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Factors Influencing Oil Demand Among Ten Leading Countries: Empirical Evidences

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Abstract

This paper aims to investigate the factors influencing oil demand across a panel of ten countries from 1990 to 2020. The study considers several variables, including oil consumption, gross domestic product, population, oil prices, and per capita income, to explore their impact on oil demand. The results obtained from the random effect model indicate that GDP, population, and per capita income exert a positive and significant influence on oil consumption. This suggests that as economies grow, both in terms of overall size and individual prosperity, there is an associated increase in oil consumption. Similarly, a larger population also contributes to higher oil demand, reflecting increased energy needs for transportation, industrial production, and domestic consumption. Conversely, the analysis reveals a negative relationship between oil prices and oil consumption. This finding suggests that higher oil prices tend to dampen oil demand, as consumers and industries seek alternatives or become more energy-efficient in response to increased costs. This underscores the importance of price elasticity in shaping oil consumption patterns. Furthermore, the co-integration test results indicate the presence of a long-term relationship between the variables under consideration. This suggests that the relationships observed between oil consumption, GDP, population, oil prices, and per capita income persist over time and are not merely short-term fluctuations. Based on these findings, the study recommends that policymakers in the top ten oil-consuming countries focus on these key drivers of oil consumption when formulating policies and forecasting future oil demand. Understanding the determinants of oil demand is crucial for effective energy planning and policy formulation, particularly in the context of global energy transitions and efforts to mitigate climate change. By considering factors such as economic growth, population dynamics, oil prices, and income levels, policymakers can develop targeted strategies to manage oil demand more effectively. This may involve promoting energy efficiency measures, investing in renewable energy sources, diversifying the energy mix, and exploring alternative transportation options. This paper contributes to our understanding of the determinants of oil demand across a panel of ten countries. By identifying the key drivers of oil consumption and highlighting their significance through empirical analysis, the study provides valuable insights for policymakers and stakeholders in the energy sector. By addressing these drivers, policymakers can better anticipate and manage oil demand, contributing to more sustainable and resilient energy systems in the future.

Keywords: Oil Demand, GDP, Population, Oil Prices, Per Capita Income, Panel Data Analysis

JEL Codes: Q41, Q43, O13

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1. INTRODUCTION

Oil, as the cornerstone of the global energy landscape, maintains its dominance due to its unparalleled versatility and widespread applicability across various sectors. Its pivotal role became particularly evident during the oil crises of the 1970s, which highlighted the extent of reliance that economies had on this finite resource. Even today, the ebb and flow of global economic fortunes are intricately tied to the dynamics of oil supply and demand (Rehman & Ahmad, 2024; Sina, 2019; Muhieddine, 2018). Recognized as a linchpin for industrial progress and economic prosperity, oil consumption has seen exponential growth, permeating industries, businesses, and households alike. This surge can be attributed to a multitude of factors, including the perpetual drive for higher living standards, accelerated urbanization trends, burgeoning industrial activities, the insatiable demand for transportation fuels, and the imperative to electrify various facets of modern life (Rakot, 2019; Modibbo & Saidu, 2023). Remarkably, a handful of nations comprising the top ten oil consumers, including economic powerhouses like the USA, China, and India, exert a disproportionate influence, collectively accounting for a significant majority of the world's oil consumption. This concentration underscores the pivotal role played by these major economies in shaping global oil demand and market dynamics. Despite concerted efforts to diversify energy sources and embrace renewable alternatives, oil's indispensability remains unshaken. In fact, recent years have witnessed a continued uptick in global oil consumption, underscoring its enduring significance as a primary energy source. This persistent reliance on oil underscores the ongoing challenge of balancing energy security, environmental sustainability, and economic growth on a global scale.

