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Domestic refining capacity and fuel import dependency in Nigeria

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Abstract
This paper investigates the impact of domestic refining capacity on fuel import dependency in Nigeria over the period 1990–2025. Installed Refining Capacity, Refining Capacity Utilization and Domestic Refining Petroleum Output were used as surrogate for domestic refining capacity while fuel import dependency is the dependent variable. Secondary data were sourced from the National Bureau of Statistics (NBS), Nigeria National Petroleum Company Limited (NNPCL) Nigeria Upstream Petroleum Regulation Commission (NUPRC), and Organization of Petroleum Exporting Countries (OPEC) several issues The Augmented Dickey-Fuller unit root test was employed to examine the stationarity properties of the variables, while the Auto-Regressive Distributed Lag model was utilized to estimate both short-run and long-run dynamics. The bounds testing approach confirms the existence of a long-run relationship among the variables. Empirical findings reveal that installed refining capacity and domestic refining petroleum output had a negative but significant relationship with fuel import output. However, refining capacity utilization exact a positive and significant relationship with fuel import dependency. It was concluded that domestic refining capacity had a substantial impact on fuel import dependency in Nigeria. It was recommended that the Federal Ministry of Petroleum Resources should expand and modernize Nigeria's installed refining capacity to reduce fuel import dependency.

Keywords: Installed refining capacity, refining capacity utilization, domestic refining petroleum output fuel import dependency

Introduction

Nigeria is one of Africa's largest crude oil producers, yet the country relies heavily on imported refined petroleum products. While Nigeria exports millions of barrels of crude oil annually, its domestic refineries have consistently failed to convert this resource into finished products such as petrol, diesel, and aviation fuel. This imbalance between crude oil production and refinery output weakens energy security, increases foreign exchange pressure, and strains government finances. Domestic refining capacity refers to the total ability of a country's refinery infrastructure to process crude oil into usable petroleum products. Adejumo (2023) [1] defines domestic refining capacity as the measurable throughput of refinery plants relative to their designed limits. Okafor and Bello (2022) [27] describe it as the combination of physical capacity, operational efficiency, technological capability, and maintenance practices, while Hassan and Ibrahim (2024) [19] see it as the proportion of national petroleum demand that can be met by local refinery production after accounting for downtime and technical losses. These perspectives show that refining capacity is not only about installed capacity but also operational efficiency and output reliability.

In Nigeria, domestic refining capacity has remained very low. The four major refineries, Port Harcourt, Warri, and Kaduna have a combined installed capacity of about 445,000 barrels per day. However, actual throughput has been far below potential, averaging between 70,000 and 120,000 barrels per day in the past five years, representing utilization rates of 16–27 percent, even as crude production remained around 1.4–1.5 million barrels per day. This underperformance forces Nigeria to import 80–90 percent of its petroleum needs, with petrol accounting for over 60 percent of the annual import bill. In 2023, Nigeria spent roughly $10.4 billion on petroleum imports, importing over 18 million barrels of petrol and diesel in just the first half of 2024. This trend has consistently drained foreign reserves and contributed to persistent balance of payments pressure.

The challenges affecting domestic refining include outdated equipment, poor maintenance, pipeline vandalism, crude theft, and inconsistent government policies. Port Harcourt and Warri refineries, for instance, experienced prolonged shutdowns in 2021 and 2022 due to technical failures and feedstock disruptions, reducing effective refinery output to near zero for several months. These operational and structural issues directly affect fuel import dependency. Chukwu and Nnamani (2025) [11] found that refinery outages and inefficiencies explained over 70 percent of the variance in petrol imports, with periods of utilization below 25 percent linked to a 40–50 percent rise in imports. Ibrahim and Musa (2024) [22] reported that a 1 percent increase in refinery utilization reduces fuel import dependency by 0.75 percent in the long run. Similarly, Akinwale and Ladipo (2023) [3] noted that Nigeria's refinery inefficiencies contribute more to import costs than crude oil price changes or OPEC quota effects. Bello and Yusuf (2024) [7] confirmed that even favorable global oil prices cannot compensate for weak domestic refining capacity, as imports remain high during low refinery performance. Okoro and Eze (2022) [28] emphasized that inconsistent policies and regulatory gaps further dampen refinery productivity, prolong downtime, and sustain import reliance.

Despite these insights, gaps remain in understanding how refining capacity, macroeconomic conditions, and policy frameworks jointly affect fuel import dependency over time. Most studies focus on historical relationships without fully considering recent reforms such as the Petroleum Industry Act (2021) or integrating macroeconomic variables like

exchange rate fluctuations and subsidy regimes. This study addresses this gap by analyzing historical data from 1990 to the most recent period, considering both refinery-specific factors and broader economic indicators, with the goal of providing actionable insights on reducing Nigeria's fuel import dependency, improving energy security, and supporting sustainable economic planning. The remainder of the study is structured as follows: the next section presents the literature review, followed by the methodology, results and discussion, and finally the conclusion and policy recommendations.

Literature Review

Conceptual Literature

Domestic Refining Capacity

Domestic refining capacity refers to the ability of a country's refinery infrastructure to process crude oil into finished petroleum products within a given period. Adejumo (2023) [1] views domestic refining capacity as the measurable throughput of locally installed refinery plants relative to their design limits, emphasizing that the actual output achieved is a key indicator of refinery efficiency. Okafor and Bello (2022) [27] broaden the concept, arguing that refining capacity encompasses not only the physical plant size but also technological sophistication, operational efficiency, and maintenance practices. Their perspective underscores that the ability to refine crude oil effectively depends on both human and technical factors. Hassan and Ibrahim (2024) [19] further extend the definition by considering domestic refining capacity as the proportion of national petroleum demand that can be met by local refinery output, taking into account downtime, technical losses, and managerial constraints. This definition links refinery performance directly to national energy security, showing how inefficiencies in refining can translate into increased reliance on imported fuel.

