive serial correlation. The F-statistics value of 2.575042 at a probability value of 0.0808 which is greater than the 0.05 significance level shows a weak model. From the coefficients and significance level, the study observes that; Price of Diesel (POD) shows a negative (-0.051980) but significant (0.0459 < 0.05) influence on the human development index of sampled OPEC countries over the study period, which means that, a unit increase in Price of Diesel (POD) is likely to have a significant 0.051980-unit decrease in HDI. Price of Petrol (POP) shows a negative (-0.001482) and insignificant (0.9503 > 0.05) influence on the human development index of sampled OPEC countries, which means that, a unit increase in price of petrol (POP) is likely to have a 0.01-unit decrease in HDI. The study cannot accept the result of this effect until we employ our diagnosis test to know if it is the optimal model. This therefore makes us proceed to the next effect (Fixed Effect).

Diagnostic test

It is improper to manually choose the optimal effect. Some diagnostic test has been created to enable researchers determine the best effect between the pooled, fixed and random effect. These tests include the Likelihood Ratio Test, Hausman Specification Test, and the Lagrange Multiplier Test.

Likelihood Ratio Test (Compares Pooled and Fixed)

This test seeks to select the best effect between the Pooled and Fixed effect. The null hypothesis supports the pooled effect.

Table 6: Likelihood ratio test output

Redundant Fixed Effects Tests
Equation: Untitled
Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	227.057574	(10,97)	0.0000
Cross-section Chi-square	351.440192	10	0.0000

Source: Extract from E-view version 10 Output

Table 6 which shows the Likelihood ratio test shows a Cross-section F-statistics value of 227.057574 at a probability level of 0.0000 which is less than the 0.05 (5%) significance level shows the rejection of the null hypothesis. This therefore shows that the best model is the fixed effect, which represents the alternate hypothesis in this case. This therefore shows that the fixed effect in light of the pooled effect is more superior.

Hausman Specification Test

This diagnostic test pits the random effect against the fixed effect. The null hypothesis in this case is the Random Effect. Therefore, a retained null supports the random effect, while a rejected null hypothesis supports the fixed effect.

Table 7: Hausman Specification Test output

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	3.797842	2	0.1497

Source: Extract from E-view version 10 Output

Table 7 shows the Hausman Specification test which seeks to examine the most valuable effect between the random and fixed effect. The Cross-section random Chi-Square statistics value of 3.797842 at a probability level of 0.1497 which is greater than the 0.05 significance level leads to the rejection of the null hypothesis. This shows that the fixed effect remains the paramount effect in the model. The study therefore moves on to determine the long run effect using the fixed effect.

Lagrange Multiplier Tests (Compares Random to Fixed effect)

Table 8: Lagrange Multiplier Tests output for model 2

Lagrange Multiplier Tests for Random Effects
Null hypotheses: No effects
Alternative hypotheses: Two-sided (Breusch-Pagan) and one-sided (all others) alternatives

	Test Hypothesis Cross-section	Time	Both
Breusch-Pagan	400.2831 (0.0000)	4.228063 (0.0398)	404.5111 (0.0000)
Honda	20.00708 (0.0000)	-2.056225 (0.9801)	12.69317 (0.0000)
King-Wu	20.00708 (0.0000)	-2.056225 (0.9801)	10.79483 (0.0000)
Standardized Honda	22.10584 (0.0000)	-1.931942 (0.9733)	10.21030 (0.0000)
Standardized King-Wu	22.10584 (0.0000)	-1.931942 (0.9733)	8.146111 (0.0000)
Gourieroux, et al.	--	--	400.2831 (0.0000)

*Mixed chi-square asymptotic critical values:

1%	7.289
5%	4.321
10%	2.952

Source: Extract from E-view version 10 Output

Using the lag range multiplier test output in Table 8, it can be observed that all probability levels point to the significance of the fixed effect model. This therefore further reinforces the optimal nature of the fixed effect. The study will therefore proceed to subsequent test using the fixed effect technique so as to ensure that future results are reliable and not spurious.