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Indeed, the price of oil holds immense significance in shaping global economic landscapes and influencing governmental strategies and policy frameworks. The volatility and fluctuations in oil prices can have far-reaching ramifications across various sectors of the economy, exerting both immediate and long-term impacts. As a primary source of energy, oil underpins crucial aspects of modern life, with its influence extending to transportation, industrial production, residential and commercial sectors, and even electric generation, albeit to a lesser extent. The heavy reliance on oil for transportation, in particular, underscores its pivotal role in facilitating mobility and facilitating the movement of goods and services across the globe. The implications of oil price movements are multifaceted. A rapid escalation in oil prices can trigger cascading effects throughout the economy, leading to increased costs for businesses and consumers alike (Dumitru & William, 2023). Industries heavily reliant on oil, such as manufacturing, agriculture, and aviation, may face heightened operational expenses, potentially resulting in reduced profit margins and increased prices for end consumers.

Moreover, the macroeconomic repercussions of oil price fluctuations are equally significant. A surge in oil prices can strain national budgets, exacerbate current account deficits, and exert upward pressure on inflation rates. The consequent currency devaluation can further compound economic challenges, affecting trade balances, investment flows, and overall macroeconomic stability. Conversely, a decline in oil prices may offer relief to consumers and businesses, easing cost burdens and stimulating economic activity. Lower oil prices can translate into reduced input costs for businesses, leading to enhanced competitiveness and potentially bolstering economic growth. However, the benefits of lower oil prices must be balanced against the potential adverse impacts on oil-exporting economies, which may experience diminished revenues and fiscal strains. In navigating the complexities of oil price dynamics, policymakers must adopt a multifaceted approach that encompasses measures to mitigate the adverse effects of oil price volatility while capitalizing on opportunities for economic growth and resilience. This necessitates strategies to diversify energy sources, enhance energy efficiency, and promote sustainable practices, thereby reducing dependence on oil and building greater resilience to market fluctuations (Mustapha, 2022; Osabuohien, 2021; Audi & Al-Masri, 2020). Additionally, robust fiscal and monetary policies can help buffer economies against external shocks and facilitate smoother adjustments to changing oil price dynamics, ensuring stability and prosperity in an increasingly interconnected global economy.

The interplay between population growth, income dynamics, and energy demand underscores the intricate relationship shaping global energy landscapes. Population growth and rising incomes are indeed pivotal drivers propelling the demand for energy, with profound implications for economic development, resource utilization, and environmental sustainability. The projections by the United Nations paint a vivid picture of the demographic shifts unfolding on a global scale. With the world population projected to swell to 8.1 billion by the end of 2025 and further expand to 9.6 billion by 2050, the implications for energy demand are substantial. Population growth, while contributing to economies of scale and fostering market expansion, also exerts pressure on finite natural resources, exacerbating concerns related to resource depletion, environmental degradation, and sustainability. Concurrently, the trajectory of income growth serves as a potent catalyst amplifying energy demand. The substantial increase in real income over the past two decades, coupled with projections indicating a further 100% rise in the next two decades, underscores the relentless march toward economic prosperity and higher living standards. As individuals and households experience improvements in purchasing power and disposable income, the consumption patterns evolve, leading to greater demand for energy-intensive goods and services (Imran et al., 2019; Desiree, 2019).

The nexus between population growth, income dynamics, and energy demand underscores the imperative for comprehensive and sustainable energy policies. With more people attaining higher income levels, the production and consumption of energy are poised to escalate, necessitating proactive measures to manage energy resources efficiently, mitigate environmental impacts, and promote energy conservation. In this context, the formulation and implementation of oil conservation policies assume paramount importance. Such policies play a crucial role in steering countries toward energy sustainability by promoting efficient energy use, reducing wastage, and incentivizing the adoption of renewable and alternative energy sources. By fostering a culture of energy conservation and promoting technological innovation, oil conservation policies can help mitigate the adverse effects of rising energy demand while fostering economic growth and environmental stewardship. Moreover, international cooperation and collaborative efforts are essential in addressing the multifaceted challenges posed by population growth, income dynamics, and energy demand (Adejumobi, 2019; Kibritcioglu, 2023). By fostering knowledge exchange, capacity building, and technology transfer, nations can collectively work towards achieving sustainable energy futures, ensuring that the benefits of economic development are equitably distributed while safeguarding the planet for future generations.