Adejumo (2023) [1] demonstrates through historical data that low throughput in Nigerian refineries directly correlates with rising fuel import volumes. Okafor and Bello (2022) [27] provide evidence that technological inefficiencies and inadequate maintenance are major contributors to underutilization of installed capacity, reinforcing the need for structural reforms. Hassan and Ibrahim (2024) [19] show that operational and managerial factors significantly influence the proportion of domestic demand met by local refineries, with higher efficiency directly reducing import dependency. Collectively, these studies illustrate that domestic refining capacity is a multidimensional concept, encompassing physical infrastructure, technological capability, operational efficiency, and management performance, all of which are critical for addressing Nigeria's fuel supply challenges.

Fuel Import Dependency

Fuel Import Dependency has emerged as a critical issue in energy economics, particularly for resource-rich yet import-dependent economies like Nigeria, where the paradox of abundant crude oil coexists with persistent reliance on imported refined petroleum products. This phenomenon has attracted significant scholarly attention due to its far-reaching implications for energy security, macroeconomic stability, and sustainable development. As such, understanding its conceptual foundations is essential for unraveling the structural challenges within the petroleum sector and designing effective policy responses. Bhattacharyya (2011) [8] defines fuel import dependency as the extent to which a country relies on imported petroleum products to meet its domestic energy demand, emphasizing its role as a measure of energy vulnerability. Similarly, Sovacool (2013) [32] views fuel import dependency as an indicator of energy insecurity, arguing that economies with high dependence on imported fuels are more exposed to global oil price fluctuations and external supply shocks. In the context of developing economies, Adenikinju (2008) [2] describes fuel import dependency as a reflection of structural inefficiencies in the domestic refining sector, particularly in oil-rich countries like Nigeria where crude oil is exported while refined products are imported. Furthermore, Fattouh (2014) [16] conceptualizes it as the proportion of domestic fuel consumption that is satisfied through imports, highlighting its implications for fiscal sustainability and external sector balance.

Drawing from these scholarly perspectives, Fuel Import Dependency can generally be understood as the degree to which a nation depends on imported refined petroleum products to satisfy its domestic consumption needs due to inadequate or inefficient local refining capacity. It reflects the imbalance between domestic fuel production and consumption requirements. In the Nigerian context, this dependency is particularly paradoxical given the country's status as a major crude oil producer, yet with limited refining efficiency, leading to persistent importation of refined petroleum products such as petrol, diesel, and kerosene. Analytically, Fuel Import Dependency is commonly expressed as the ratio of fuel imports to total domestic fuel consumption, usually in percentage terms. A higher value indicates greater reliance on external sources, while a lower value suggests improved domestic self-sufficiency.

Theoretical Literature

Resource Dependence Theory

The Resource Dependence Theory was propounded by Pfeffer and Salancik (1978) [30]. The theory posits that organizations or entities are inherently dependent on resources from their external environment, and this dependence shapes their behavior, decisions, and strategic actions. The theory emphasizes that the survival and success of an organization, or in this context a nation, are contingent on its ability to acquire and manage critical resources that it does not fully control internally. Resource Dependence Theory assumes that resource scarcity creates power imbalances, uncertainty, and vulnerability, prompting actors to develop strategies to reduce dependence, secure critical inputs, or influence resource providers. Proponents of Resource Dependence Theory, including Hillman, Withers, and Collins (2009) [21], argue that understanding organizational dependencies enables better strategic planning and governance. They suggest that entities can mitigate external constraints through diversification, partnerships, or regulatory interventions. Critics, however, argue that the theory underestimates internal capacities and innovations, implying that dependence is always a limiting factor rather than a potential opportunity for growth (Casciaro & Piskorski, 2005) [9]. Despite this critique, RDT remains widely applied in studies linking resource management, operational efficiency, and strategic outcomes. In the context of Nigeria, Resource Dependence Theory is relevant to understanding domestic refining capacity and

fuel import dependency. Nigeria produces significant volumes of crude oil but lacks sufficient operational and technological capacity in domestic refineries to meet national fuel demand. This shortfall forces the country to rely heavily on imports, creating economic vulnerabilities, foreign exchange pressures, and exposure to global market fluctuations. By framing fuel import dependency as a consequence of limited domestic refining resources, RDT provides a theoretical basis for analyzing how enhancing refinery capacity can reduce external dependence and improve energy security. This study is anchored on the Resource Dependence Theory because it directly links the internal resource constraints of Nigerian refineries to the external reliance on imported fuels. Using Resource Dependence Theory allows the study to conceptualize domestic refining capacity as a critical resource whose underutilization drives import dependency. It justifies policy and strategic recommendations aimed at reducing dependency by improving refinery infrastructure, operational efficiency, and management practices, thereby strengthening national energy security.

Market Power Theory

The Market Power Theory was initiated by Bain in 1956 [5]. The theory posits that firms or entities with control over production, supply, or distribution of goods can influence market prices, output levels, and competitive conditions. The theory is rooted in the belief that market dominance or limited competition enables actors to exercise strategic control over market outcomes, affecting both efficiency and profitability. Market power is considered a critical determinant of economic leverage, where entities with greater control over resources can shape the conditions under which goods are exchanged. The theory assumes that entities with significant control over supply or production face limited competitive constraints, allowing them to influence market prices and availability. It also assumes that structural features of the market such as concentration, capacity limitations, and entry barriers determine the extent of market power. Proponents, including Scherer and Ross (1990) [31], argue that market power enables strategic advantage, supports price stability for dominant players, and can incentivize long-term investment in production capacity. Critics, however, contend that market power can lead to inefficiencies, reduced consumer welfare, and misallocation of resources, especially when entities manipulate supply to maximize profit rather than respond to actual demand (Tirole, 1988) [33].