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Table 9: Cointegration Test

Pedroni Residual Cointegration Test
Series: HUMAN_DEVELOPMENT_INDEX__HDI_ PRICE_OF_DIESEL__ POD__US$ PRICE_OF_PETROL__POP__US$
Date: 06/28/24 Time: 16:46
Sample: 2010 2019
Included observations: 120
Cross-sections included: 9 (3 dropped)
Null Hypothesis: No cointegration
Trend assumption: No deterministic trend
User-specified lag length: 1
Newey-West automatic bandwidth selection and Bartlett kernel

Alternative hypothesis: common AR coefs. (within-dimension)

	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	2.252665	0.0121	1.986511	0.0005
Panel rho-Statistic	0.473444	0.6821	0.195730	0.0006
Panel PP-Statistic	-2.705781	0.0034	-3.499543	0.0002
Panel ADF-Statistic	-0.751067	0.2263	-0.977924	0.0001

Alternative hypothesis: individual AR coefs. (between-dimension)

	Statistic	Prob.
Group rho-Statistic	1.453336	0.0009
Group PP-Statistic	-5.322507	0.0000
Group ADF-Statistic	-0.738280	0.0002

Source: Extract from E-view version 10 Output

Table 9 above shows through the probability level that there is evidence of long run relationship between employed variables. The probability values are observed to be lower than the 0.05 significance level. This therefore reinforces the need of an Error Correction mechanism to adjust for disequilibrium in the long. In the presence of a uniform stationarity of employed variables at first difference (1(I)), the study proceeds to the cointegration test to determine the existence or otherwise of a long run relationship amongst employed variables of the study. This is presented in subsequent section.

Error Correction Model (Model 2 – Human Development Index):

Table 10: Error Correction Model Summary for Model 2

Panel Error Correction Model
Dependent Variable: D(HDI)
Method: Panel Least Squares
Date: 06/28/24 Time: 16:52
Sample (adjusted): 2013 2019
Periods included: 8
Cross-sections included: 17
Total panel (balanced) observations: 108

	Coefficient	Std. Error	t-Statistic	Prob.
D(POD)	0.000319	0.000242	1.319134	0.0095
D(POP)	0.195373	0.076446	2.555712	0.0118
ECM	-0.214287	0.05.8837	-3.642081	0.0163
Root MSE	63.87006	R-squared		0.749655

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Mean dependent var	-4.361544	Adjusted R-squared	0.688916
S.D. dependent var	69.51878	S.E. of regression	66.35619
Akaike info criterion	11.29864	Sum squared resid	554796.2
Schwarz criterion	11.51280	Log likelihood	-758.3073
Hannan-Quinn criter.	11.38567	F-statistic	2.463897
Durbin-Watson stat	2.601036	Prob(F-statistic)	0.012731

Source: Extract from E-view version 10 Output

In the second model, the above error correction estimate as shown in table 10 above shows that the ECM values of -0.214287 displays the expected negative sign and signifies that the discrepancies between the short and long run can be adjusted backwards by approximately 21.43% annually towards maintaining equilibrium in both long and short run. The coefficient of determination (R^2) displays a value of 0.749655 which shows that in the long run, the predictors variables jointly account for approximately 74.97% of variations in the criterion i.e. The level of employed predictor variables adequately captures the movement of employed criterion i.e., Human Development Index (HDI). All variables were found to be statistically significant as deduced from all their respective probability level which were lower than the 0.05 (5%) significance level with the exception of POD. The f -statistics probability level of 2.463897 at a probability level 0.012731 which is less than the 0.05 (5%) significance level and shows a great fit of the linear panel model while the Durbin Watson statistics value of 2.601036 is identified to be within the relevant range.

V. CONCLUSIONS

The study results revealed that refined petroleum product prices have significant influence of the economic development in OPEC countries. Higher prices for crude oil, the source material for refined products, can lead to increased government revenue for OPEC countries through export sales. This revenue can be invested in infrastructure, social programmes, and other areas that stimulate economic growth. High petrol and diesel prices may incentivize investments in public transportation and fuel-efficient technologies, leading to long-term economic benefits.

i. For price of petrol, a positive influence is seen in terms of GDP and HDI while a positive. Increased government revenue from petrol could be used for investments in social programs that improve HDI and GDP.
ii. Price of Diesel shows a positive and significant relationship with GDP and HDI. Long-term planning and policies that prioritize social development alongside economic considerations are crucial for maximizing the positive effects of oil revenue that will improve HDI and GDP.

5.1 Recommendations

In view of the study findings, the following recommendations were made:

1. The government of OPEC countries should encourage and invest in the development of other industries beyond oil production. This could include tourism, manufacturing, renewable energy, and technology sectors.
2. The government of OPEC countries should invest in programmes that create a skilled workforce. This can involve vocational training, skills development initiatives, and promoting science, technology, engineering, and math (STEM) education. A skilled workforce can contribute to economic diversification, which can further improve HDI in the long run.
3. Government of OPEC countries should support research and development of cleaner diesel technologies and alternative fuels like biodiesel. This can lessen reliance on traditional diesel and its price volatility, promoting long-term economic benefits.
4. Government of OPEC countries should allocate resources towards developing and implementing renewable energy sources for public transportation and electricity generation. This reduces long-term dependence on diesel and promotes environmental sustainability, leading to a healthier population and potentially improving HDI scores.

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