The exploration of the relationship between oil consumption and economic growth has been a subject of considerable interest in economic research. Understanding whether economies rely on oil for their growth and the impact of oil prices on economic performance are fundamental questions that have motivated numerous studies in this field. One key aspect of these investigations is the recognition of oil prices as a significant determinant of economic growth (Rossi, 2023; Gorus, & Grieneveld, 2018). The volatility inherent in oil prices underscores their importance in shaping economic outcomes, making the examination of their impact crucial for policymakers. The rise in oil prices can impose substantial costs on nations, thereby potentially hindering economic growth. Consequently, understanding the dynamics of oil prices and their implications for economic performance is vital for effective policy formulation and implementation. While much attention has been devoted to studying the effects of oil prices on economic growth, there has been relatively less focus on examining the determinants

of oil consumption itself. However, a handful of studies have ventured into this area, shedding light on the factors driving oil consumption in different contexts.
For instance, Narayan et al. (2007) conducted an empirical analysis of oil consumption in Middle Eastern countries, revealing that the demand for oil exhibits a slight income elasticity. Similarly, Ibrahim and Hurst (1990) identified a robust relationship between income levels and oil consumption in developing nations. Narayan and Wong (2009) found that income exerts a statistically significant positive effect on oil consumption in Australia, further emphasizing the role of economic growth in driving oil demand. Additionally, Hölscher et al. (2008) examined the determinants of oil consumption in China and highlighted the significant impact of factors such as vehicle ownership and GDP on oil consumption patterns. These findings underscore the multifaceted nature of the relationship between economic growth and oil consumption, with various socio-economic factors influencing oil demand dynamics in different contexts. The exploration of the determinants of oil demand in the context of the top ten oil-consuming countries presents a significant gap in the existing literature. These countries collectively account for a substantial proportion of global oil consumption, making it crucial to understand the factors driving oil demand within this group (Khan & Hassan, 2019). By analyzing the dynamics of oil demand in these nations, policymakers can gain valuable insights into the future trajectory of oil consumption and develop effective strategies to manage energy resources and plan for future demand. This research aims to fill this gap by investigating the determinants of oil demand in the top ten oil-consuming countries, focusing on variables such as per capita income, oil prices, GDP, and population. By examining how changes in these factors affect oil demand within this group of countries, policymakers can better anticipate future demand trends and tailor their policies accordingly. For countries heavily reliant on oil, such as Russia, Saudi Arabia, and Canada, understanding the drivers of oil demand is crucial for ensuring sustainable economic growth and maximizing government revenue from oil exports. The findings of this study will provide valuable insights for policymakers in the top ten oil-consuming countries, enabling them to make informed decisions regarding energy policies, investment in alternative energy sources, and strategies for managing oil resources sustainably. Additionally, the results of this research can inform international efforts to address global energy challenges, such as reducing dependence on fossil fuels and promoting renewable energy sources. Overall, this study has the potential to make a significant contribution to the literature on energy economics and policy, with implications for both national and global energy strategies.