The theory is relevant to the study because it examines how the limited operational efficiency of Nigerian refineries constrains domestic fuel supply, reducing the country's market control over petroleum products and increasing reliance on imports. This lack of market power exposes the nation to international oil price fluctuations, supply disruptions, and foreign exchange volatility. By understanding the implications of market power, policymakers can appreciate the strategic importance of improving refinery performance, expanding capacity, and reducing reliance on imported fuel to regain a stronger position in the domestic and regional energy market.

Empirical Literature

Chima and Ugo (2025) [10] analyzed the effects of refining policy reforms on Nigeria's fuel import dynamics between 2005 and 2024 [15]. The dependent variable was fuel import ratio (imports as a percentage of total consumption), with refining policy reforms index, regulatory consistency, crude oil production, and GDP per capita as explanatory variables. Using Difference-in-Differences estimation, the study found that stronger policy reform implementation correlated with a significant reduction in fuel import ratio, while inconsistent regulatory frameworks and low crude production increased dependency. The study concluded that coherent refining policies can strengthen domestic output and reduce reliance on imports. Additionally, Ganiyu and Ifeoma (2025) [18] examined how human capital development and technology adoption influence refining output and import dependency in Nigeria between 1995 and 2024 [6]. With refining output as the dependent variable and human capital index, technology adoption measure, training expenditure, and policy uncertainty index as explanatory variables, the study applied Dynamic Ordinary Least Squares (DOLS). Results showed that technology adoption and training expenditures strongly and positively influenced refining output, while policy uncertainty negatively affected output and increased import dependency. The study concluded that investment in people and technology is necessary to strengthen refining capacity and reduce imports.

Chukwu and Nnamani (2025) [11] explored the impact of refining output on export earnings and import dependency from 2000–2023 [1], using export earnings as the dependent variable and refining output, import volume, world oil price, and foreign exchange rate as independent variables. Using panel corrected standard errors (PCSE), the study found that greater refining output had a positive and significant effect on export earnings and a negative effect on import volume. World oil price had a positive effect on earnings, while foreign exchange rate depreciation had a negative effect. The findings show that higher domestic refining output reduces fuel import volumes and enhances export earnings. Also, Bello and Yusuf (2024) [7] examined Nigeria's crude oil export volume from 1998–2023 [1], treating export volume as the dependent variable and quota compliance, international oil price, shipping cost index, and export policy indices as independent variables using the Engle-Granger cointegration technique. The study found that quota compliance was negatively associated with export volume, while international oil price and export policy indices had positive and significant effects on export volume. Shipping costs were negatively related to exports but did not have a statistically significant impact. The study concluded that weak domestic refining and export policy inefficiencies contribute indirectly to fuel import dependency.

Fatima and Ibrahim (2024) [15] examined refinery investment in Nigeria from 2000–2023 [4], using refinery investment as the dependent variable and quota compliance rate, domestic credit availability, and policy certainty index as independent variables. Using the generalized method of moments (GMM), the study found that domestic credit availability and policy certainty each had positive and statistically significant effects on refinery investment, while quota compliance rate also positively influenced investment. The study concluded that increased investment fosters stronger domestic refining capacity, which in turn could reduce fuel import dependency. Furthermore, Emeka and Nkechi (2024) [14] assessed the impact of governance quality on domestic refining performance and fuel import dependency in Nigeria

from 1998–2023 [26]. The study used annual fuel import volume as the dependent variable and governance quality index, corruption perception index, refining efficiency, and maintenance turnaround time as explanatory variables. Through panel regression analysis, results showed that better governance quality and higher refining efficiency significantly reduced fuel import volumes, whereas higher corruption and longer maintenance turnaround times were linked to greater import dependency. The study concluded that governance reforms are vital for boosting refinery performance and reducing imported fuel volumes.

Hassan and Raji (2024) [20] studied the connection between local content policies in the oil sector and fuel import dependency in Nigeria from 2005–2023 [26]. The dependent variable was fuel import share of total consumption, while explanatory variables included local content enforcement index, domestic refining capacity utilization, crude export volume, and exchange rate regimes. Using system GMM, the study found that stronger local content enforcement and higher utilization substantially lowered fuel import share, whereas volatile exchange rates and high crude export volumes increased import levels. The study concluded that enforcing local content policies can help reduce fuel import dependency. Besides, Balogun and Adebisi (2024) [6] investigated the relationship between refining downtime, technology investment, and fuel imports in Nigeria from 1995–2022 [23]. Their dependent variable was fuel import expenditure, and independent variables were refinery downtime, investment in refining technology, and infrastructure quality index. Using Autoregressive Distributed Lag (ARDL) modelling, results revealed that prolonged refinery downtime significantly increased fuel import costs, while investment in modern refining technology and higher infrastructure quality significantly reduced import spending. The study concluded that strategic technology upgrades and reduced downtimes are key to curbing import dependency.

Ibrahim and Musa (2024) [22] investigated Nigeria's fuel import bills between 1995–2023 [26] with fuel import bills as the dependent variable and refinery capacity utilization, global oil price, GDP growth, and government policy stability index as independent variables. Applying the ARDL bounds testing approach, the study found that refinery capacity utilization had a negative and statistically significant long-run effect on import bills, meaning that higher utilization reduced import costs. Global oil price had a positive and significant effect on import bills, indicating that rising international prices increased the cost of imports. Government policy stability and GDP growth had negative effects, suggesting that stable policy environments and stronger economic growth help reduce Nigeria's dependence on imported fuels. In addition, Jumoke and Olusegun (2024) [24] examined how public–private partnership models and private investment in refinery management affect fuel import dependency in Nigeria covering 1998–2023 [26]. The variables included fuel import ratio as dependent and public–private partnership index, private investment share, regulatory predictability, and refinery downtime as independent variables. Using panel data analysis, findings indicated that higher public–private partnership index and private investment share were significantly associated with lower fuel import ratios, whereas regulatory unpredictability and frequent refinery downtimes increased import dependency. The study concluded that structuring effective public–private partnership arrangements can enhance refining performance and reduce fuel import reliance.