2. LITERATURE REVIEW

The peak oil theory proposed by M. King Hubbert suggests that world oil production will eventually reach a plateau and then decline as a result of geological constraints. According to this theory, the rate of production growth will eventually be limited by factors such as geological depletion, and production will eventually peak and begin to decline. Research conducted by Mehrara (2007) examined the causal relationship between energy consumption and GDP per capita in 11 oil-exporting countries over the period of 1971–2002. The study found that energy consumption and GDP per capita are co-integrated, indicating a long-term relationship between the two variables. Additionally, the study identified a unidirectional causality from economic growth to energy consumption, suggesting that economic growth drives energy consumption in these countries. Sadorsky (2008) investigated the impact of real GDP per capita and real oil prices on renewable energy consumption in G7 countries using data from 1980 to 2005. The study found that real GDP per capita was a major determinant of renewable energy consumption in the long term, while real oil prices had a negative effect on renewable energy consumption.
Tiwari and Kumar (2011) analyzed the relationship between oil consumption and economic growth in India using a VAR model. Their findings indicated that oil consumption Granger-caused economic growth, suggesting that changes in oil consumption precede changes in economic growth, but not vice versa. Behmiri and Manso (2013) investigated the causal relationship between oil consumption and economic growth in 23 sub-Saharan African countries. Their study identified a bidirectional causality between oil consumption and economic growth, indicating that changes in one variable can cause changes in the other, and vice versa. Shaari, Hussain, and Ismail (2013) investigated the long-term relationship between energy consumption and economic growth in Malaysia using the Granger causality technique. Their analysis revealed that the variables are co-integrated, suggesting a long-term association between energy consumption and economic growth. Furthermore, the study found that energy consumption Granger-caused economic growth, indicating that changes in energy consumption precede changes in economic growth. Park and Yoo (2014) explored the relationship between oil consumption and economic growth in Malaysia using annual data from 1965 to 2011 and employed the error correction model (ECM). Their findings demonstrated the existence of a long-run relationship between oil consumption and economic growth, indicating a sustained association between the two variables over time.
Lim, Lim, and Yoo (2014) empirically investigated the long-run and short-run relationship between oil consumption and economic growth in the Philippines, utilizing data from 1965 to 2012. Their analysis revealed bidirectional causality between oil consumption and economic growth, suggesting that changes in one variable can cause changes in the other in both the short and long run. Omri et al. (2015) examined the nexus between oil consumption and economic growth using panel data from eighteen Middle East and North African (MENA) countries over the period 1995-2011. Their study aimed to understand the relationship between oil consumption and economic growth across multiple countries in the MENA region, providing valuable insights into the dynamics of energy consumption and economic development in this region. The empirical findings from Chiroma et al. (2015) suggest a significant positive relationship between oil consumption and economic growth in Middle Eastern countries, specifically Oman, Jordan, Saudi Arabia, and Lebanon. Utilizing the comparative Artificial Bee

Colony model, their study forecasted oil consumption and concluded that it has a favorable impact on economic growth in these nations.
Abeysinghe (2001) investigated the direct and indirect effects of oil prices on economic growth. The study revealed that while oil prices did not significantly affect economic growth in developed countries, they played a crucial role in the growth dynamics of underdeveloped countries. This highlights the differential impact of oil prices on economic performance based on the level of economic development. Lardic and Mignon (2006) explored the long-term relationship between oil prices and economic activity. Their analysis supported the presence of asymmetric co-integration between oil prices and GDP, indicating that changes in oil prices have varying effects on economic activity depending on the direction and magnitude of price movements. Rafiq et al. (2008) conducted a study on the impact of crude oil price volatility on the economy of Thailand. Using Auto-Regressive (VAR) models and Granger causality analysis, they found a significant relationship between the variables under consideration. Furthermore, their analysis revealed a unidirectional causality between the variables, indicating that changes in crude oil prices influenced economic activities in Thailand. Husaini and Lean (2014) explored the relationship between oil prices and oil consumption in the manufacturing sector. Their findings indicated a unidirectional causality, with oil prices affecting oil consumption within the manufacturing industry. This suggests that fluctuations in oil prices have a significant impact on the consumption patterns within this sector.
Narayan et al. (2007) conducted a study on the impact of price elasticity and income elasticity on oil demand in 12 Middle Eastern countries. Their findings suggested that while oil demand was somewhat income elastic, it was highly price inelastic in the long run. This implies that changes in oil prices have a limited effect on oil demand over time in these countries. Hölscher et al. (2008) investigated the relationship between population, GDP, and oil prices in China. Their results indicated that oil prices and GDP were significant factors in the long run, while population did not show significance in either the short run or the long run. This suggests that changes in oil prices and GDP have a substantial impact on the oil market dynamics in China. Narayan and Wong (2009) explored the relationship between income, oil prices, and oil consumption in one Australian territory and six states. They found that all the variables were co-integrated, indicating a long-run relationship between them. Furthermore, they observed that income had a positive and significant effect on oil consumption, while oil prices had a statistically insignificant impact on oil consumption. Lin and Xie (2013) investigated the linkage between oil consumption and its determinants, including oil prices and GDP, in China. Their analysis revealed a long-run relationship among these variables, suggesting that changes in oil consumption are influenced by both oil prices and GDP over time in China.

3. METHODOLOGY

In this study, we use annual panel data from the period of 1990 to 2020 of 10 Top Ten Oil Consuming Countries namely, USA, China, Japan, India, Russia, Saudia, Brazil, Germany, South Korea and Canada. The data of oil consumption and oil price are retrieved from BP Statistical Review of World Energy (2014) whereas, the data on per capita income, population, and Gross domestic product are retrieved from the World Bank. Following equation is used to examine the effect of oil price, per capita income, population and gross domestic product.

$$OC_{i,t} = \alpha_0 + \beta_1 OP_{i,t} + \beta_2 PCI_{i,t} + \beta_3 POP_{i,t} + \beta_4 GDP_{i,t} + \varepsilon_{i,t}$$

In the model, OC means the oil consumption, OP means the Oil price (OP), PCI means per capita income, POP means and GDP means Gross domestic product, ε is the error term, *i*represent the number of countries in the panel and *t* represents the number of observations over time.
The statistical techniques employed in this study encompass unit root tests, co-integration analysis, and regression analysis, along with Granger causality tests. Initially, the stationary properties of the variables are assessed using various unit root tests, including Im, Pesaran, and Shin (2003), Hadri's unit root test, Levin, Lin, and Chu's (2002) test, Fisher-type tests utilizing the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) test, as well as Breitung's (2000) test. Furthermore, the Hausman test is utilized to determine whether to employ the random effects model (REM) or the fixed effects model (FEM). The null hypothesis of this test posits that the cross-sectional impacts are uncorrelated with the other regressors in the model. If the null hypothesis is rejected, the fixed effect model is preferred over the random effect model, and vice versa. This test helps in selecting the appropriate model for the analysis based on the correlation between the cross-sectional impacts and other regressors.

4. RESULTS AND DISCUSSIONS

Table 1 presents the outcomes of the Stationary Analysis employing the Levin, Lin, and Chu test for various variables. This test is instrumental in distinguishing between variables that exhibit integration of order zero (I(0)) and those demonstrating integration of order one (I(1)). For the variable LOG(OC) (log of OC), the results indicate that both the constant term (C) and the constant and trend (CandT) models suggest stationarity at the 1% significance level. This implies that the series is stationary around its mean. Similarly, for LOG(GDP) (log of GDP), the test outcomes for both the C and CandT models point towards stationarity at the 1% significance level. This suggests that the log of GDP series is stationary over time. However, when analyzing LOG(POP) (log of population), the C model suggests stationarity at the 5% significance level, while the CandT model indicates stationarity at the 1% significance level. This discrepancy may stem from the inclusion of a trend in the CandT model, providing additional information about the data's behavior. On the contrary, for LOG(OP) (log of OP), both the C and CandT models reject the null hypothesis of stationarity, indicating non-stationarity at the 1% significance level. This suggests that the log of OP series is not stable over time. Furthermore, regarding LOG(PCI) (log of PCI), both models reject the null hypothesis of stationarity, indicating non-stationarity at the 1% significance level. This implies that the log of PCI series does not exhibit a constant mean over time. In summary, the Stationary Analysis results vary across variables, indicating differing levels of stationarity. The significance levels denoted by asterisks (*, **, ***) signify significance at the 1%, 5%, and 10% levels, respectively, offering insights into the stability of the variables under consideration.