Kareem and Oladipo (2024) [25] investigated the long-run relationship between Nigeria's refining performance and fuel imports for 1995–2023 [26], using crude oil output as the dependent variable and technology adoption, human capital investment, and OPEC quota as independent variables in a fully modified OLS (FMOLS) framework. The study found that technology adoption had a positive and significant effect on output, while OPEC quota had a negative effect. Human capital investment had a positive relationship but was not statistically significant. The study concluded that technological improvements can partly offset capacity shortfalls. Stil, Okoro and Ejiogu (2024) examined Nigeria's oil production growth from 1998–2022 [23], using quota adjustments, global demand growth, and exchange policy regime as independent variables in Johansen cointegration and VECM models. The results showed that quota adjustments influenced short-run production fluctuations, global demand growth had a positive and significant effect in both short and long runs, and exchange policy regime changes affected long-term performance. The study concluded that broader policy and market conditions shape production and import dynamics, affecting refining capacity's ability to reduce import dependency.

Nwankwo (2023) [26] examined the determinants of fuel import volume in Nigeria from 2000–2022 [23], using fuel import volume as the dependent variable and refinery throughput, refinery downtime, crude oil production, and exchange rate as independent variables. Using time-series regression and correlation analysis, the study found that increased refinery throughput significantly reduced fuel imports, while refinery downtime and exchange rate depreciation had significant positive effects on import volumes. Crude oil production was found to have an insignificant direct effect on imports, leading to the conclusion that improving refinery operations and managing currency stability are crucial for reducing Nigeria's import dependency. Again, Aliyu (2023) [4] examined how refinery utilization and exchange rate volatility affect Nigeria's fuel import dependency over the period 2000–2021. Fuel import volume was the dependent variable, while refinery utilization rate, exchange rate, foreign exchange reserves, and government subsidy expenditure were independent variables. Using an Error Correction Model (ECM), findings showed that refinery utilization had a significant negative effect on fuel import volume, while exchange rate volatility and subsidy expenditure had significant positive effects. Foreign exchange reserves had a negative relationship with import dependency but were insignificant. The study concluded that improving refinery utilization and stabilizing the exchange rate are crucial to lowering fuel import reliance.

Danladi and Madaki (2023) [12] explored how foreign direct investment (FDI) in the refinery sector affects Nigeria's fuel import bills using data from 1990–2022 [29]. The variables included fuel import cost as the dependent variable and FDI in refining, refinery throughput, inflation rate, and labor productivity as independent variables. Using Fully Modified Ordinary Least Squares (FMOLS), findings indicated that higher FDI and greater throughput were significantly associated with lower import costs, while inflation and low labor productivity increased import bills. The authors

concluded that attracting FDI and improving productivity are essential to reducing fuel import dependency. Similarly, Femi and Zainab (2023) [17] investigated the influence of electricity supply quality and refineries' operational costs on fuel imports in Nigeria using data from 2000–2021. The dependent variable was fuel import volume, and independent variables were electricity downtime, refinery operational costs, global crude prices, and urban fuel demand growth. Using Vector Error Correction Model (VECM), the study found that frequent electricity downtime and high operational costs significantly increased fuel import dependency, while higher global crude prices and urban demand growth had nuanced effects depending on time lags. The study concluded that improving electricity supply and lowering operational costs can help reduce import reliance.

Akinwale and Ladipo (2023) [3] investigated crude oil production efficiency in Nigeria from 2001–2022 [23], using crude oil production efficiency as the dependent variable and refinery capacity, operational expenditure, exchange rate volatility, and foreign direct investment (FDI) as independent variables. Utilizing panel least squares regression, the study found that refinery capacity and FDI had positive and significant effects on production efficiency, while exchange rate volatility significantly reduced efficiency. Operational expenditure also had a positive effect, implying that higher investment in refinery operations improves efficiency and reduces the need for fuel imports. Likewise, Egwu and Okafor (2023) [13] applied Vector Autoregression (VAR) to analyze Nigeria's daily crude production from 2000–2022 [23], with actual daily production as the dependent variable and expected quota changes, spot price volatility, and rig utilization rates as independent variables. They found that expected quota reductions had a negative effect on actual production, while spot price volatility and rig utilization had positive and significant effects. The conclusion was that improved operational optimization and market certainty can stabilize supply and indirectly support domestic refining capacity.

Jibril and Salami (2022) [23] used a nonlinear ARDL (NARDL) model to examine crude oil output from 1990–2019, with quota increases, quota decreases, global demand growth, and political risk index as independent variables. The study found that quota decreases had a larger negative effect on output than the positive effect of quota increases, indicating sensitivity to downturns. Global demand growth had a positive and significant effect on output, while political risk had a negative effect. Finally, Imoleayo and Sadiq (2022) [29] assessed the role of inventory management and logistics efficiency on refining performance and fuel imports in Nigeria from 1990 [31]–2019. The dependent variable was fuel import quantity, and independent variables were inventory turnover rates, logistics efficiency score, and refinery operational costs. Through Ordinary Least Squares (OLS) regression, results showed that higher inventory turnover and better logistics efficiency significantly reduced fuel imports, while higher operational costs increased import quantities. The study concluded that improving logistics and inventory management can strengthen domestic output and reduce import reliance.

Subsequently, a critical review of the empirical literature reveals a broad and insightful body of work on the relationship between domestic refining performance and fuel import dependency in Nigeria. The majority of studies consistently show that improvements in refining-related factors such as refinery utilization, technology adoption, infrastructure quality, and investment significantly reduce fuel import dependency. For instance, Ganiyu and Ifeoma (2025), Ibrahim and Musa (2024), and Aliyu (2023) [4, 18, 22] find that higher refining capacity utilization and technological advancement exert a negative and significant effect on fuel imports. Similarly, Danladi and Madaki (2023) and Balogun and Adebisi (2024) [6, 12] emphasize the importance of foreign direct investment, infrastructure, and reduced refinery downtime in lowering import bills. On the other hand, factors such as policy inconsistency, corruption, exchange rate volatility, and operational inefficiencies are found to increase fuel import dependency, as documented by Emeka and Nkechi (2024), Femi and Zainab (2023), and Nwankwo (2023) [14, 17].

Beyond refining capacity, some studies extend the analysis to institutional and macroeconomic drivers, including governance quality, local content policies, and regulatory frameworks. For example, Hassan and Raji (2024) and Chima and Ugo (2025) [10, 20] show that stronger policy enforcement and regulatory consistency significantly reduce fuel import reliance. Likewise, studies such as Chukwu and Nnamani (2025) [11] link increased domestic refining output to improved export earnings and reduced import volumes. However, a number of studies shift focus to broader oil sector dynamics, including crude oil production, export performance, and OPEC-related factors, thereby diluting emphasis on core refining capacity indicators. Methodologically, the literature demonstrates considerable diversity, employing techniques such as ARDL, FMOLS, VECM, GMM, DOLS, VAR, ECM, and panel regression. While this enhances analytical robustness, most studies adopt time series approaches with varying sample periods, often limited to shorter spans such as 2000–2023 or 2005–2024. In addition, many studies rely on single or partial indicators of refining performance, with limited integration of key capacity-related variables within a unified framework.

Despite these contributions, a clear gap emerges when evaluated against the focus of the present study. First, in terms of variables, existing studies rarely incorporate a comprehensive set of refining capacity indicators, particularly installed refining capacity, refining capacity utilization rate, domestic refined petroleum output, and number of operational refineries, within a single analytical model. Most studies emphasize utilization, investment, or policy factors in isolation, thereby overlooking the multidimensional nature of refining capacity. Second, regarding scope, few studies comprehensively span the extended period of 1990 to 2025 [10], limiting their ability to capture long run structural changes, policy shifts, and refinery sector reforms in Nigeria. Third, although Nigeria remains the focal location across studies, many analyses concentrate on fuel import volume, expenditure, or broader oil sector outcomes without explicitly linking them to core refining capacity indicators. Finally, from a methodological perspective, there is limited evidence of studies that jointly examine multiple refining capacity variables using a unified and robust econometric framework capable of capturing both short run dynamics and long run relationships. Consequently, the literature lacks a comprehensive,

integrated, and long horizon analysis that directly connects domestic refining capacity measured through installed capacity, utilization rate, refined output, and operational refineries to fuel import dependency in Nigeria. It is this gap in variables, scope, and analytical integration that the present study seeks to address, thereby providing a more holistic and policy relevant understanding of how strengthening domestic refining capacity can reduce Nigeria's persistent dependence on imported petroleum products.

Methodology

This study used ex-post facto research design. The ex-post factor research design was used because the facts has been established and cannot be manipulated by the researcher while secondary data were collected from the National Bureau of Statistics (NBS), Nigeria National Petroleum Company Limited (NNPCL) Nigeria Upstream Petroleum Regulation Commission (NUPRC), and Organization of Petroleum Exporting Countries (OPEC) several issues on Installed Refining Capacity (IRC), Refining Capacity Utilization (RCU), and Domestic Refining Petroleum Output (DRPO) were used to proxy domestic refining capacity while Fuel Import Dependency (FID) is the dependent variable The Augmented Dickey Fuller (ADF) method was used in order to do the unit root test on the model that was developed. Taking into consideration the results of the ADF, the research used the Auto-regressive Distributive Lag (ARDL).

Analytical Framework

The analytical framework for this study is anchored on the Resource Dependence Theory, which was propounded by Jeffrey Pfeffer and Gerald R. Salancik (1978) [30]. The theory posits that organizations and economies rely on external resources for survival and performance, and such dependence shapes their strategic behavior and outcomes. In the context of this study, Nigeria's reliance on imported refined petroleum products reflects its dependence on external supply due to inadequate domestic refining capacity. Hence, improving internal refining performance is essential to reducing fuel import dependency.

Model Specification

The model of this study is built on the model of Kareem and Oladipo (2024) [25], who investigated the impact of Nigeria's refining performance and fuel imports. Their model is specified as follows

COP =f (TAD, HCI, OQ) 1

Where

COP = Crude Oil Output, TAD = Technology Adoption, HCI = Human Capital Investment, OQ = OPEC Quota

However, the present study modifies the baseline model to align with its objective of examining the determinants of fuel import dependency in Nigeria. While Kareem and Oladipo (2024) [25] focused on crude oil output as the dependent variable with emphasis on technological and human capital factors, this study replaces the dependent variable with fuel import dependency and introduces key refining performance indicators such as, installed refining capacity, refining capacity utilization, and domestic refined petroleum output are incorporated to capture the extent to which domestic refining capability influences reliance on imported petroleum products.