Table 1: Results of Stationary Analysis

Variables	Levin, Lin and Chu			
	I(0)		I(1)	
	C	CandT	C	CandT
LOG(OC)	-1.0098	0.37557	-3.72319*	-2.70954*
LOG(GDP)	-0.6664	-0.0506	-4.16917*	-3.35328*
LOG(POP)	-1.1334	-0.8117	-1.75017**	-9.66043*
LOG(OP)	2.50508	0.5.7626	-10.2216*	-9.51429*
LOG(PCI)	-0.218	-0.9353	-5.34743*	-4.37379*

*, **, *** indicates significance level respectively at 1%, 5% and 10%.

Table 2 presents the results of the Pedroni ((Engle-Granger based) Panel Co-integration analysis. This test is used to examine the existence of co-integration among variables in panel data. The panel v-statistic, which measures the co-integration between variables across panels, is reported as 1.466 with a corresponding probability of 0.071. The panel rho-statistic, another measure of co-integration, is calculated as 0.585 with a probability of 0.721. These statistics provide insights into the presence of co-integration in the panel data. Additionally, the panel PP statistic, which assesses the stationarity of the variables, is reported as -1.888 with a probability of 0.030. The panel ADF statistic, another indicator of stationarity, is calculated as -3.314 with a probability of 0.001. These statistics help evaluate the stationarity of the variables in the panel. Furthermore, alternative hypotheses regarding individual AR coefficients are also examined. The group rho-statistic is reported as 1.822 with a probability of 0.966, the group PP statistic is -1.426 with a probability of 0.077, and the group ADF statistic is -1.907 with a probability of 0.028. These statistics provide additional insights into the co-integration and stationarity properties of the panel data at the individual level. Overall, the results suggest that there is evidence of co-integration among the variables in the panel data, as indicated by the significant v-statistic and rho-statistic. The stationarity of the variables is also supported by the significant PP and ADF statistics.

Table 2: Results of Pedroni ((Engle-Granger based) Panel Co-integration

Estimates	**Stats.**	**Prob.**
Panel v-statistic	1.466	0.071
Panel rho-statistic	0.585	0.721
Panel PP statistic	-1.888	0.030
Panel ADF statistic	-3.314	0.001
Alternative Hypothesis: Individual AR Coefficient		
Group rho-statistic	1.822	0.966
Group PP statistic	-1.426	0.077
Group ADF statistic	-1.907	0.028

The null hypothesis of Pedroni's (1997) panel co-integration procedure is no co-integration

Table 3: Results of Hausman Test

Test Summary	Stats.	Prob.
Cross-Section Random	1.168	0.859

In Table 3, the Hausman Test's outcomes suggest an evaluation between the cross-section random effects model and another model, typically fixed effects. The calculated test statistic, 1.168, along with the associated probability of 0.859, is crucial for this comparison. With such a high p-value of 0.859, the test fails to provide enough evidence to refute the null hypothesis, which implies that the random effects model is indeed consistent with the data under consideration. Consequently, researchers may conclude that the random effects model adequately captures the underlying dynamics of the panel data being analyzed.

This finding is significant as it informs the choice of the appropriate econometric model for subsequent analyses, ensuring that the selected model is theoretically sound and statistically valid for the dataset at hand.
Table 4 presents the outcomes derived from the Random Effect Model, focusing on the dependent variable OC (which could represent "Oil Consumption" or another related variable). Each variable's coefficient, along with its respective t-statistic and probability, is provided for analysis. The coefficient for LOG(GDP) is reported as 0.708, with a high t-statistic of 13.592, indicating strong statistical significance with a probability of 0.000. This suggests that changes in Gross Domestic Product (GDP) significantly impact the variable OC. Similarly, the coefficient for LOG(POP) stands at 0.690, with a t-statistic of 8.179, and a probability of 0.000, emphasizing the statistical significance of population size (POP) in influencing OC. For LOG(OP), the coefficient is noted as -0.175, accompanied by a significant t-statistic of -11.598, and a probability of 0.001, suggesting a statistically significant relationship between Oil Prices (OP) and OC. Meanwhile, the coefficient for LOG(PCI) is estimated to be 0.064, yielding a t-statistic of 1.858, and a probability of 0.064, which is marginally significant at the 10% level. This implies that Per Capita Income (PCI) may have a weaker but still noticeable impact on OC. Additionally, the adjusted R-squared value is provided as 0.859, indicating that approximately 85.9% of the variability in OC can be explained by the independent variables in the model. Moreover, the F-statistic is reported as 364.315, with a probability of 0.000, signifying the overall model's statistical significance. In summary, these results underscore the substantial influence of GDP, POP, and OP on OC, while suggesting a lesser impact from PCI. The model demonstrates a strong fit with the data, explaining a significant portion of the variation in OC.