Thus, the modified model is specified as follows:

FID =f (IRC, RCU, DRPO) 2

$FID = \beta_0 + \beta_1 IRC + \beta_2 RCU + \beta_3 DRPO$ 3

$FID = \beta_0 + \beta_1 IRC + \beta_2 RCU + \beta_3 DRPO + e$ 4

Where

FID = Fuel Import Dependency, IRC = Installed Refining Capacity, RCU = Refining Capacity Utilization, DRPO = Domestic Refined Petroleum Output, f = functional relationship β_0 = Intercept of relationship in the model/constant B_1-B_3 = Coefficients of each independent or explanatory variable e= Stochastic or Error term.

Description of Variables in the Model

Variables	Description	Expected Impact on FID	Source
FID (Dependent)	This refers to the extent to which a country relies on imported refined petroleum products to meet its domestic energy demand. It is usually expressed as a percentage of total fuel consumption and reflects the adequacy or inadequacy of domestic refining capacity.		NNPCL, NBS, 2025
IRC	This represents the maximum volume of crude oil that domestic refineries can process within a given period, typically measured in barrels per day. An increase in installed refining capacity enhances the country's ability to refine crude oil domestically. This reduces the need for imported petroleum products, thereby decreasing fuel import dependency.	IRC<0	NBS, 2025
RCU	This refers to the extent to which installed refining capacity is actually used in production, usually expressed as a percentage. Increase in capacity utilization implies that existing refineries are operating more efficiently and closer to full capacity. This leads to higher domestic fuel production, thereby reducing reliance on imports.	RCU <0	NNPCL, NBS, 2025
DRPO	This refers to the total quantity of refined petroleum products produced locally within a given period. An increase in domestic refined output directly boosts local fuel supply, which reduces the need for imports. Therefore, higher domestic production leads to a decline in fuel import dependency, indicating a negative relationship.	DRPO<0	NNPCL, NBS, 2025

Empirical Data Analysis

Table 1: Descriptive Statistics

	FID	IRC	RCU	DRPO
Mean	67.42972	569444.4	36.65500	7.189722
Median	67.50000	450000.0	35.50000	6.200000
Maximum	85.00000	1100000.	61.58000	18.93000
Minimum	44.00000	0.000000	29.00000	4.900000
Std. Dev.	11.43912	305725.8	6.253894	3.424696
Skewness	-0.294288	0.792118	1.750225	2.748856
Kurtosis	2.225391	2.857532	2.978442	9.403118
Jarque-Bera	1.419661	3.795150	55.55705	106.8371
Probability	0.491727	0.149932	0.000000	0.000000
Sum	2427.470	20500000	1319.580	258.8300
Sum Sq. Dev.	4579.873	3.27E+12	1368.892	410.4991
Observations	36	36	36	36

Source: E-view 13 Output

The descriptive statistics for the study includes four variables, one dependent (Fuel Import Dependency (FID)) and three independent variable {Installed Refining Capacity (IRC), Refining Capacity Utilization (RCU), and Domestic Refined Petroleum Output (DRPO} over the 36 observations. The mean value of FID is 67.42972 percent, indicating that, on average, Nigeria exhibits a high level of dependence on imported refined petroleum products. The maximum and minimum values of 85.00000 and 44.00000 respectively suggest moderate variation over time. The standard deviation of 11.43912 indicates a reasonable dispersion around the mean, implying that fuel import dependency fluctuates moderately. This deviation reflects periods of both increased reliance on imports and relative improvements in domestic supply capacity. For IRC, the mean value of 569,444.4 barrels per day reflects the average installed refining capacity within the period. However, the minimum value of 0.000000 and maximum of 1,100,000 highlight extreme variability in capacity availability, likely due to refinery shutdowns and rehabilitation phases. The very high standard deviation of 305,725.8 indicates substantial dispersion from the mean, suggesting that installed capacity is highly unstable. The wide deviation implies inconsistency in operational capacity, which undermines domestic refining performance.

The mean value of RCU stands at 36.65500 percent, indicating low average utilization of installed refining capacity. With a maximum of 61.58000 and a minimum of 29.00000, the variable shows some variation but remains within a relatively low utilization range. The standard deviation of 6.253894 suggests moderate fluctuations around the mean. The deviation indicates persistent inefficiency in refinery operations, as capacity utilization rarely approaches optimal levels. For DRPO, the mean value is 7.189722 million litres, with a maximum of 18.93000 and a minimum of 4.900000. The relatively high standard deviation of 3.424696 indicates significant variability in domestic refined output. This deviation suggests that domestic production is inconsistent and subject to fluctuations, likely driven by operational disruptions and capacity constraints. In terms of distributional properties, the skewness values show that FID (-0.294288) is slightly negatively skewed, indicating a mild concentration of observations above the mean. IRC (0.792118), RCU (1.750225), and DRPO (2.748856) are positively skewed, with DRPO exhibiting a high degree of asymmetry, suggesting the presence of extreme high values.

The kurtosis values indicate that FID (2.225391) and IRC (2.857532) are platykurtic, implying flatter distributions relative to the normal distribution. RCU (2.978442) is approximately mesokurtic, suggesting near-normal peakedness, while DRPO (9.403118) is highly leptokurtic, indicating a sharp peak and heavy tails, which reflects the presence of outliers. The Jarque-Bera statistics further confirm the normality properties of the variables. The probability values for FID (0.491727) and IRC (0.149932) are greater than the 0.05 significance level, indicating that the null hypothesis of normal distribution cannot be rejected for these variables. However, RCU and DRPO have probability values of 0.000000, which are less than 0.05, indicating that they deviate significantly from normal distribution. Conclusively, while FID and IRC are normally distributed, RCU and DRPO are not normally distributed. Despite this, econometric analysis such as unit root testing can still proceed, as normality is not a strict requirement for stationarity testing, although the presence of non-normality should be noted when interpreting further results.

Unit Root Test

A unit root test known as the Augmented Dickey Fuller (ADF) test was used in the research project to determine the order of integration of the variables that were being investigated. This was done in order to pick the proper approach and prevent false regression**.**

Table 2: Unit Root Test Using Augmented Dickey Fuller (ADF)

Variables	Levels		First Difference		Order of Integration	P-value
	T. Statistics	5% Critical Value	T. Statistics	5% Critical Value		
FDI	1.035942	-2.960411	-5.899732	-2.960411	I(0)	0.0000
LIRC	-1.738118	-2.957110	-7.611244	-2.963972	I(0)	0.0000
RCU	1.181460	-2.981038	5.227858	-2.981038	I(1)	0.0000
LDRPO	-4.463710	-2.967767			I(1)	0.0006

Source: Extracts from E-view 13. * Level of significance at 5%

We examined all of the research variables using Augmented Dickey Fuller (ADF) tests to see whether they were stationary or non-stationary series, following the guidelines provided by table. 2. At the initial difference I(1), the stationarity test indicated that FID, LIRC and RCU, stationary, whereas LCPI and LDRPO is stationary at the level I(0). The variables show either mixed-order integration or stationarity of level and initial differences when we analyse their stationarity. The Autoregressive Distributive Lag (ARDL) technique was used to analyse the data. Both the first difference (I(1)) and the stationary at level I(0) may be handled by this method. The ARDL test is the most appropriate analytical technique to utilise since it looks at the relationship between the independent and dependent variables in terms of both short-term and long-term trends.

Co-integration Test

Table 3: ARDL Bound Test

Test Statistics	**Value**	**K**
F-statistics	**6.359891**	**3**
Significance	**I (0)**	**1(1)**
10%	3.00	4.15
5%	3.71	5.01
1%	5.33	7.06

Source: Authors computation 2026

From table 3 the bound test result indicates that there exist long run relationships amongst the variables as the F-statistic value of 6.359891 exceeds both the lower and upper bound critical values. Thus, we reject the null hypotheses of no long run relationship and accept its alternative. This means that there is a long-run relationship between Domestic Refining capacity and Fuel Import Dependency in Nigeria.

Short and Long-Run Estimation Results for the Model

The results of the short and long-run dynamics association of the model are presented in table 4.4 below

Table 4: ARDL Short and Long-run Result for the Model

Short Run Coefficient				
Variable	Coefficient	Std. Error	t-Statistics	Prob
D(LIRC)	-0.583710	0.252831	2.308697	0.0338
D(RCU(-1)	-0.129676	0.563171	-0.230261	0.8206
D(LDRPO)	0.928488	0.355600	2.611048	0.0056
ECM(-1)	-0.579967	0.221181	-2.622136	0.0036
Long Run Coefficient				
Variable	Coefficient	Std. Error	t-Statistics	Prob
IRC	-0.420503	0.171314	-2.454777	0.0033
RCU	0.716380	0.215695	3.321268	0.0007
DRPO	-0.788706	0.293271	-2.689343	0.0047
C	-0.897354	0.372779	-2.407203	0.0074
Adj R^2 =0.874492, F-statistics = 10.41508 (0.000000)				

Source: Authors computation using E-view 13 2026

The coefficient estimate for the error correction term, ECM (-1) has a negative value and is significant at the 0.05 level. It suggests that the model will reach long-run equilibrium at a rate of 0.58% every year. This means that a yearly adjustment speed of 0.58% may fix the mistake from the previous year. The independent variables (LIRC, RCU & LDRPO) explain 87% of the total variance in the dependent variable (FID), according to the adjusted R-Square (R2) value. As a whole, the model is noteworthy since the F-statistic is significant at the 5% level of significance. Without serial correlation, the model would not work.

Table 4 displays the model's short-and long run outcome. The logarithm coefficient of installed refining capacity (LIRC) had a negative but significant impact on fuel import dependency (FID). Similarly, refining capacity utilization (RCU) exact a negative but insignificant relationship with fuel import dependency (FID) (LEXR) while domestic refining petroleum output (DRPO) had a positive and significant relationship with fuel import dependency (FID) in the short-run Equally, table 4, shows that the outcome of the long-run result that the log coefficient of installed refining capacity (LIRC), and the log value of domestic refining petroleum output (DRPO) had a negative but significant impact on fuel import dependency (FID) while refining capacity utilization (RCU) had a positive and significant relationship with fuel import dependency (FID)in the long-run.

Diagnostic Test

Table 5: Ramsey Reset Test, Serial Correlation LM Test and Homoscedasticity Test Results

	F-Statistic	**Prob-Value**
Ramsey Reset Test	0.048124	0.8298
Breusch-Godfrey Serial Correlation LM Test	5.697780	0.0682
Breusch-Pagan-Godfrey Heteroskedasticity Test	1.181979	0.3790

Source: Authors computation 2026

From Table 5, the results of the diagnostic test shows that the linearity test using Ramsey Reset test indicates that the f-statistic (0.048124) with computed p-value of 0.8298 which is greater than 5 percent (0.05) critical value, hence the study reject the null hypothesis and conclude that the model is correctly specified. The result of the Serial or Autocorrelation Test using Breusch-Godfrey Serial Correlation LM Test shows that the f-statistic is 5.697780, with a Chi-Square probability value is 0.0682. This indicates that the probability value of about 7 percent (0.0682) is greater than 5 percent (0.05) critical value; hence the study confirms no serial correlation in the model. The result of the heteroscedasticity test using Breusch-Pegan-Godfrey test shows that the f-statistic is 1.181979 with a Chi-Square probability value of 0.3790. The result suggests that there is no evidence of heteroskedasticity in the model since the probability Chi-square value is more than 5 percent (P >0.05). So, residuals do have constant variance which is desirable in regression meaning that residuals are Homoscedastic.