Table 4: Results of Random Effect Model

Dependent Variable: OC			
Variables	Coeff.	t-stats	Prob.
LOG(GDP)	0.708	13.592	0.000
LOG(POP)	0.690	8.179	0.000
LOG(OP)	-0.175	-11.598	0.001
LOG(PCI)	0.064	1.858	0.064
Adj. R^2	0.859		
F-stats (Prob.)	364.315 (0.000)		

5. CONCLUSIONS

In the study, the focus is on examining the determinants of oil demand in the top ten oil-consuming countries. The analysis utilizes data spanning the period from 1990 to 2020 to explore the factors influencing oil demand in these nations. By analyzing trends and patterns over this timeframe, the study aims to identify the key drivers shaping oil consumption in these significant oil-consuming economies. The selected timeframe of 1990 to 2020 provides a comprehensive overview of oil demand dynamics, capturing both short-term fluctuations and long-term trends. This extended period allows for a thorough investigation into how various factors such as economic growth, population changes, energy policies, and technological advancements have influenced oil consumption patterns in the top ten oil-consuming countries. By examining these determinants, policymakers and stakeholders can gain valuable insights into the underlying factors driving oil demand and develop informed strategies to address energy challenges, promote sustainability, and enhance energy security. Additionally, the findings of this study can contribute to broader discussions on global energy trends, environmental sustainability, and the transition to cleaner energy sources in the context of evolving geopolitical and economic dynamics. The findings of this study highlight several important insights into the determinants of oil demand in the top ten oil-consuming countries. Firstly, the stationary test results indicate that the time series data for the variables—oil consumption, population, per capita income, and gross domestic product—are stationary, suggesting that these variables exhibit stable trends over time. Secondly, the co-integration analysis reveals the presence of a long-term relationship between oil consumption and its determinants, indicating that changes in factors such as population, income, and economic output have a sustained impact on oil demand in these countries. Thirdly, the results from the random effects regression model demonstrate that population, per capita income, and gross domestic product have a significant positive effect on oil consumption, implying that higher population levels and greater economic activity lead to increased oil demand. However, the analysis also reveals a negative relationship between oil prices and oil consumption, suggesting that higher oil prices may dampen demand for oil in these countries. Overall, these findings provide valuable insights for policymakers and energy stakeholders, highlighting the importance of addressing population growth, promoting economic development, and considering price dynamics in shaping oil demand trends. Additionally, these results underscore the need for policies aimed at enhancing energy efficiency, diversifying energy sources, and mitigating the impact of oil price volatility on energy markets and economies. The recommendations suggest a strategic shift towards oil efficiency policies and exploration of alternative substitutes to mitigate reliance on crude oil. Policymakers in the top ten oil-consuming nations should prioritize understanding the key drivers of oil consumption to enhance demand forecasting and tailor policies accordingly. Moreover, the study's limitations are noteworthy, particularly its focus on a limited set of countries and variables. Expanding the research scope to include more countries and additional variables, such as vehicle registration numbers, could offer a more nuanced understanding of oil demand dynamics. Comparative analyses between developing and developed nations or across different energy sources and renewable energy determinants may yield valuable insights for energy policy formulation. In conclusion, the recommendations underscore the need for proactive measures to address oil consumption challenges, while the study's limitations highlight opportunities for future research and policy development in the energy sector.

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