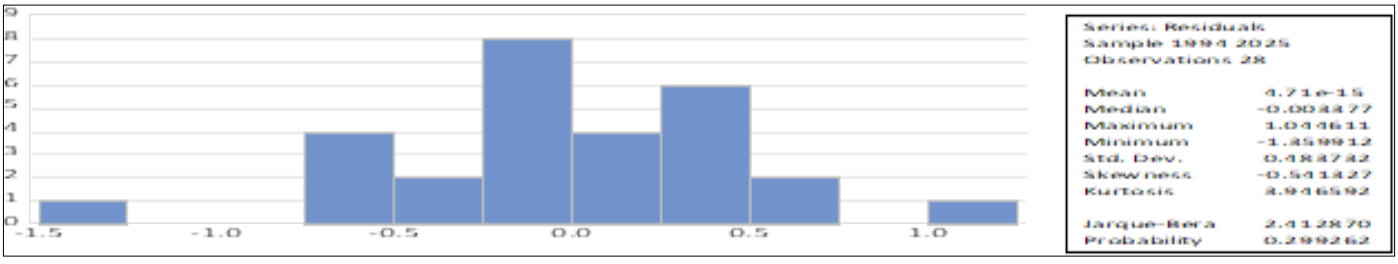

Fig 1: Normality Test

Figure 1, shows summary of the normality test with Jarque-Bara value of 2.412870 and a corresponding probability value of 0.299262 more than 0.05 level of significance, indicating that the residuals are normally distributed

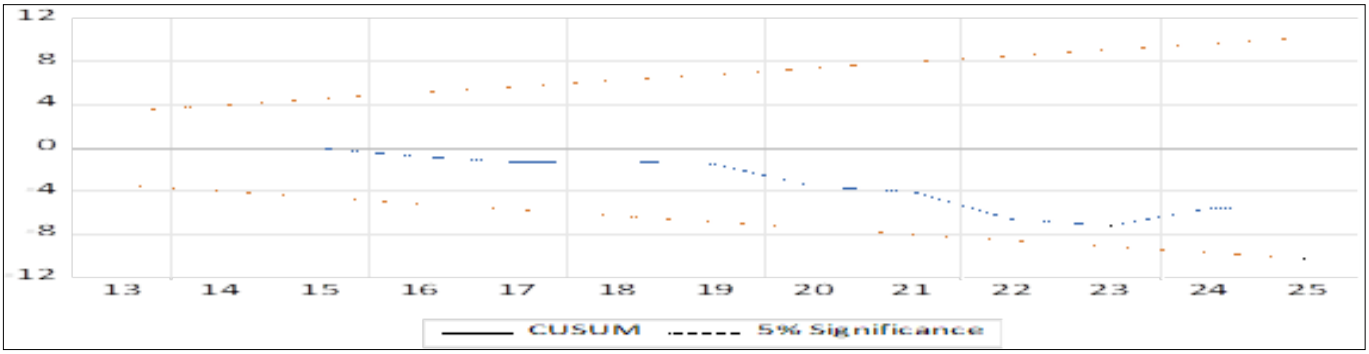

Fig 2: Stability Test

Figure 2 shows summary of the stability test, the result showed that the model is stable. This is evident to the fact that the blue line is in-between the two red (-5 & +5) or less than 0.05 level of significance.

Discussion of Findings

The estimated results show that Installed Refining Capacity (IRC) has a negative and statistically significant relationship with fuel import dependency, with a coefficient of -0.421 and a probability of 0.0033. This indicates that a 1% increase in installed refining capacity is associated with approximately a 0.42% reduction in fuel import dependency. This highlight the critical role of expanding domestic refining infrastructure. This finding aligns with Chima and Ugo (2025) [10], who observed that robust refining policies and infrastructure significantly reduce Nigeria's reliance on imported fuel.

Conversely, Refining Capacity Utilization (RCU) exhibits a positive and significant effect on fuel import dependency, with a coefficient of 0.716 and a probability of 0.0007. This unexpected result suggests that merely increasing utilization rates without addressing operational inefficiencies may not sufficiently reduce imports, possibly due to refinery downtime or outdated technology. Aliyu (2023) [4] similarly noted that higher utilization alone does not guarantee reduced fuel imports unless accompanied by efficiency improvements.

Finally, Domestic Refining Petroleum Output (DRPO) shows a negative and significant relationship with fuel import dependency, with a coefficient of -0.789 and a probability of 0.0047. This implies that increased domestic output directly reduces the need for imports, reinforcing the importance of boosting actual production levels. This result is consistent with Chukwu and Nnamani (2025) [11], who found that higher domestic refining output significantly lowers import volumes and strengthens energy self-sufficiency.

Conclusion and Recommendation

Conclusion

The study on the impact of domestic refining capacity on fuel import dependency in Nigeria submit that installed refining capacity and domestic refining petroleum output had a negative but significant relationship with fuel import output. However, refining capacity utilization exact a positive and significant relationship with fuel import dependency. Hence, it was concluded that domestic refining capacity had a substantial impact on fuel import dependency in Nigeria

Recommendations

1. The Federal Ministry of Petroleum Resources should expand and modernize Nigeria's installed refining capacity to reduce fuel import dependency.
2. Further, the Department of Petroleum Resources (DPR) should improve operational efficiency and oversight in refineries to ensure that higher capacity utilization effectively lowers reliance on imported fuel.
3. Finally, the Nigerian National Petroleum Corporation (NNPC) should optimize domestic refined petroleum output through consistent production and maintenance of refineries to directly reduce fuel import dependency.

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